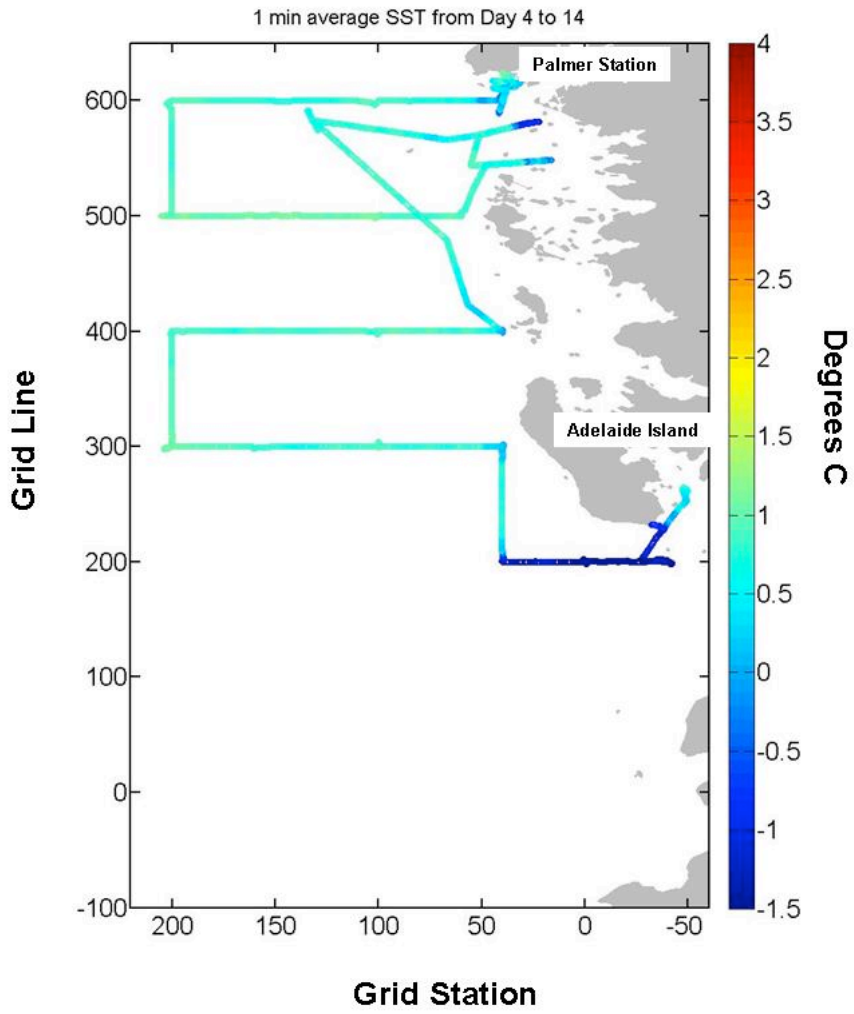
LMG 12-01: 29 Dec. 2011 – 07 February 2012 LTER Cruise 20
Weekly Science Report 2: 10-16 Jan 2012

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

The overall long term objective of Palmer LTER is to understand the mechanistic linkages by which climate, physical oceanographic forcings and sea ice extent and duration control ocean productivity, food web processes, krill and penguin recruitment and carbon biogeochemistry in the marginal sea ice zone of the western Antarctic Peninsula (WAP) region. The WAP is one of the most rapidly-warming regions on the planet, and we have documented responses throughout the foodweb from phytoplankton to penguins. The annual oceanographic cruise (now in our 20th year) provides a large scale regional view of physical-trophic-biogeochemical processes in the region, and contributes to a time series of ecosystem transformation in response to regional warming and sea ice loss.



In the past week, we completed sampling along LTER Grid lines 400 and 300, and occupied three grid stations on the 200 line within Marguerite Bay (MB). The LTER sediment trap was successfully recovered, serviced and redeployed in the midshelf region to the west of Palmer Station. As predicted by ice imagery supplied by Paul Morin (Polar Geospatial Center, University of Minnesota) we encountered a loose ice edge in Marguerite Bay near LTER Station 200.-040. Sea surface temperatures were cold in the MB region, reflecting the recent retreat of sea ice cover (Figure 1).

Figure 1. Map of underway sea surface temperature along the LMG 12-01 track since 04 January (Plot by Matthew Erickson, B-045).

We successfully deployed B-013 team members Kristen Gorman and Jen Mannas to Avian Island for their planned 5-day field camp. Then we started our second process study in the penguin foraging region just off Avian & Adelaide Islands (**Figure 2**).

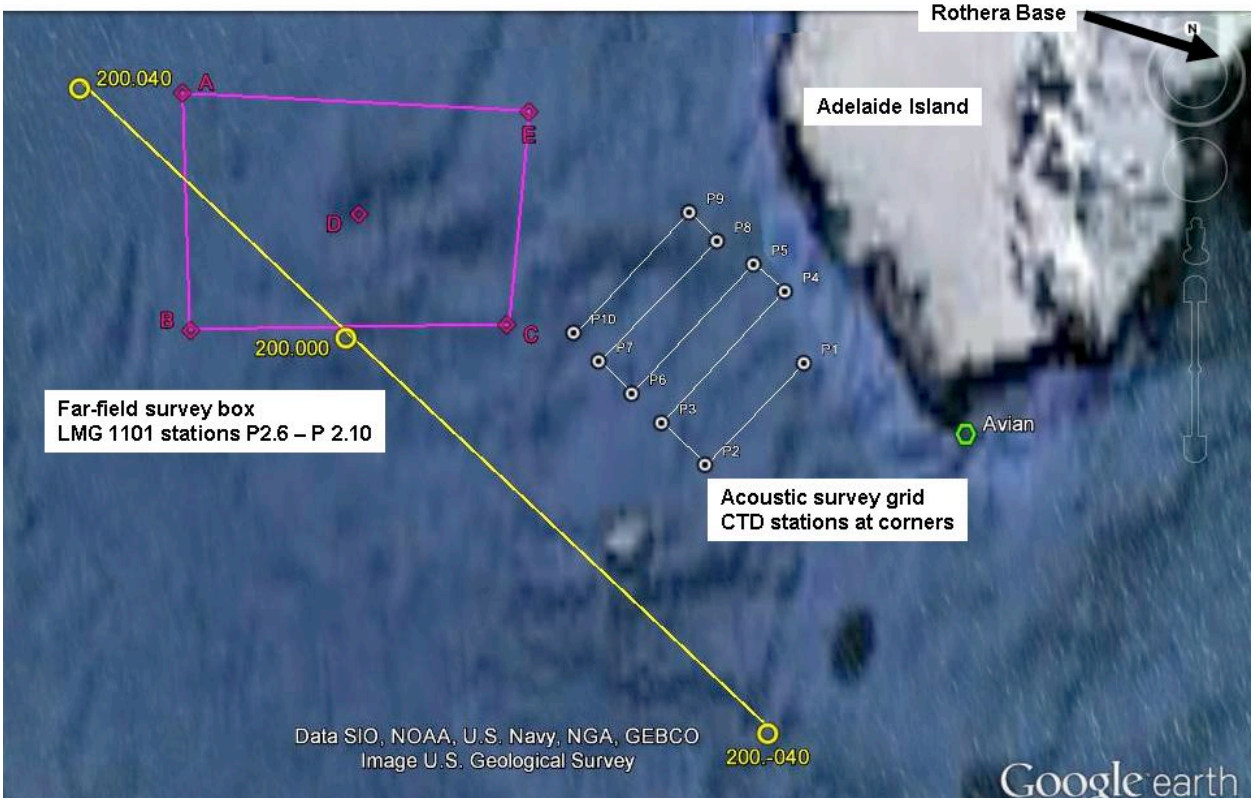


Figure 2. Process Study near Avian Island to investigate relationships among bathymetry, krill distribution and penguin foraging behavior.

During the week we benefitted from excellent support by the Raytheon science support team and the officers and crew of the LMG.

Individual component reports:

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

Field Team Members: Jen Mannas and Kristen Gorman are on Avian Island (**Figure 3**) and will continue their reports next week.

Figure 3. Avian Island, site of large Adelie penguin colony (65,000 breeding pairs) and annual LTER field camp. Photo courtesy Mike Coons.

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

Team Leader: Oscar Schofield (Rutgers Univ). Field Team Members: Kaycee Coleman, Marie Séguret, Christian Laber, Amelia Snow, Andrew Irwin

The objective of this component is to understand how ocean physics regulates overall phytoplankton productivity and community composition and how these dynamics affect the higher trophic levels of the food web.

During the second week of operations the team has documented a strong inshore to offshore gradient in phytoplankton biomass and productivity. Generally across the upper five LTER sampling lines the inshore carbon fixation rates are ~3-4 times higher than the offshore shelf region. Based on FlowCam imagery the 600-500-400 lines indicated that the small (<10 microns) flagellates were numerically dominant. While the upper inshore shelf stations were above the WAP climatological mean the southern portion of the WAP was close to climatological mean of 700 mg C-fixed/m^2/day. The productivity gradients were complemented with a high-resolution (10 kilometer) sampling grid of micronutrients. The spatial sampling is complemented with a second process study looking at the differential uptake of different forms of nitrogen isotope by bacteria and phytoplankton.

The deep-water glider sampling of the canyon complements the process study sampling aboard the RV Gould. The RU26D glider was launched before Thanksgiving from Palmer Station and has travelled to the south and has been sampling just offshore Avian Island waiting for the ice to break up. The retreat in the ice has allowed us to start the RU26 glider in for its approach to Rothera. The current location is shown in **Figure 4.**

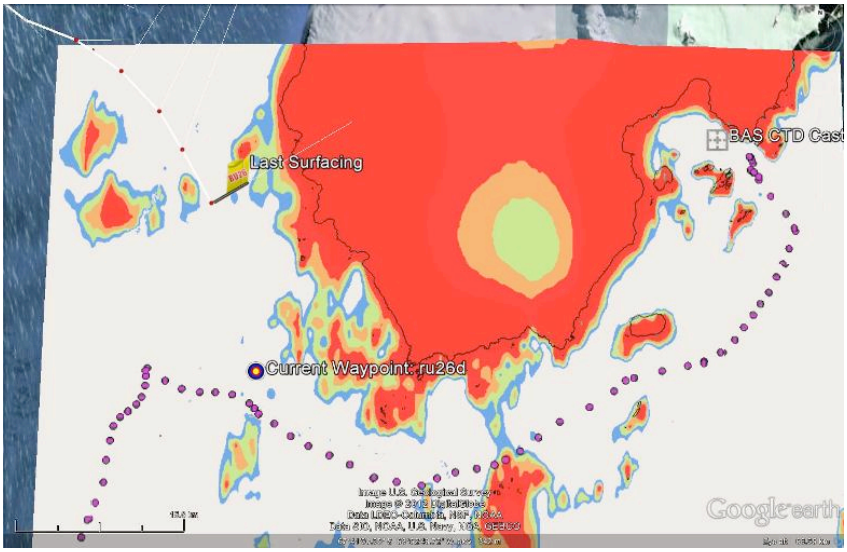


Figure 4. Map of Avian Island Process Study showing current position of RU26 Glider and 2009 process study track to Rothera Base.

The crew/RPSC support on the ship has been excellent. The marine science technicians have been invaluable in repairing sea cables for our optical instrumentation that had been damaged. Their hard work got the optical gear fixed and is now back into a standard sampling. Additionally Lindsey Loughry provided excellent assistance after there were some mechanical issues with the scintillation counter in the carbon-14 radiation van.

B-020. Zooplankton Component (D. Steinberg, VIMS; PI)
Field Team Members: Joe Cope, Kim Bernard, Kate Ruck, Lori Price, Karen Stamieszkin, Frances Armstrong.

During the second week, we completed full stations along LTER 200, 300, and 400 grid lines. Samples were dominated by *Euphausia superba*; salps were present at the outer stations. We continued to collect samples for zooplankton lipid and gut fluorescence analyses. We successfully completed operations at the second process study station off Avian Island. B-013 found that penguins in the area were feeding heavily on juvenile krill. A bio-acoustic survey conducted within known penguin foraging grounds detected only a few aggregations of large krill. However, our macrozooplankton and mesoplankton net tows within the foraging area collected large numbers of juvenile krill. Our second pair of day/night MOCNESS tows was deployed in the survey area. Fecal pellet production experiments were performed on *Euphausia superba* and gut evacuation experiments on dominant copepod species. A microzooplankton dilution experiment was also conducted. We collected krill samples for Jose Torres at the University of South Florida for genetic and enzyme analyses.

B-045: Microbial Biogeochemistry Component (H. Ducklow, MBL; PI).

Team Leader: Hugh Ducklow. **Field Team Members:** Matthew Erickson, Cat Luria, Pam Moriarty, Sevrine Sailley, Mike Stukel.

During the past week we obtained a full set of biogeochemical and microbial profiles at 9 stations on the 400, 300 and 200 lines, and successfully recovered and redeployed the moored

sediment trap. Leucine incorporation rates (an indicator of bacterial secondary production suggest average to low rates of bacterial activity at the stations measured thus far, and a linear relationship of bacterial production rate (BP) with nanoplankton abundance (as determined by flow cytometry) (Figure 5). This relationship illustrates the dependence of bacterial activity on organic matter supplied by phytoplankton.

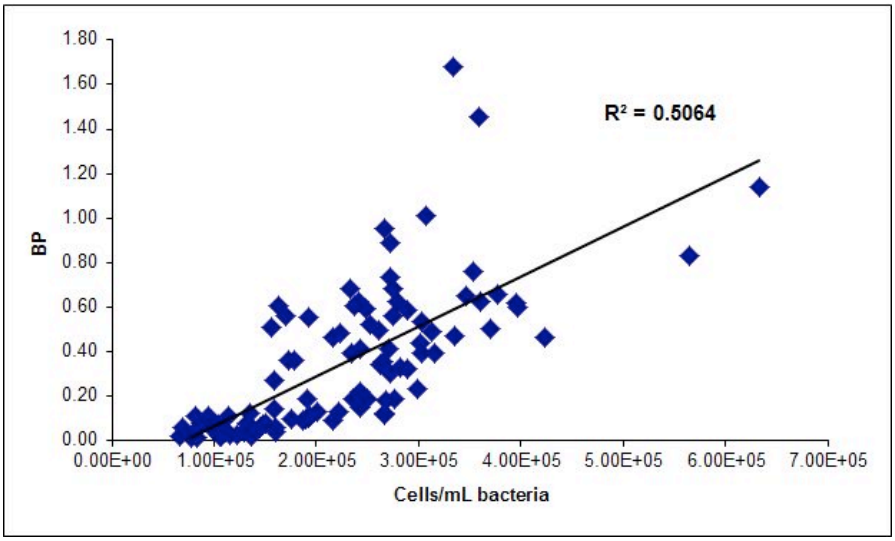


Figure 5. Relationship between discrete depth nanoplankton abundance (determined by flow cytometry and bacterial production rate (derived from leucine incorporation rates) on discrete depth samples in the upper 100 meters at LTER Grid stations.

LTER Guest Component: Distribution, abundance, and movement patterns of baleen whales within the Palmer LTER study area. PI: Ari Friedlaender.

Through a combination of visual surveys and satellite telemetry, the aim of this project is to better characterize the distribution and movement patterns of baleen whales within the LTER study area. By linking the movement patterns and distribution of these krill predators to oceanographic conditions and the historic feeding areas for Adelie penguins, we can begin to understand the ecological relationships that are likely to be affected by warming conditions in the Western Antarctic Peninsula region.

To date, 103 sightings of 214 humpback whales have been made. As well, two satellite-linked Argos tags have been deployed on humpback whales in the vicinity of Palmer Station. Their movement patterns suggest both residency in the krill-rich region around Anvers Island and longer-range movements to find other high-density krill areas in which to feed both to the north and south, but remaining in coastal waters around the islands of the Western Antarctic Peninsula. Two sightings of four minke whales have also been made. In general, it appears that the relative abundance of humpback whales is much greater in the northern portion of the study area than to the south in Marguerite Bay. In three days of excellent conditions and significant survey effort, relatively few humpback whales have been seen.

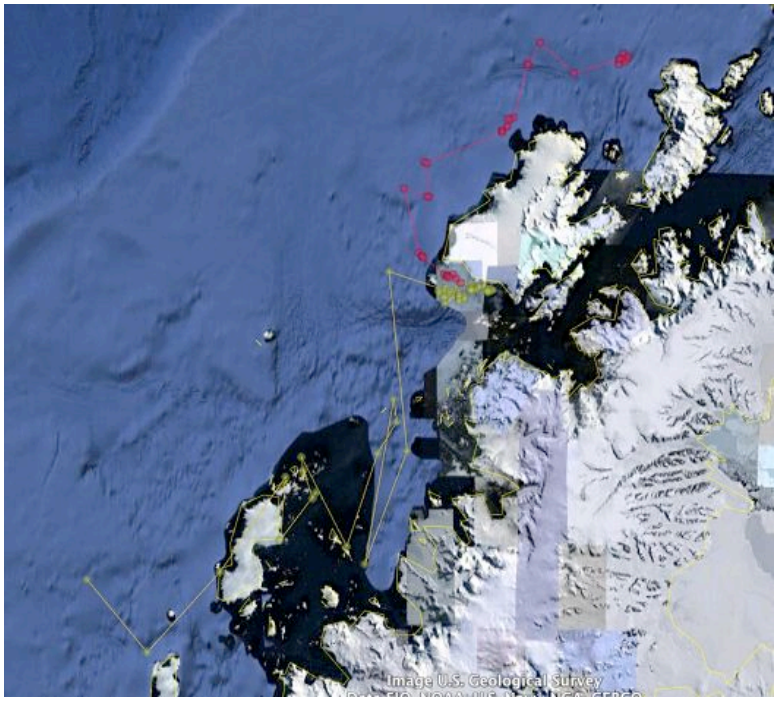


Figure 6. Satellite-linked locations of two humpback whales and their movements in the region of Anvers Island and south to Renaud Island.

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

Field Team Leader: Bruce Barnett.

Measurements of dissolved N2, O2, Ar and CO2 have continued. Measurements were disrupted for approximately half a day due to water entering the instrument but resumed after replacing a few capillaries and heating the system to 150C. We have been working on generating a map showing results to be completed prior to Weekly Report #3. With Marie Seguret's help, we were able to collect a series of filtered samples along a couple of the transect lines and will continue to sample the remaining lines. This work is collaboration Adrian Marchetti at the University of North Carolina-Chapel Hill. Adrian has developed a molecular technique for the determination of diatom iron limitation status. RNA will be extracted from the filtered diatoms and analyzed for specific target genes Adrian has identified.