

**LMG 13-01: 30 Dec. 2012 – 07 February 2013 LTER Cruise 21
Weekly Science Report 4: 28 Jan. – 02 Feb., 2013**

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



The final week of our cruise began with a brief drive-by at Rothera Base to pick up NSF OPP Ocean Projects Manager Tim McGovern and NSF/AAAS Policy Fellow Nature McGinn. Tim and Nature spent the past week with us en route to Palmer Station, observing our scientific operations and talking with scientists, contractors and ship's officers and crew. We deployed three physical oceanography moorings, recovered the LTER time series sediment trap, deployed two traps (see below) and conducted a followup process study in the Palmer Deep area, in conjunction with the RV PT SUR, operating out of Palmer Station with LTER personnel.

Overall, we had a very successful cruise. Weather and seas cooperated; we lost no time to bad conditions and had only minor complications from equipment malfunction. We express our thanks to all members of the ECO officers and crew, Lockheed/ASC contractor support team, Palmer Station and Punta Arenas science support personnel for indispensable and professional help, without which our work could never be accomplished (see full personnel lists appended).

Final weekly reports from each of the science groups are given below. We also append group photos of each science team.

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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 fourth week of LTER 13-01 we continued bird and marine mammal surveys during process study 4 in the Palmer deep area. We also assisted with whale ops, inventoried all of our Avian gear, and prepared for our arrival back at Palmer. Bird activity had picked up in the Palmer deep area, as to be expected. While at Neko Harbor, on February 1, we conducted a count of Gentoo adults and chicks from the same colonies as last season. Final counts for chicks and adults were similar to last season although some of the colonies had disappeared and others had merged from 2 into 1.

Overall this was a very successful cruise for B-013 and we would like to extend our thanks to everyone who made that happen.

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

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

The traditional LTER time series sampling was completed this week. The measurements show higher productivity in the southern waters of the LTER grid. The productivity in the southern region appeared to be dominated by *Phaeocystis*, however confirmation will require analysis of the HPLC data. Additionally, the final sampling was conducted for the deck board mesocosm experiment that was initiated at Avian island. The mesocosm was designed to test the relative effects of light versus nutrients associated with modified Upper Circumpolar deep Water (UCDW), which is upwelled in nearshore coastal seafloor canyons. Our success this season highlights the great team that phytoplankton group had this year (Appendix).

Glider operations were successfully completed with recovery of three Webb gliders. For two of the missions, the team conducted a full shelf survey with two 1000-m class Webb gliders. One glider ran 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 Station, 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 were recovered with 20 minutes of each other after successfully navigating the gliders to a single rendezvous location over the course of 3 days. A third, shallow glider was also recovered successfully.

Table 1. Mooring deployment locations during the 2013 LTER cruise.

	Latitude	Longitude
Mooring 1	-66.851291	-72.14795
Mooring 2	-66.130676	-70.84233
Mooring 3	-66.510804	-69.87928

Working in cooperation across all the LTER teams, the three Lamont Doherty physical oceanography moorings, which had been recovered by the team earlier in the cruise, were deployed for another year (**Table 1**).

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Finally, the filming being conducted by Dena Seidel and Christopher Linder has compiled 100s of hours of video and still photography footage. This was supported by an NSF Communicating Research to Public Audiences grant, and will result in an hour long documentary about the PAL LTER called "Antarctica: Beyond the Ice". Dena Seidel from Rutgers is producing, directing and filming this long form story along with Chris Linder who is also filming and co-producing the documentary shoot in Antarctica. Oscar Schofield and Dena Seidel wrote this grant together after the success of Atlantic Crossing, a feature documentary Dena made with her students, which premiered at the Blue Ocean Film Festival. Over the next year, 20 Rutgers film students will work with Dena to shape this hour-long program. Oscar graciously gave up two of his lab team slots for the film crew which now has hundreds of hours of science-in-action footage featuring all members of the LTER.

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 fourth week, the zooplankton group concentrated our efforts at our last 3-day process study 4 (P4) site situated near the Palmer Deep canyon area and LTER grid point 600.040 (repeat of P1). At P4, we conducted another bio-acoustic survey to map out aggregations of krill over a transect along the axis of the Palmer Deep, and 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 few krill aggregations during the bioacoustic survey during the day- only a few small aggregations, then larger ones once we got to the head of the canyon. We saw large, dense surface aggregations of *Euphausia superba* at night, and indication of diel vertical migration.

We conducted one final experiment measuring the rate of dissolved organic carbon (DOC) by zooplankton (on ostracods). 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 last fecal pellet production experiments on krill- *Euphausia superba*.

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.

In week 4, our group completed our core measurement program in microbial oceanography and biogeochemistry, successfully recovering our time series sediment trap moored at LTER grid point 585,132, about 100 km west of Palmer Station in 350 meters depth on the mid-continental shelf. We redeployed the LTER trap and also deployed a new sediment trap with a different design nearby (**Figure X**). Performance of the two traps will be compared over the next several

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years. We are very grateful to the Lockheed/ASC support group (Andy Nunn, Chance Miller, Mike Coons, Tony D'Aoust, Lindsey Loughry) for assistance with trap operations.

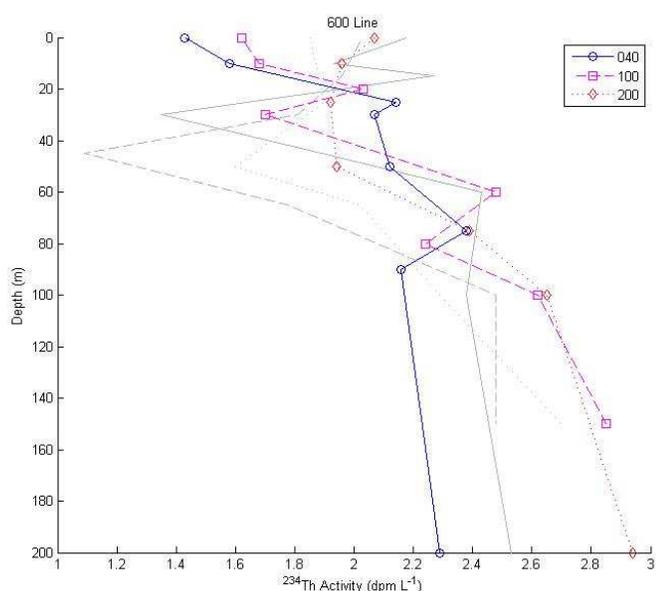
In connection with the sediment traps, postdoc Mike Stukel has been measuring the Uranium-238/Thorium-234 disequilibrium in the upper water column. This ratio is an indicator of particle removal. Preliminary observations suggest significant depletion and particle removal throughout the LTER study region (**Figure X**). Stukel subsampled the most recent trap samples to determine the amount of Th-238 captured by the trap, in order to determine the trap collection efficiency.

During our cruise soil scientists Emelia DeForce (WHOI) and Natasja van Gestel (Texas Tech) collected soil samples near Palmer and Rothera Stations and (with help from B-013) Charcot Island. Emelia will sequence community DNA and RNA to characterize microbial community structure. Natasja conducted temperature response assays using ^3H -leucine incorporation to determine temperature minima and optima on soil and seawater bacterial communities (**Figure X**). The results suggest the active bacterial assemblage is dominated by typical mesophilic bacteria, without evidence of a strong psychrophilic (cold-loving) response.



Figure X (above). SARL Technicap time-series sediment trap “Frenchie” deployed from LM GOULD, 31 Jan. 2013.

Figure X (right). Thorium-234 activity along the LTER 600 line, 5-8 January, 2013 (colors) and in 2012 (gray). Note depletion in upper 50-75 meters resulting from particle scavenging and sinking.



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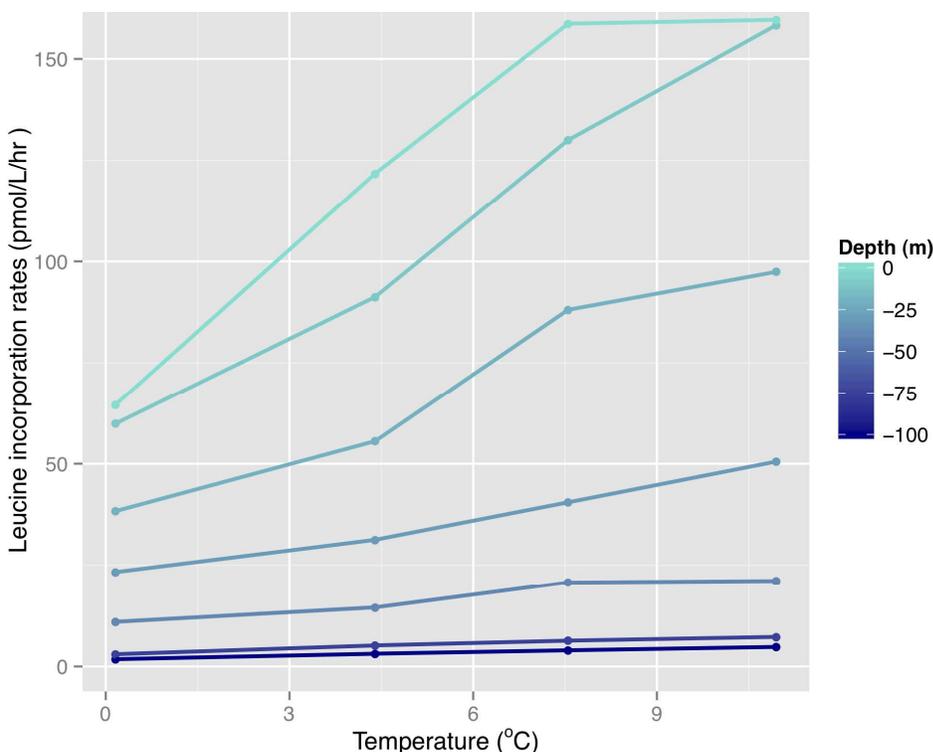


Figure X. Response of seawater bacteria at various depths to incubation temperature.

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.

Over the cruise duration, 331 sightings of marine mammals were collected. The majority of cetacean sightings (121 - 37% of total) were humpback whales. Crabeater seals dominated the sighting history for the entire cruise, accounting for 42% of the total. A total of 140 groups of crabeater seals were detected, representing 1891 individual seals. Details on all species sighted on the cruise are presented in **Figure 1** below. When group size for each species encounter is accounted for, these sightings represent a total of 2269 individual marine mammals. A total of 45 biopsy samples were collected for diet and molecular analysis during the cruise, along with numerous fluke photographs for ID purposes (**Figure 2**).

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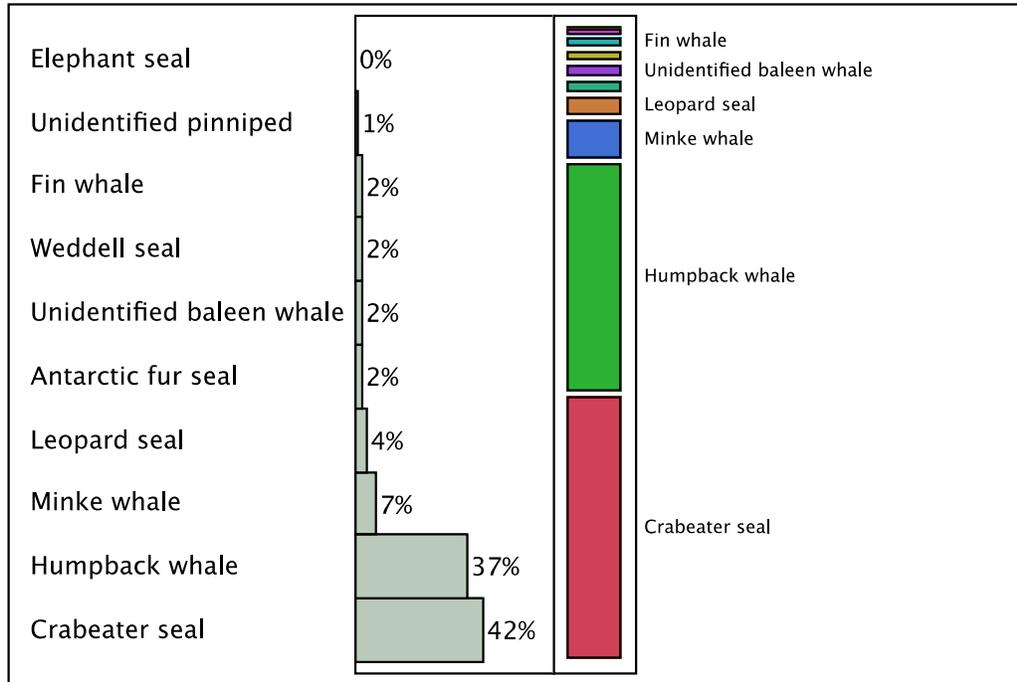


Figure 1. Summary of marine mammals sighting during the Palmer LTER cruise.



Figure 2. The flukes of a humpback whale biopsied in the Palmer Deep region.

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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

For the entirety of the cruise, I have used equilibrator inlet mass spectrometry (EIMS) to measure net community production (NCP) in the mixed layer. This method pulls water from the ship's underway system and continuously measures dissolved gasses (Nitrogen, Oxygen, Argon and Carbon Dioxide) in the sea water. With the exception of port calls at Palmer Station and Rothera, EIMS was in operation starting December 31 and will continue during our return transit through the Drake Passage.

The mass spectrometer functioned very well throughout the cruise and we are excited by the resolution and quality of our data. I am in the process of calibrating the measurements now with hopes to have them completed and mapped along side measurements from last year's LTER by the end of the cruise.

As a side project, I completed filtrations of surface water from the underway system at every grid station during the cruise. These will be used for RNA extractions by Adrian Marchetti's lab at the University of North Carolina Chapel Hill. They are working to develop a molecular indicator method of evaluating iron status using specific genes from diatoms.

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Appendix 1. This year's cruise was brought to you by the following scientists, students and volunteers.



Left: The LM Gould and Palmer Station B-019 phytoplankton team for the 2013 field season. The team included (L to R): Grace Saba, Dena Seidel, Johanna Blasi, Nicole Cuoto, Mikela Provost, Christopher Linder, Zachary Swaim, Oscar Schofield, and Ana Filipa Carvalho. **Right:** B-020 zooplankton group aboard the LMG: (L to R): Debbie Steinberg, Miram Gleiber, Josh Stone, Joe Cope, Brandon Conroy, Kate Ruck.



Above left: O-405 mass spec field operator Rachel Eveleth (Duke University). **Above Center:** B-013 team members Cameron Rutt (center) and Jenn Mannas (right) with MT Dave Moore, and Adelle penguin chicks at Charcot Island. **Above right:** B-045 Palmer Station and LMG team members (L to R standing)) Lara Vimercati, Cat Luria, David Johnston, Natasja van Gestel, Mike Stukel, Sarah Laperriere. Front L to R: Emelia DeForce, Kathleen Woods, Stefanie Strebel, Hugh Ducklow

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Appendix 2. Science support team and ship's officers and crew.

Lockheed/ASC:

Andy Nunn, MPC
Mike Coons, ET
Tony D'Aoust, ET
Lindsey Loughry, MLT
Chance Miller, MT
David Moore, MT

Edison Chouset Offshore:

Joe Abshire, Captain
Mike Brett, Chief Engineer
Peter Kaple, Chief Mate
Arnulfo Aaron, AB
Romeo Agonias, Cook
Lloyd Aguirre, Oiler
Roberto Cortez, AB
Ricardo Doberti, Galley hand
Ramses Farrow, Head Chef
Ryan Gannon, Asst Engineer
Gregory Goodwin, 3rd Mate
Samuel Guillermo, AB
Terry Jackson, Asst Engineer
Drew Merget, 2nd Mate
Elfren Prado, Bosun
Kaleb Smith, Asst Engineer
Noli Tamayo, Oiler