PALMER STATION MONTHLY SCIENCE REPORT

JUNE 2013

Divers Julie Schram and Maggie Amsler return to the surface after a dive off the Palmer dock.
Image Credit: Janice O'Reilly

NEWS FROM THE LAB
By Janice O'Reilly, Assistant Supervisor of Laboratory Operations

Palmer Station supported another busy month of lab experiments, field work, and fishing cruises during June. Members from B-027-P (McClintock/Amsler), B-029-P (Postlethwait), B-036-P (O'Brien) and B-228-P (Amaral-Zettler) continued their research during the entire month. Dive operations for B-027-P (McClintock/Amsler) continued by Zodiac boat and from the floating dock. One fishing cruise was completed mid-June onboard the *ARSV Laurence M. Gould* (LMG).

The natural landscape surrounding Palmer Station became quieter, as wildlife populations dwindled to only the occasional sighting. Early in the month approximately one dozen fur seals were observed on Bonaparte from the galley window. Backyard hikers occasionally passed one or two fur seals along the edge of Hero Inlet and Arthur Harbor. On 6 June a cluster of eight elephant seals was seen huddled in a melted ice depression next to Sheathbill Cove of Amsler Island. Approximately five elephant seals were seen on Elephant Rocks on a separate day, early in the month. There was one report of a leopard seal resting on floating ice near Gamage Point on 11 June. Sightings of crabeaters swimming in the water were observed by divers working on the boat ramp project next to the pier, and on 30 June three crabeaters were seen resting on the frozen surface of Hero Inlet.

Several species of birds were still present during the month. A flock of over 100 Antarctic terns were frequently observed swarming around the backyard and resting along the Arthur Harbor shore. One or two cormorants could be seen perched on snow-covered rocks of local islands. The largest sighting of six cormorants was seen on 1 June flying by Palmer Station. On 5 June two Adélie penguins were seen, one on Janus Island and one on Torgersen Island. No other penguin sightings were reported for the month. Other bird species observed during June included giant petrels, kelp gulls, snow petrels, and snowy sheathbills.

JUNE 2013 WEATHER
By Graham Tilbury, Research Associate

June turned out to be a relatively normal month at the station. Apart from a heavy snowfall on the 13th, little snow fell for the rest of the month. Low SW winds on mid-winter day, made for a pleasant, though cool period. The pressure systems over the station varied from a low of 948 mb to a high of 1004mb, recorded one week later on the last day of the month.

The average temperature for this month was -3.5°C, with a low of -10.1°C on the 26th. Strong N to NE winds during the first few days of the month raised the temperature significantly, resulting in a max of 3.2°C on the 6th. The peak wind gust for the month was recorded on the third day, at 61 knots. The average wind speed for the month was 11 knots, almost exactly the same as last year's June value.

The melted precipitation for June was 23 mm. Snowfall for the month measured 50 cm, with almost half of that falling on one day. The snowstake stood at 28cm at month's end, having reached a maximum of 55 cm midway through the month. This level is very close to the June level for last year.

The average sea surface temperature (SST) was -1.5°C. At no time during the month did it rise above 0°C. Despite this cool temperature, very little sea ice was seen. The back of Hero Inlet froze over early in the month, and occasional pancake ice formed there and in Arthur Harbor during the colder days towards the end of the month. A few large ice bergs were seen from the station, but remained well offshore. The glacier fronting Arthur Harbor continued calving intermittently, though at a noticeably slower rate.

B-027-P: THE EFFECTS OF OCEAN ACIDIFICATION AND RISING SEA SURFACE TEMPERATURES ON SHALLOW−WATER BENTHIC ORGANISMS IN ANTARCTICA

James McClintock, Charles Amsler, and Robert Angus, Principal Investigators, University of Alabama at Birmingham

Personnel on station: Margaret Amsler, Kate Schoenrock, Julie Schram.

Routine maintenance of the project's microcosm ocean acidification continued into the early days of the month. As the spectrophotometry and alkalinity titrations ended last month environmental conditions within the 48 microcosms were monitored via temperature probe and Durafet pH probe. This monitoring ceased the second week of the month as the multi-day takedown began. Throughout the duration of the two month experiment over 4000 readings were recorded. The experimental two species of algae and two species of amphipods were sampled for various parameters to determine the effects of the pH and temperature combinations within the microcosm.

Field work this month was limited to three dives which allowed us to collect food for experimental amphipods as well as additional algal collections which extended temporal and spatial sampling of one species in particular.

The bulk of the latter half of the month's activity focused on packing project gear and science samples as well as lab cleanup.

The project is greatly appreciative of the exemplary support provided by numerous ASC staff: Meredith Helfrich efficiently effected our boating operation and also served as tender with Darren Yates, Yuki Takahashi, and Mike (Shorts) Sieger; Graham Tilbury refilled our scuba tanks; Janice O'Reilly and Juliet Alla assisted with our assigned labs cleanup and check out; and Gift Glimchit and Cedar Reimer promptly dealt with our cargo needs.

B-029-P: DEVELOPMENTAL MECHANISMS FOR THE EVOLUTION OF BONE LOSS

Dr. John H. Postlethwait, Principal Investigator, Institute of Neuroscience, University of Oregon, Eugene, and Dr. H. William Detrich, Co-PI, Northeastern University

Personnel on station: Ashley Nelson, Urjeet Khanwalkar.

June had some high points and some disastrous losses.

On a positive note, we had several matings of Antarctic notothenioid fish that are important for continuing our investigation of bone development. Current crosses include:

• *Notothenia coriiceps* (yellow bellied rockcod) cross #7/8. These crosses occurred by natural overnight spawning in the outside tank #2 over the course of several days and so the date of fertilization varies. The female and male individuals remain unknown, which makes genetic analysis problematic. In addition, the embryos vary in developmental stage. The oldest embryos were at 22 somites at the end of June and the youngest were at the mid-gastrula stage.

• *N. coriiceps* cross #12. These animals were fertilized on June 25th in a natural overnight spawning in our "watch tank", the aquarium containing fish we were watching for gravid animals. For this cross, the female is known, but the male parent or parents are unknown. Embryos at the end of June were at the early to late blastula stage.

• A big problem for us is that there were no icefish crosses, and at this point it is unlikely that we will have any this field season. We obtained two gravid females on the June 11th to 14th fishing trip, but both expired within 72 hours. We attempted to obtain eggs by expressing them from the abdomen by gentle pressure. Regrettably, no mature males were available and we had to resort to macerating testes, a technique that generally works for many species of fish. Unfortunately, the 'fertilized' eggs did not exhibit any cleavage divisions and deteriorated over time.

• We currently have three indoor tanks and one outdoor tank that contain fish. The divided watch tank sitting near Environmental room-2 contains *N. rossii* (marbled rockcod), a robustly mineralized species (15 animals) and several gravid or mature *N. coriiceps* (7 individuals). The tank near the entryway to the labs have *N. coriiceps* (15+ fish), including some non-gravid females and some milking/non-milking males. The tank of non-gravid *Caenocephalus aceratus* (blackfin icefish, 5 individuals) will close down once we have sampled all of the icefish. Tank #1 outdoors with *N. coriiceps* (15+ fish) collected in the June 11th to 14th fishing trip contains several small and non-gravid individuals.

• We collected several samples for histology, gonadal-somatic index (GSI), and for RAD-sex, a next-generation sequencing technique to identify the genetic region containing the major sex determinant, the genes that cause an animal's gonad to develop into an ovary or a testis. We continue collecting these genetic samples on expired or spawned out individuals, including some specimens generously donated from project B-036.

• Total fish collected for this season include: *C. aceratus* – 276; *Champsocephalus gunnari* (mackerel icefish) – 99; *Chionodraco rastrospinosus* (ocellated icefish)- 20; *Pseudochaenichthys georgianus* (South Georgia icefish) – 44; *N. rossii* – 31; *N. coriiceps* – 102; *Gibionotothen gibberifrons* (humped rockcod)-120.

• Samples taken: Histology and RAD-sex samples (along with some frozen whole fish) were sent back to the States on last cruise back to Punta Arenas on July 2nd . Embryos have been fixed for gene expression by RNA-seq and for histology in Bouin's fixative. *N. coriiceps* embryos were sampled at the following developmental stages: unfertilized eggs, "sphere" stage, "shield" stage, 60-80% epiboly, and at 10-15 somites.

• Dates of note:

-- June 11th to 14th- A fishing trip to Low Island collected over 25 *C. aceratus* for B-029, but only two were gravid females. Most of the other females were already spawned out for the season. The lesson here is that next year sampling must be accomplished before mid-June to increase the likelihood of success with this important species.

Unfortunately, the majority of specimens died with 48-72 hours due to the stress of the trawl and transfer. Because these fish have osteopenic skeletons – the very feature we want to

learn the genetic basis of – they are 'floppy fish'. They suffer substantial damage in the trawl and in extricating fish from the by-catch. The lesson here is that we must devise fishing methods that are kinder and gentler for icefish.

-- The second fishing trip was cancelled.

-- June 16th – We had several thousand *N. coriiceps* embryos developing from identified and genetically sampled individuals at know times from in vitro fertilization in our specially designed aquaria in E-room #1. On the morning of June 16th, we discovered that all were dead. This was caused by an algae blockage in the sand filtration system.

Embryo death may have been due to 1) decreased flow or stopped flow rate leading to oxygen depletion or waste buildup and death, or 2) due to agents used to clear the blockage, or 3) agents produced by the algae and liberated when the blockage was cleared from the system. Sudden death seems unlikely to be due to oxygen depletion or waste buildup overnight because in 2008, we packed several hundred *N. coriiceps* embryos in sealed 50 ml Falcon tubes in Punta Arenas and brought them as personal luggage to Eugene Oregon, a trip of about 48 hours, and nearly all animals survived.

-- June 25th – Sea water flow to the entire station was halted from about 4pm to 8pm due to a mechanical issue with water pump(s) at the pumphouse. Palmer station personnel and the crew of the LMG were heroic in their effort to assist in establishing a bucket brigade to transfer fresh seawater gathered off the pier into all the fish tanks, and this is greatly appreciated.

The B-029 group thanks the dedicated LMG staff and crew, and the cheerful and skillful Palmer Station staff, with special regards to the laboratory team for constant attention, the I&O crew, who worked diligently helping with various kinds of issues in water systems and incubators, and the administrative support staff for their important contributions to sample collecting, maintenance, shipping and making the science here possible, productive, and enjoyable!

B-036-P: REDOX BALANCE IN ANTARCTIC NOTOTHENIOID FISHES: DO ICE FISHES HAVE AN ADVANTAGE?

Kristin O'Brien, Principal Investigator, University of Alaska Fairbanks

Personnel on station: Kristin O'Brien, Elizabeth Crockett, Theresa Grove, Johanne Lewis, Corey Oldham and Amanda Reynolds.

We continued our studies aimed at determining if there is physiological or biochemical advantage to being an icefish. We hypothesize that the presence of the iron-containing proteins hemoglobin and myoglobin increases levels of oxidatively-damaged proteins, warranting greater rates of protein turnover and higher rates of protein synthesis in red-blooded notothenioids compared to icefishes. O'Brien and Amanda Reynolds completed measurements of rates of protein synthesis in hearts, pectoral adductor muscle and liver tissue of the icefishes *Chaenocephalus aceratus* and *Pseudochaenichthys georgianus* and in the red-blooded species *Gobionotothen gibberifrons* and *Notothenia coriiceps*. Dr. Theresa Grove measured the energetic costs of protein synthesis in hepatocytes and cardiac myocytes in the red-blooded species *N. coriiceps* and in the icefishes *P. georgianus* and *C. aceratus*. Corey Oldham began measurements of the maximal oxidative capacities of liver, pectoral adductor and hearts in the icefish *P. georgianus* and red-blooded species *N. coriiceps* but was unable to complete all

measurements because the spectrophotometer (Perkin Elmer Lambda 40) broke down. Dr. Lisa Crockett continued analyses of non-heme iron contents in heart ventricles, livers, pectoral adductor muscles, spleens, plasma, and urine from red- (2 species) and white-blooded (4 species) fishes. Other tissue samples (e.g. head and trunk kidney), bile and feces were also collected from analyses at Crockett's home institution.

We treated the red-blooded notothenioid *N. coriiceps* with the iron-binding drug, desferioxamine (DFO). Tissues (liver, spleen, oxidative skeletal muscle and heart) were harvested and transported to our home institutions for further analyses to determine if reducing iron decreases oxidative stress.

Field team members Crockett, O'Brien, Oldham and Dell participated in a successful fishing trip on the *R/V Laurence M. Gould* from June 12- June 16 off of the south shore of Low Island and in an area north of Dallmann Bay. In addition to our typical catch of *C. aceratus, N. coriiceps*, and *G. gibberifrons* we were able to obtain a dozen specimens of *P. georgianus* and *C. rastrospinosus*, both of which are white-blooded yet express myoglobin in their hearts.

PolarTREC teacher and field team member, Paula Dell successfully launched the 'Fish Spy' camera constructed by her students at *Lindblom Academy of Math and Science Academy* in Chicago, Illinois. We attempted to deploy the camera at our fishing grounds near Low Island but unfortunately, the cable was too short given the strong current, and waters too rough for the camera to reach the bottom. Instead, the camera was successfully deployed from a zodiac at several locations near Palmer Station. Dell obtained footage of the fish (*N. coriiceps*) as well as invertebrates and seaweeds. This work could not have been completed without the outstanding support from the *LMG*'s MTs (Ryan Wallace and Matt Ulsh), ETs (Sheldon Blackman and Kevin Pedigo), MST (John Betts) and MPC (Jamee Johnson).

B-228-P: COLLABORATIVE RESEARCH: MICROBIAL COMMUNITY ASSEMBLY IN COASTAL WATERS OF THE WESTERN ANTARCTIC PENINSULA

Linda Amaral-Zettler, Principal Investigator, Marine Biological Laboratory, Woods Hole, MA; Jeremy Rich, co-Principal Investigator, Brown University, Providence, RI

Personnel on station: Madie Willis, Sean O'Neill, and Jeremy Rich

In June we arrived at Palmer Station to begin our six-month field campaign sampling station B and seawater intake on a weekly basis. The goal of the project is to examine seasonal changes in microbial community structure from winter to summer. Winter is currently poorly sampled for microbial communities and so this project will provide unique datasets. We are examining controls on seasonal changes by conducting seawater carboy experiments (50L) amended with diatom exudates and sea-ice containing diatom biofilms.

The main objective for the month was to get the lab set up and for the research team to gain familiarity and confidence with boating in the field and laboratory protocols. This has been accomplished and Jeremy left at the end of the month, leaving Madie and Sean on station in high spirits and capable hands to conduct the remainder of the work through the winter.

After unpacking the flow cytometer, it was calibrated for the unique wintertime microbial communities present, low in photosynthetic microbes. Bacteria are present and active based on flow cytometry and bacterial production measurements. Although rates are low as expected, we are intrigued by presence of microbial activity in winter twilight and darkness. Preliminary measurements indicate about twice as many bacterial cells and double the growth rate in seawater intake samples compared to station B. Seawater samples were filtered for chlorophyll and particulate matter analyses, as well as samples for nutrients and dissolved organic carbon. Seawater was filtered to collect microbial cells for DNA analyses, which we will use to measure the number and types of microbial species present and how they change from week to week. There are likely to be thousands of species present in our samples.

We carried with us organic matter exudates produced by diatoms and extracted by the graduate student working on the project, Cat Luria. We resuspended one bottle of exudates and added the carbon to a preliminary set of carboys. The results were promising and indicated stimulation of microbial growth in carbon treated carboys compared to controls without carbon. Madie and Sean will conduct a larger scale diatom exudate carboy experiment in the coming weeks.

The project is off to a great start thanks to Madie and Sean on station and Cat Luria's preparations. Thank you to the support of laboratory and boating support staff at Palmer Station enabling us to get a quick start, particular Janice O'Reilly, Juliet Alla, and Meredith Helfrich. They were incredibly helpful and a pleasure to work with. Thank you to Hugh Ducklow's group B-045 for lending knowledge and supplies in the start-up phase.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
June 2013
Graham Tilbury

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION.
Kent Anderson, Principal Investigator, Incorporated Research Institutions for Seismology (IRIS)

Station PMSA is one of more than 150+ sites in the GSN, monitoring seismic waves produced by events worldwide. Real-time telemetry data is sent to the U.S. Geological Survey (USGS). The Research Associate operates and maintains on-site equipment for the project.

The system operated normally during the month.

A-109-P: ANTARCTIC EXTREMELY LOW FREQUENCY/VERY LOW FREQUENCY (ELF/VLF) OBSERVATIONS OF LIGHTNING AND LIGHTNING-INDUCED ELECTRON PRECIPITATION (LEP).
Robert Moore, Principal Investigator, University of Florida

ELF/VLF radio wave observations at Palmer Station are used to provide a deeper understanding of lightning and its effects on the Earth's inner radiation belt. The Research Associate operates and maintains on-site equipment for the project.

The site operated normally during the month.

A-132-P: FABRY-PEROT INTERFEROMETER (FPI)
Qian Wu, Principal Investigator, National Center for Atmospheric Research

The Fabry-Perot Interferometer observes mesospheric and thermospheric neutral winds and temperatures at Palmer Station by measuring the wind-induced Doppler shift in the air's nightglow emissions. The Research Associate operates and maintains on-site equipment for the project.

The system operated normally throughout the month.

O-202-P: ANTARCTIC METEOROLOGICAL RESEARCH CENTER (AMRC) SATELLITE DATA INGESTOR.
Mathew Lazzara, Principal Investigator, University of Wisconsin

The AMRC computer processes satellite telemetry received by the Palmer Station TeraScan system, extracting Automated Weather Station information and low-resolution infrared imagery and sending the results to AMRC headquarters in Madison, WI. The Research Associate operates and maintains on-site equipment for the project.

The data ingestor operated normally for the month.

O-204-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL TO DECADAL VARIATIONS IN TERRESTRIAL AND MARINE ECOSYSTEMS.
Ralph Keeling, Principal Investigator, Scripps Institution of Oceanography

The goal of this project is to resolve seasonal and interannual variations in atmospheric O_2 (detected through changes in O_2/N_2 ratio), which can help to determine rates of marine biological productivity and ocean mixing as well as terrestrial and oceanic distribution of the global anthropogenic CO_2 sink. The program involves air sampling at a network of sites in both the Northern and Southern Hemispheres. The Research Associate collects samples fortnightly from both TerraLab and the VLF Building.

Scheduled air samples were collected throughout the month.

O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD WORLDWIDE FLASK SAMPLING NETWORK
James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

The NOAA ESRL Carbon Cycle Greenhouse Gases (CCGG) group makes ongoing discrete measurements to document the spatial and temporal distributions of carbon-cycle gases and provide essential constraints to our understanding of the global carbon cycle. The Halocarbons and other Atmospheric Trace Species (HATS) group quantifies the distributions and magnitudes of the sources and sinks for atmospheric nitrous oxide (N2O) and halogen containing

compounds. The Research Associate collects weekly air samples for the CCGG group and fortnightly samples for the HATS group.

Carbon Cycle and Halocarbon sampling were completed as scheduled during the month.

O-264-P: ULTRAVIOLET (UV) SPECTRAL IRRADIANCE MONITORING NETWORK
James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

A Biospherical Instruments (BSI) SUV-100 UV spectroradiometer produces full sky irradiance spectra ranging from the atmospheric UV cutoff near 290nm up to 605nm, four times per hour. A BSI GUV-511 filter radiometer, an Eppley PSP Pyranometer, and an Eppley TUVR radiometer also continuously measure hemispheric solar flux within various spectral ranges. The Research Associate operates and maintains on-site equipment for the project.

Absolute Calibrations were completed as scheduled.
The system operated normally throughout the month.

O-283-P: ANTARCTIC AUTOMATIC WEATHER STATIONS (AWS).
Mathew Lazzara, Principal Investigator, University of Wisconsin

AWS transmissions from Bonaparte Point are monitored using the TeraScan system and the Data Ingestor system. Data collected from this station is freely available from the University of Wisconsin's AMRC website. The Research Associate monitors data transmissions for the project and performs quarterly maintenance on the station at Bonaparte Point.

The Bonaparte Point automated weather station was run in test mode and the data collected was verified. The equipment was removed from the TeraLab roof and prepared for installation on Bonaparte Point.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION.
Joe Pettit, Principal Investigator, UNAVCO

Continuous 15-second epoch interval GPS data files are collected at station PALM, compressed, and transmitted to the NASA-JPL in Pasadena, CA. The Research Associate operates and maintains on-site equipment for the project.

The GPS station performed normally during the month.

A-336-P: ELF/VLF OBSERVATION OF LIGHTNING DISCHARGE, WHISTLER-MODE WAVES AND ELECTRON PRECIPITATION AT PALMER STATION.
John Gill, Principal Investigator, Stanford University

Stanford University has been operating a Very Low Frequency (VLF) receiver antenna at Palmer Station since the 1970's. By receiving naturally and manmade signals between 1 and 40 kHz, the Stanford VLF group is able to study a wide variety of electromagnetic phenomenon in the ionosphere and magnetosphere. The Research Associate operates and maintains on-site equipment for the project.

The VLF system performed normally during the month.

T-312-P: TERASCAN SATELLITE IMAGING SYSTEM
The TeraScan system collects, processes, and archives DMSP and NOAA satellite telemetry, capturing approximately 25-30 passes per day. The Research Associate operates and maintains on-site equipment for the project.

Satellite passes were captured normally throughout the month.

A-357-P: EXTENDING THE SOUTH AMERICAN MERIDIONAL B-FIELD ARRAY (SAMBA) TO AURORAL LATITUDES IN ANTARCTICA
Eftyhia Zesta, Principal Investigator, University of California Los Angeles

The three-axis fluxgate magnetometer is one in a chain of longitudinal, ground-based magnetometers extending down though South America and into Antarctica. The primary scientific goals are the study of ULF (Ultra Low Frequency) waves and the remote sensing of mass density in the inner magnetosphere during geomagnetically active periods. The Research Associate maintains the on-site system.

The magnetometer operated normally throughout the month.

B-466-P: FLUORESCENCE INDUCTION AND RELAXATION (FIRe) FAST REPETITION RATE FLUOROMETRY (FRRF)
Deneb Karentz, Joe Grzymski, Co-Principal Investigators, University of San Francisco

The focus of this project is to identify and evaluate changes that occur in genomic expression and physiology of phytoplankton during the transition from winter to spring, i.e., cellular responses to increasing light and temperature. A Fast Repetition Rate Fluorometer (FRRF) with a FIRe (Fluorescence Induction and Relaxation) sensor is installed in the Palmer Aquarium. The Research Associate downloads data and cleans the instrument on a weekly basis.

Weekly cleaning of the instrument and data downloads were performed as scheduled.

T-998-P: INTERNATIONAL MONITORING STATION (IMS) FOR THE COMPREHENSIVE NUCLEAR TEST BAN TREATY ORG. (CTBTO)
Managed by General Dynamics

The IMS Radionuclide Aerosol Sampler and Analyzer (RASA) is part of the CTBTO verification regime. The automated RASA continually filters ambient air and tests for particulates with radioisotope signatures indicative of a nuclear weapons test. The Research Associate operates and maintains the instrument.

The system operated normally during the month.

TIDE GAGE
Tide height and seawater temperature are monitored on a continual basis by a gauge mounted at the Palmer Station pier. The Research Associate operates and maintains on-site equipment for the project.

The tidegage system replacement equipment details were finalized and the order issued.

METEOROLOGY
The Research Associate acts as chief weather observer, and compiles and distributes meteorological data. Weather data collected using the automated electronic system is archived locally and forwarded twice each month to the University of Wisconsin for archiving and further distribution. Synoptic reports are automatically generated every three hours by the Palmer Meteorological Observing System (PalMOS) and emailed to the NOAA for entry into the Global Telecommunications System (GTS).

The system operated normally during the month.