LMG 13-01: 30 Dec. 2012 – 07 February 2013 LTER Cruise 21
Weekly Science Report 2: 20-27 January.

Palmer Long Term Ecological Research Project: Looking Back in Time Through Ecological Space. (H. Ducklow, Lead PI and Chief Scientist).

In Week 3 of the annual LTER cruise we made our annual visit to the British Antarctic Survey (BAS) Rothera Base, and hosted British and Dutch scientists on a day cruise to carry out joint water and sediment sampling at three regular stations in Ryder Bay. The rest of our overnight stay included the annual football (soccer) game (we lost, 1-0), dinner and a party. After departing Rothera early Sunday, we occupied regular stations on the LTER grid 100, 000 and -100 lines, and conducted our third process study near Charcot Island, focusing on the canyon (**Figures 1,2**).

Figure 1. Charcot Island. 70° S, 75° W. Adelie penguin colony is to right of tall iceberg, not visible in this view. Photo by Chris Linder.

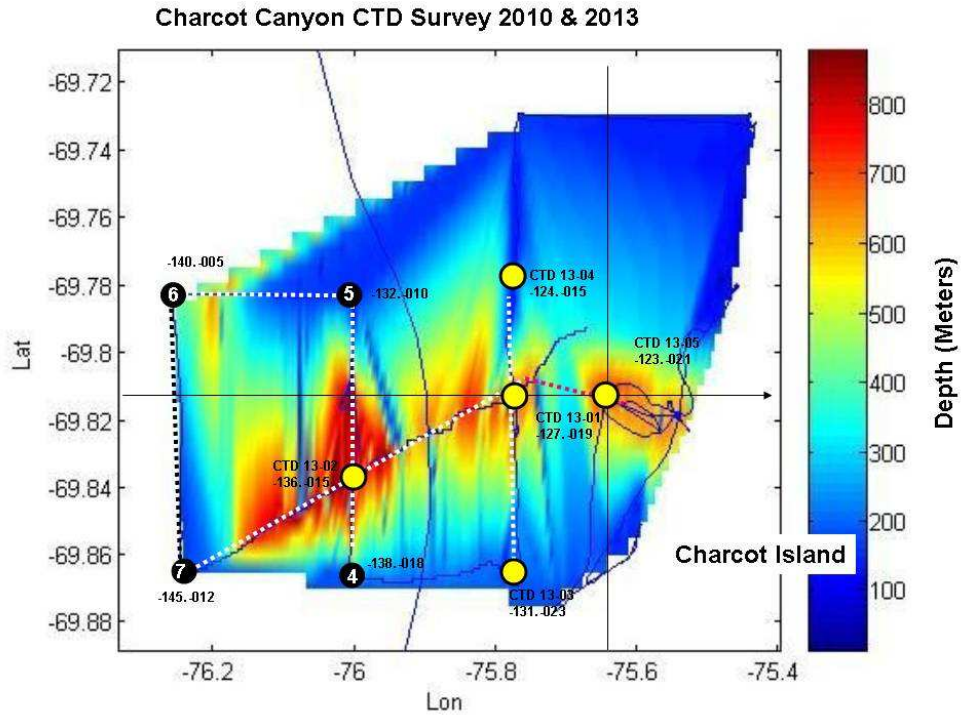

Figure 2. Contour map of nearshore bottom depth, based on LMG cruise tracks in 2010 and 2013 showing canyon or deep region just offshore of the Adelie penguin colony on Charcot Island. (Contour map courtesy M. Erickson).

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Individual component reports:

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

Field Team Members: Jen Mannas and Cameron Rutt

During the third week of LTER 13-01 we continued bird and marine mammal surveys along the 100, 000, and -100 lines as well as during the third process study near Charcot Island. We also successfully finished processing our diet samples this week. On January 22 we made it to Charcot Island to census the Adelie penguin population and weigh 20 chicks. We counted a total of 78 adults and 80 chicks. In addition we collected soil samples from Charcot for the B-045 group.

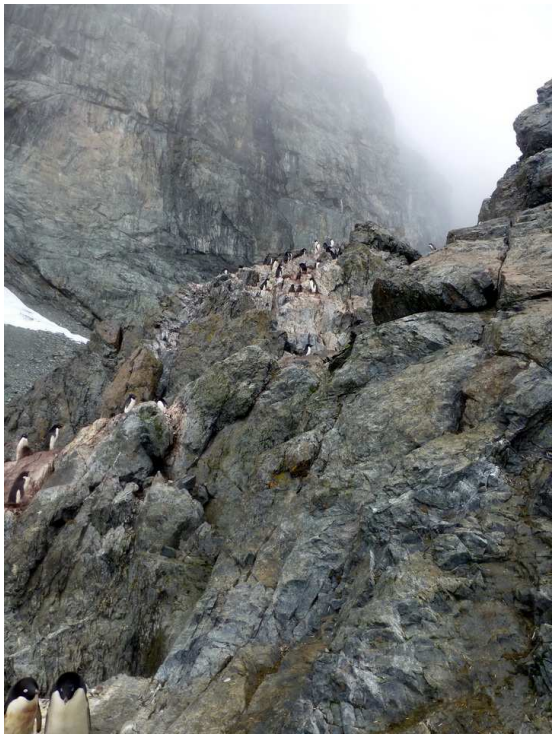

Figure 3 (left). Adelie penguin colony on Charcot Island. Photo by Jen Mannas.

Figure 4 (right). Science team members David Moore, Cameron Rutt and Jenn Mannas (L to R) weighing penguin checks. Photo by Lindsey Loughry.

Landing on Charcot was especially important, this season, as we were unable to last season because of sea ice in the area. We would like to thank Lindsey Loughry, Tony D'Aoust, and Dave Moore (our honorary birders) for their help maneuvering through pack ice, scrambling around on rocks, and getting covered in poo with us. Special thanks to MPC, Andy Nunn, and the ship mates for patiently awaiting our return to the Gould and keeping track of us. And last but not least; a very very special thank you to our friends in the Hydro Lab for sharing their space and enduring the smells of partially digested krill all week.

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 compared to past years the productivity rates are moderate compared to past years. This despite the high quantum yield measurements. Generally there has been an overall increase in the total productivities as we have sampled southward towards Charcot Island.

The primary features in the southern waters are stupendous subsurface peaks in the chlorophyll. The values are not coincident with the winter water and appear to reside just below a surface low saline water mass. The peak values in the subsurface waters in the Southern Portion of the grid have been excess in of 40 mg chlorophyll a m^{-3}. In southern region of the grid, this large subsurface peak was dominated by *Phaeocystis*, which was confirmed by both microscopic analysis as well as by the "sniff" test of filtrate that had significant amount of DMS present. This was the first year we have observed large *Phaeocystis* populations down around Charcot Island.

The traditional LTER sampling is being complemented with a series of deck board mesocosm experiments. The mesocosm was 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 mesocosm experiment which we began at Avian Island was completed this week and the samples have been processed and frozen away for storage back in our labs in New Jersey. Visual inspection of the filters suggest that deep water did result in enhanced productivity rates.

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 historical and more recent decimated ship survey grid is missing. This glider, launched from Palmer has run the LTER 600, 500, 400 and 300 LTER time series lines. 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 in the United States are adaptively flying the glider in collaboration. Both gliders now have been directed to rendezvous near a mooring deployment location to allow for recovery by the RV Gould early next week.

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 third week, we completed full stations along the LTER 100, 000, and -100 lines and concentrated our operations at a Process-3 (P3) study region near Charcot Island (and resident penguin colony). At each station we performed a pair of net tows and identified and sorted animals as described in our previous reports. We also took samples at selected stations for zooplankton gut fluorescence analyses. We are still catching krill at almost every station, and down south here we are catching a lot of *Euphausia crystallorophias*, the crystal krill. Our marine mammal biologists on board noted a large number of Crabeater seals in the area (counted over 1,000 near Charcot); we suspect they are taking advantage of the high numbers of krill. We also started catching juvenile *Pleurogramma Antarctica* (the Antarctic Silverfish) at these southern stations. At one station very close to Charcot Island we caught 31 *Pleurogramma* in one tow.

At Process study station 3, we conducted another bio-acoustic survey to map out aggregations of krill on a transect along the axis of the deep Charcot canyon 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. We saw very few krill aggregations during the bioacoustic survey- during day or night, however during the day survey we were only able to cover a portion of the transect line due to ice cover.

We conducted two more experiments measuring the rate of dissolved organic carbon (DOC) by zooplankton (on the krill *Euphausia superba* and the copepod *Calanoides acutus*), finished our first KPX- Krill Pee Experiment (described in previous report) in conjunction with Hugh Ducklow's group (**Figure 5**). We were very excited to find that after a lag of 4 days bacterial production and abundance increased substantially in the presence of krill zooplankton excretia, but not in controls without excretia. We were hoping to repeat this experiment using salp excretia, but we have not caught any salps to speak of this year.

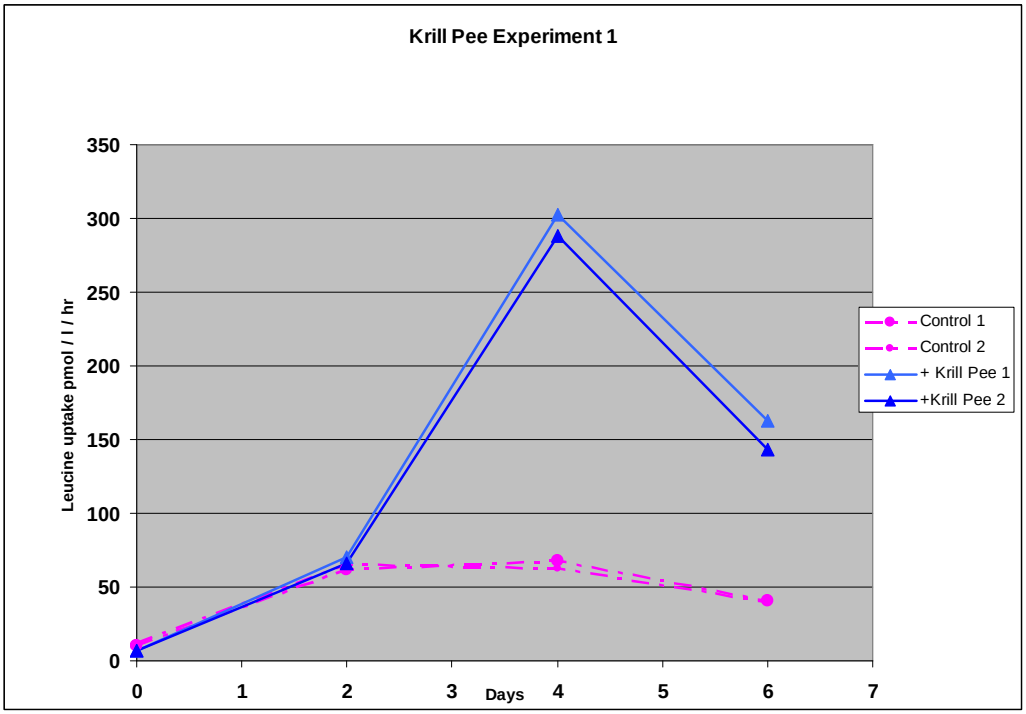

Figure 5. Influence of krill dissolved excretia ("pee") on bacterial leucine incorporation.

Graduate student Miram Gleiber completed one more gut evacuation rate experiment and two 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 two additional fecal pellet production experiments on krill- *Euphausia superba*, and *Thysanoessa macrura*.

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.

We continued to sample microbial and biogeochemical properties at the remaining grid stations and during the Charcot Island Process Study. Completion of the southern legs revealed strong north-south and inshore to offshore gradients in bacterial activity (**Figure 6**). Preliminary observations suggest this patterns is driven by coupling of bacteria to phytoplankton biomass accumulation.

We also showed that bacteria respond strongly to the presence of krill excretory products (**Figure 5**).

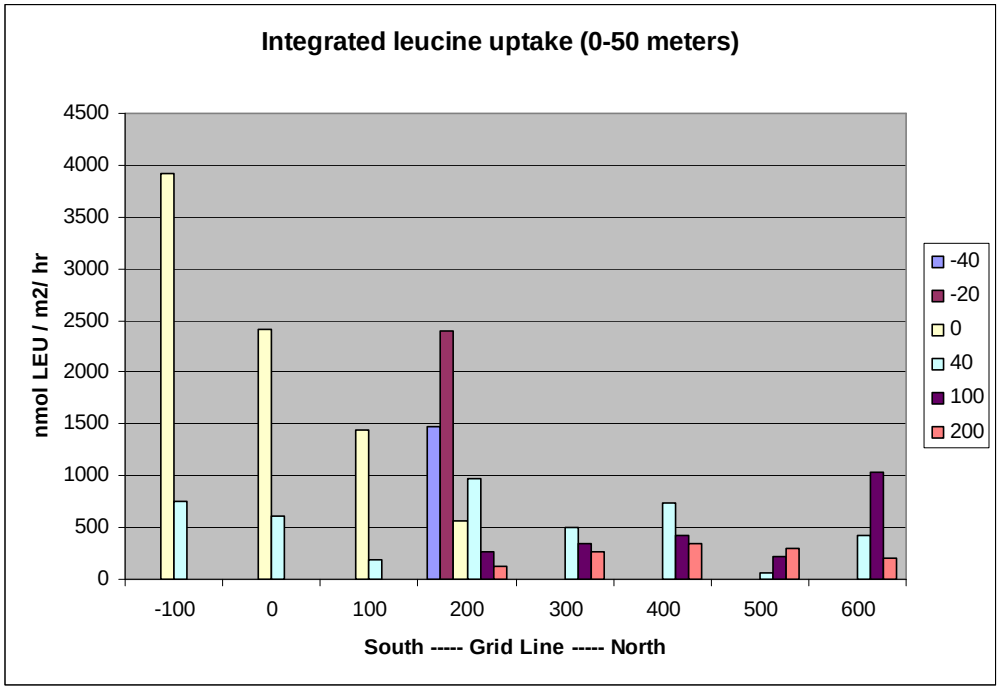

Figure 6. Distribution of bacterial leucine incorporation along the LTER Grid, Jan. 5-26, 2013

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 Zach Swaim and David Johnston from Duke University.

To date, 226 sightings of marine mammals have been made, more than doubling the number of sightings made since the last report. The majority of cetacean sightings (19%) have been humpback whales. The large increase in overall sightings stems from the high densities of

crabeater seals encountered near Charcot Island during Jan 22-25. Crabeater seals now dominate the sighting history for the entire cruise, accounting for 58% of the total. In the Charcot Island area, 123 groups of crabeater seals were detected, representing 1815 individual seals. Details on all species sighted so far on the cruise are presented in **Figure 7** below. When group size for each species encounter is accounted for, these sightings represent a total of 2044 individual marine mammals.

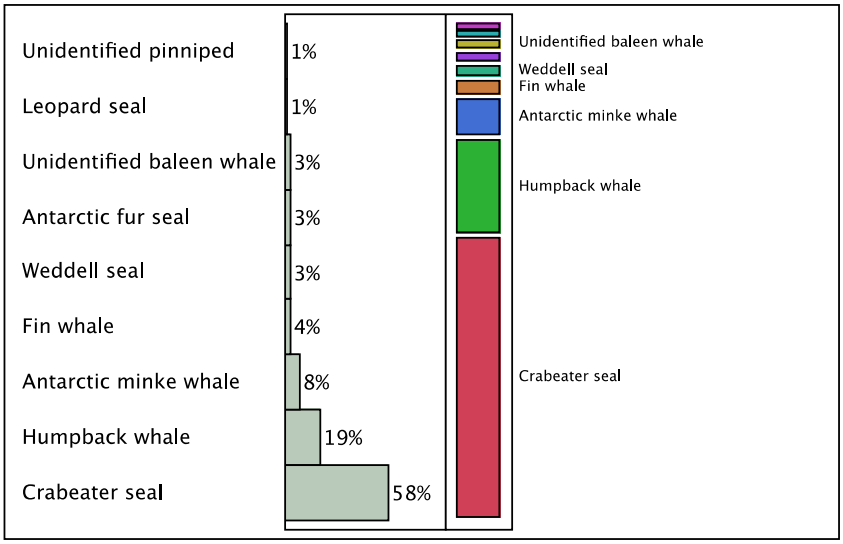

Figure 7. Summary of marine mammals sighting during 03/01/2013 to 26/01/2013 on Palmer LTER cruise

Previous habitat modeling studies indicate that during light ice years, crabeater seals may be concentrated in nearshore regions where ice platforms for haulout may remain more abundant. For example, niche models for crabeater seals in 2001 (derived from seal satellite telemetry data and GLOBEC hydrographic measurements) were compressed towards the shoreline of the southern peninsula as compared to the following year, which exhibited heavier ice conditions and dispersed seal habitat (**Figure 8**). Our recent crabeater seal sightings were concentrated just south of a hotspot predicted for the region in 2001.

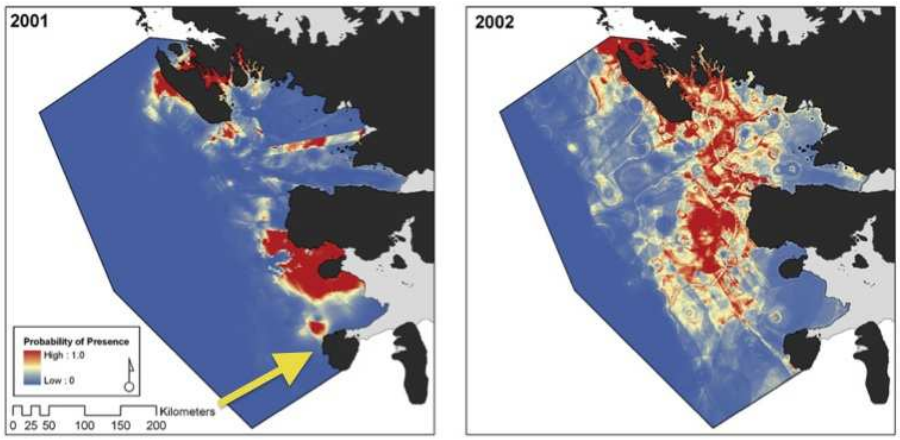

Figure 8. Niche models of crabeater habitat for a light (2001) and heavy (2002) ice year.

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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

I have continued to measure dissolved gases using equilibrator inlet mass spectrometry (EIMS) with particular focus on O2/Ar as a measure of net community production (NCP). The instrument has been operating well and we are pleased with the quality and resolution of data. We look forward to examining the data we have gathered while transiting this canyon region during week three, as we are interested in physical controls on NCP including the roles of bathymetry and sea ice. I will begin to calibrate the data in the coming week in order to calculate biological oxygen saturation for the cruise.