LTER LMG-1001; Sit-Rep Week I (5-12 January, 2010)

This is the first report of LTER January Cruise 18, LMG 1001, that departed Palmer Station on 05 January to commence research operations. This year's science party includes our usual groups (PI/Team leaders): B-013 (Fraser/Gorman), B-019 (Schofield/Kahl), B-020 (Steinberg/Cope), B-045 (Ducklow/Erickson), and the guest B-XXX group from WHOI (Ken Buesseler, PI, S. Pike, team leader). B-021 (Physical Oceanography/D. Martinson) sampling is conducted by other team members aboard the vessel, with spiritual support from Doug, afar.

This year's cruise has 4 principal components: occupation of as many traditional CTD/Net tow stations on the LTER Grid as time allows, conducting extended 3-day Process Studies at 3 locations TBD, the B-013 Field Camp at Avian Island, and recovery/redeploy of a sediment trap mooring and 5 physical oceanography moorings.

We thank all the ship's officers and crew, and RPSC personnel in port and aboard the vessel, for outstanding support getting LTER-18 off and running. We have experienced several instances of over-the-side equipment loss or non-recovery, but all personnel went out of their way to try and correct each situation.

Iceberg collapse January 8, near Process Study Station 1 (585.135, 64 deg 30 South, 66 deg 12 West). Photo by Mike Coons ©.

Individual reports follow.

B-013. Seabird Component (W.R. Fraser, PI). Field Team Members: Shawn Farry and Kristen Gorman.

(NB: This report includes Week 2 up to just before deployment onto Avian Island).

The port call at Palmer Station prior to leaving for the LTER 1001 cruise went very smoothly. We thank Station Managers, Bob Farrell and Rebecca Shoop, for their efforts, particularly with respect to planning for the tarp installation on the Avian Island hut. The Palmer Boating Coordinator, John Fonseca, helped us tremendously in preparing the Mark III zodiac for the LTER cruise, specifically ensuring that there are extra fuel tanks available and oars, in addition John constructed a harness for the Mark III to be used with crane operations allowing a much more safe approach for craning gear in the zodiac off the ship. We also thank Palmer Lab Supervisor, Phil Spindler, specifically for recognizing in Punta Arenas that our propane for the Avian Island field camp was not purchased properly by RPSC marine. Phil was also instrumental in organizing an alternative plan for propane and camp stoves to be used at Avian Island. The Logistics crew at Palmer Station, Bob Devalentino and Jon Brack supported our LTER cruise operations by moving some of our heavy gear on to the ship and ensuring that all supplies from Palmer Station for the Avian Island hut tarp were ready and available for onload to the LMG.

The first week of our work this cruise, 5-11 January 2010, consisted primarily of at-sea observations of seabirds and marine mammals along the 600 and 500 lines and Process Study Station I. The numbers of birds observed were generally low. We worked at the process station 585.135 between 1/8/10 through 1/10/10 conducting 30 min surveys every hour between 06:00 and midnight for the duration of the process station. Again, the numbers of birds and marine mammals observed were low.

The second week of our work this cruise, 12-16 January 2010, again consisted of at-sea observations of seabirds and marine mammals along the 400, 300, and 200 lines of the LTER regional study grid, in addition to preparations for the Avian Island field camp which was deployed on 17 January 2010. Along the 400, 300, and 200 lines, numbers of birds were generally low, although we would occasionally see some higher activity, particular with the sightings of more Antarctic prions further south on the grid. RPSC marine on the ship has been very attentive to ensuring that sea-ice imagery sent from the Palmer Station Research Associate is available to our science group, we thank Jamee Johnson and Mike Coons for their support.

B-019 Phytoplankton & AUVs (O. Schofield, PI). Field Team Members: Megan Cimino, Kaycee Coleman, Michael Garzio, Tina Haskins, L. Alex Kahl, Rob Sherrell.

The 2010 LTER Phytoplankton & AUV component is maintaining the traditional suite of measurements such as pigments (chlorophylls and accessory pigments), bio-optics (Apparent and Inherent Optical Properties of the water column), variable fluorescence, and simulated *in situ* primary production experiments. We are also continuing our expanded LTER bio-physical surveys using autonomous underwater vehicles to measure salinity, temperature, fluorescence, backscatter, and mean depth currents. Furthermore, on this cruise we have introduced trace metal sampling via a specialized sampling port, to collect both discrete and underway samples which will be analyzed at Rutgers University.

This far on this year's cruise, we have benefited from the hard work of Palmer Station FEMC's construction of our new primary production on-deck incubators. We have also had tremendous success collecting and processing samples in the trace metal-clean environment constructed by the Marine MTs. Despite losing our free-falling hyperspectral radiometer to the Gould's propeller on our third cast of the cruise, we have assembled an excellent array of Inherent Optical Properties using our bio-optics cage. The IOPs have subsequently been used to initialize Hydrolight water column radiative transfer model runs in an effort to establish the idealized subsurface light field used to inform simulated *in situ* sampling depths on the CTD casts. At the first process study station we also flew our AUV, a Teledyne-Webb Slocum glider, upstream from the drifting sediment trap arrays to record the fluorescence and backscatter of the source water mass feeding the sediment traps. The same glider is currently being prepared for deployment at Ocean Station Obama where it successfully followed drifting sediment trap arrays on last year's cruise. Thus far, we are thankful for the professional attitude, tireless effort, and selfless work ethic of the RPSC Marine and ECO personnel on the L.M. Gould.

B-020. Zooplankton Component (D. Steinberg, PI). Field Team Members: Joe Cope, Kim Bernard, Kate Ruck, Lori Price, Beth Simmons, Sarah Glitz.

The overall objective of our component in Palmer LTER is to understand the role that zooplankton community structure plays in biogeochemical cycling of carbon and nutrients, and the effects of climate change on zooplankton communities in the continental shelf sea of the west Antarctic Peninsula. This year, with three process study stations, we emphasize the role that zooplankton play in the biological pump (grazing, particle or fecal pellet production, and diel vertical migration).

In the first week, we completed full stations along the LTER 600 and 500 lines and concentrated our operations at a special 3-day process study station situated near the sediment trap mooring at LTER grid point 590.130. At each station we performed a pair of net tows for larger macrozooplankton (e.g., krill, salps) and smaller mesozooplankton (e.g. copepods). Animals from the macrozooplankton tows were identified and counted on board, while the presence of taxonomic groups was noted in the mesozooplankton samples. We also took samples at selected stations for zooplankton lipid and gut fluorescence analyses. At the process study station, we performed depth-stratified zooplankton sampling using the MOCNESS (Multiple Opening-Closing Net Environmental Sensing System) to investigate depth distribution of the abundant taxa over a diel cycle. Despite the almost constant light, we did detect diel vertical patterns in some taxa (e.g., copepods and *Thysanoessa*). We also performed a dilution experiment to measure microzooplankton grazing and several gut evacuation rate experiments on larger zooplankton; these, coupled with gut fluorescence measurements of the larger zooplankton mentioned above, will allow us to quantify removal of primary producers by the zooplankton community. Finally, we measured fecal sinking rates of salps to determine their potential transport of organic carbon to the deep ocean.

The crew/RPSC support on the ship has been excellent. The marine science technician has provided us with some essential equipment that was not listed on the SIP. The deployment of our net tows went smoothly with the expertise of the vessel pilots, marine technicians, and winch operators. Due to adverse weather conditions, some nets were damaged during their deployment; the marine technicians rapidly repaired the nets so that no stations were missing.

The electronic technicians assembled and tested the MOCNESS system. We are very thankful for their efforts.

B-045. Microbial Component (H Ducklow, PI). Field Team Members: Hugh Ducklow, Matthew Erickson, Mirko Lunau, Maggie Waldron, Dan Whiteley.

The overall objective of our component in Palmer LTER is understanding the biogeochemical cycle of carbon and roles of bacteria in the continental shelf seas of the west Antarctic Peninsula. This year, we have a new capability to analyze microbial populations in near-real time, using our new Accuri C6 Flow Cytometer on board the vessel. We also have guest investigator Dr Mirko Lunau (Alfred Wegener Institute for Polar Research, Bremerhaven, Germany). Dr Lunau will be conducting N15 stable isotope tracer experiments with the objective of studying microbial transformation of reactive nitrogen and its coupling with carbon cycling in this part of the southern ocean.

In the first week, we completed 13 full CTD profiling stations on the LTER 600, 500, 400 and 300 lines and concentrated our operations at a 3-day process study station situated near the sediment trap mooring at LTER grid point 585.135. During this period we performed repeated CTD casts as well as other operations described above and in the other component reports. Preliminary analysis of flow cytometric data from fresh samples shows the dominance of Nanoeucaryotes (most likely diatoms) in the upper 50m of the water column and then rapidly decreasing with depth. Picoeucaryotes and flagellates were frequently observed. Preliminary results using fluorescent activity dyes show a tight coupling of depth integrated phytoplankton dynamics and microbial activity (leucine incorporation). Our regular suite of measurements includes bacterial abundance and production rates, dissolved inorganic and organic carbon, dissolved oxygen and oxygen-17 isotopic abundance (for M Bender, Princeton).

On 10 January we failed to recover our time-series sediment trap moored in 350 meters near 585.135 (deployed 10 Jan. 2009). This event is addressed in a separate report. We are considering options for deploying a second trap to cover the upcoming year.

We recognize and thank all ECO and RPSC personnel for outstanding support of our science project aboard the LMG.

B-021. Physical Oceanography Component (D Martinson, PI)

The overall objective of our component in Palmer LTER is to provide fundamental ocean property distributions in support of the overall PAL LTER hypothesis that the ecosystem is responding to the physical environment. Also, given that the rapid atmospheric winter warming is not due to the sun, determine the role of the warm ocean waters in contributing to the excessive winter atmospheric warming and excessive glacial melt.

So far, we have completed a full depth CTD at every full station occupied (18). We have also recovered the thermistor moorings at 400.100, and refurbished/redeployed it near 300.160. We failed to recover the mooring at 300.100. This is addressed in a separate report. The CTDs extend our previous data establishing the increase of ocean heat on the continental shelf, while

the moorings show the temporal change in ocean heat throughout the year, refining our understanding of the mechanisms responsible.

As with every other component, our program benefited tremendously from the excellent Raytheon field support. In particular Tony D'Aoust and Mike Coons worked the CTD as well as anyone ever has, and downloaded/reprogrammed the mooring sensors for quick turn-around. All mooring work was further assisted by Chance Miller and Justin Smith on deck for the recovery and deployments. Likewise, the moorings could not have been turned around nearly as quickly without the flawless, efficient and cheerful help from SO-MOIST team members Matthew Erickson, Megan Cimino and Mike Garzio in constructing the new mooring strings for deployment.

O-288. WAP Flux - New Tools to Study the Fate of Phytoplankton Production in the West Antarctic Peninsula. (K Buesseler, PI). Field Team Members: Steve Pike, Stephanie Owens, Jim Valdes

The objective of the WHOI group is to apply new tools to study the fate of phytoplankton production off the West Antarctic Peninsula (WAP-Flux). Direct measurements of particle flux will be made using neutrally-buoyant sediment traps (NBSTs) and a drifting array with a combination of unique sediment traps located at 3 depths. The array consists of respiration chambers to evaluate in situ degradation of sinking particles by bacteria, polyacrylamide gels for identification of intact sinking particles, and conventional sediment trap tubes for quantification of the sinking flux. In addition to the deployment of sediment traps at the process stations, naturally occurring thorium-234 (^{234}Th) will be measured and used as a proxy for particle flux at the process stations, LTER CTD stations, and during underway sampling. Images of sinking and suspended particles will be taken using a Video Plankton Recorder (VPR) to evaluate the relationship between particle concentrations and particle flux, derived from the sediment trap results.

During this first week, 10-point profiles of ^{234}Th from 14 CTD casts were collected to determine particle flux and 60 underway samples of ^{234}Th were collected at 10-20 km intervals to evaluate the spatial variability of particle flux. These underway measurements were made in combination with measurements of factors that contribute to the magnitude of the particle flux including algal cell-size distribution and phytoplankton community composition. The VPR was successfully deployed at each CTD station. At the LTER process station, ^{234}Th sampling and VPR deployments continued and in addition, the in situ pumps, the drifting array, and one NBST were deployed. The drifter was recovered after a 48-hour deployment however, an ARGOS transmission from the NBST was never received and the instrument was lost. A more detailed report has been filed by the MPC.

We would like to recognize and thank all ECO and RPSC personnel for their help with all aspects of science and deck operations. We also thank the Captain and crew of the *ARSV* L.M. Gould.