

PALMER STATION MONTHLY SCIENCE REPORT AUGUST 2014



Trawl net full of benthic fauna from a B-010 (Cheng) fishing cruise in the Gerlache Strait
(Image Credit: Linnah Neidel)

NEWS FROM THE LAB

Linnah Neidel, Winter Laboratory Supervisor

Palmer Science was very productive during the first half of August, with members of the B-010/B-266 (Cheng/Bilyk) groups fishing for numerous species on two cruises aboard the *ARSV Laurence M. Gould* (LMG). These groups were diligently attempting to obtain additional fish to sample right up until the moment the LMG departed Palmer on their final northbound trip!

Meanwhile, on station, the labs were rarely quiet. Tanks were set up for temperature studies, dissections were performed to collect an array of tissues, and experiments were performed to isolate proteins from blood. The winter-over members of B-037 (Detrich) continued their embryogenesis work, monitoring *N. coriiceps* embryos in the incubators by microscopy.

During much of August the increasingly longer days were relatively calm and cool. Several episodes of sea ice took hold in the vicinity of the station, greatly reducing boating activities. The snow that fell accumulated, leaving the backyard and glacier with a consistent covering of snow. Calving events were infrequent. The local UV values slowly began to rise toward the end of the month and nacreous clouds became more frequent, as the ozone hole processes developed. By mid-month large groups of giant petrels returned to the nearby islands and to Bonaparte, and several large flocks of several hundred cormorants passed over the station. By month's end a few Antarctic terns, several gulls, and a lone Gentoo penguin had been spotted near station.

AUGUST 2014 WEATHER

Graham Tilbury, Research Associate

The weather for August was characterized by several periods of clear, calm days due to persistent high pressure systems for most of the month. A brief period of moderate strength winds from SW brought with them the heaviest snowfall of the month, dumping an 8 cm layer of snow onto the station within a 24 hour period. Other than that, snowfall for the rest of the month was fairly light. At month's end, the year to date total stood at 209cm, below the historic average of 246 cm. Melted precipitation amounted to a mere 19.6mm, well below the 53mm average for August.

The average temperature for the month was -5.5°C , only slightly warmer than -5.9°C , the 15-year average for the station. The coolest days arrived during the latter part of the month, with the coldest temperature of -16.3°C being recorded on the morning of the last day. Conversely, the warmest day, with a high of 3.0°C was on 7th day of the month.

Sea surface temperatures remained at or below -1.7°C for the entire month. During a brief period of strong E to NE winds, peaking at 62 knots on the 15th, the thin layer of newly formed sea ice was completely cleared from the station's immediate vicinity. The dominant high pressure system that settled over the area during the last week brought with it the coldest temperatures and lowest wind speeds. By month's end the sea surface was completely frozen.

B-010-P: ANTARCTIC NOTOTHENIROID FISH FREEZE AVOIDANCE AND GENOME WIDE EVOLUTION FOR LIFE IN THE COLD

Christina Cheng-DeVries and Arthur DeVries, Principal Investigators, University of Illinois at Urbana-Champaign

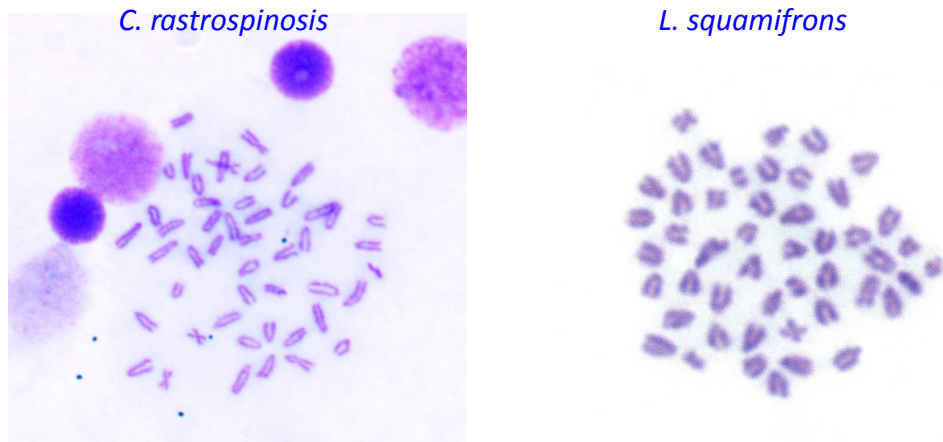
Personnel on Station: Christina Cheng-DeVries, Arthur DeVries, Elliot DeVries, Lauren Fields, Katherine Murphy, Xuan Zhuang

This report covers the remaining 10 days (Aug. 7- August 16) of our field season since the prior monthly report. During this time, we worked intensively to finish up continuing experiments as described in the prior report during this time, and cleaned up our work spaces in the PAL labs and aquaria, and on the LMG.

These include:

1. We completed the testing of acute thermal tolerance (as measured with Critical Thermal Maximum) for the icefish *C. rastrospinosus*, as representative of the highly derived polar characters. A comprehensive array of tissues was collected and preserved for RNAseq analysis back in UIUC.
2. We tested temperature preference in the thermal gradient of additional species that are AFGP-fortified including icefishes to compare to the AFGP-null *L. squamifrons*.

3. To determine the presence/integrity of the AFGP gene family or AFGP-like sequences in the *L. squamifrons* genome, we prepared metaphase chromosome from head kidney cells to be used for fluorescent in situ hybridization with AFGP probes on return to UIUC. As control, we also prepared chromosomes from species with functional AFGP trait. We were able to obtain excellent preparations in most cases. Figure below shows images of two such preparations.
4. Testing of frequency of splenic ice in various species of ice fishes. We were able to utilize the aquarium onboard of the LMG to complete this study during the first day underway for the north bound.



We thank the excellent marine tech crew – Meghan King, Scott Bingen and Ildi Incze, and the MPC Lindsey Loughry for their hard work in the fishing efforts that made our field program successful. We thank the PAL station folks for all their assistance and comaraderie, especially Jon Charczuk for overseeing the functioning of the aquarium facility, Adina Scott for assistance in instruments and their operations, Linnah Neidel for assistance in various lab related matters, and Julian Race and Ryan Andres for their IT help and helping out with fishing.

B-037-P: PROTEIN FOLDING AND EMBRYOGENESIS IN ANTARCTIC FISHES: A COMPARATIVE APPROACH TO ENVIRONMENTAL STRESS

H. William Detrich, Principal Investigator, Marine Science Center, Northeastern University

Personnel on Station: Nathalie R. Le François and Eileen Sheehan

Antarctic notothenioid fishes have evolved a suite of characters that makes them well adapted to their Southern Ocean (SO) habitat, which cooled to the freezing point of seawater (-1.9°C) by $\sim 8-10$ million years ago and has remained at this temperature to the present. However, these cold-adapted stenotherms are now threatened by rapid warming of the SO, the temperature of which is likely to increase by $2-5^{\circ}\text{C}$ over the next two centuries. We are investigating the impact of this projected warming on development of the embryos of notothenioid fishes to determine whether they have the capacity to recruit

to adult populations under this climate change scenario.

During the current winter season, Le François and Sheehan are carrying out long-term incubations of embryos from the Bullhead notothen, *Notothenia coriiceps*, at control (-1°C) and experimental ($+4^{\circ}\text{C}$) temperatures. Using *N. coriiceps* broodstock captured during the LMG14-04 fishing cruises, Le François and Sheehan obtained nine biparental crosses by *in vitro* fertilization for the thermal perturbation experiment. These crosses are being maintained in our purpose-built embryo incubation system (Aquamerik, Quebec, Canada) located in Environmental Room 1 of the Palmer Station Aquarium. Two of the crosses were lost during August due to freezing of the seawater supply lines, but others continue to yield viable embryos.

The oldest of the clutches have now obtained 90+ days post-fertilization. Embryos at -1°C and $+4^{\circ}\text{C}$ are being monitored daily by microscopy to ensure that we sample embryos at comparable stages for the two temperature treatments, and image banks of key developmental stages are being generated.

Embryos sampled at specific developmental stages will be analyzed for potential perturbation of gene expression by high-throughput RNA sequencing (RNAseq) and by *in situ* hybridization to important developmental genes at my home institution and those of my collaborators.

At the end of *Laurence M. Gould* Cruise 14-06, Sheehan and Le François packaged embryo and tissue samples for retrograde transport to Northeastern University (Detrich) and to collaborators at the University of Oregon (Postlethwait) and the University of Massachusetts, Amherst (Albertson). These samples were consigned to the ASC sample transportation chain of custody. Unfortunately, the sample sets for Oregon, which included all experimental and control embryos sampled during the first 2.5 months postfertilization, were placed in a -20°C freezer on the *LMG* that was not operating. As a consequence, the samples thawed before arrival of the *LMG* in Punta Arenas, Chile, and most are a total loss. We trust that the ASC is conducting a thorough investigation into this logistic failure, which appears to be attributable to a breakdown in the ASC sample transport system, and will implement procedures to prevent similar sample jeopardy in the future.

We thank the ASC Palmer Station personnel and the Captain, crew, and ASC personnel of the *ARSV Laurence M. Gould* for their hard work on our behalf. We are deeply concerned by the loss of the embryo samples, the cornerstone of our field season's research efforts, through human error.

B-266-P: EVOLUTINARY FATE OF HAPTOGLOBIN AND HEME SCAVENGERS IN THE ANTARCTIC ICEFISHES

Kevin Bylik, Principal Investigator, University of Illinois at Urbana-Champaign

Personnel on Station: Kevin Bylik, Mateusz Grobelny, Konrad Meister

The Antarctic icefishes are remarkable for being the only adult vertebrates where the oxygen binding protein hemoglobin has been lost, a loss that even extends to myoglobin in six of the sixteen icefish species.

A number of proteins normally function in support of the role of hemoglobin and we would expect that the evolutionary loss of hemoglobin in these fishes would have relaxed the selective pressure for these supporting functions. This project is an investigation of the evolutionary fate of two such proteins, haptoglobin and the heme scavenger hemopexin, with work at Palmer station focused on haptoglobin.

While at Palmer Station we have been using hemoglobin from the local red-blooded notothenioid, *Notothenia coriiceps*, as bait for any hemoglobin binding proteins in icefish blood plasma. This would include haptoglobin if it remains active in these fishes. Initial work centered on incubating hemoglobin coated beads in small batches of icefish blood plasma to isolate any hemoglobin binding proteins. This resulted in signals for a number of putative hemoglobin binding proteins but the small sample volumes limited further down-stream analyses. During our second month we began using affinity column chromatography to test larger volumes of plasma from the collected peninsula icefish species. In addition, the remainder of our time on station was spent stockpiling blood plasma from red and white blooded notothenioids as well as isolating hemoglobin from *N. coriiceps* so that we can continue this work back in Illinois.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT AUGUST 2014

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 throughout 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 VLF tower was inspected twice this past month. All four lower antenna feed lines are now covered by snow drifts. The receiver 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 through the month.

O-204-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL TO DECADEAL 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 O₂ (detected through changes in O₂/N₂ 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 CO₂ 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.

Air samples were collected every two weeks, as scheduled.

**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 air samples were collected as scheduled.

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.

The system operated normally throughout the month.
The bi-weekly absolute calibration scans were completed as scheduled.

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 University of Wisconsin's 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.

Quality checks of the downloaded data were performed daily.
The system operated normally throughout the month.

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.

All three GPS station receivers operated normally throughout 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. The TeraScan weather and ice imagery is used for both research and station operations.

The scheduled daily passes were successfully downloaded and the system continues to perform adequately.

B-466-P: FLUORESCENCE INDUCTION AND RELAXATION (FIRe) FAST REPETITION RATE FLUOROMETRY (FRRF)

Deneb Karentz, Joe Grzyski, 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.

Daily instrument checks, weekly cleaning 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.

Daily filter samples were processed and packaged for shipping.
The system continued operating normally throughout the month.

OCEANOGRAPHY

Daily observations of sea ice extent and growth stage are also recorded, along with continuous tidal height, ocean temperature, and conductivity at Palmer's pier.

The tide level, conductivity and sea water temperature monitoring system performed adequately the entire month. A possible intermittent problem with the pressure sensor is being addressed. The prototype of the new display screen, incorporating Tidegauge data plots has been installed and is undergoing adjustment.

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 National Weather Service for entry into the Global Telecommunications System.

The system operated normally during the month. The new integrated display screen, incorporating individual weather data plots has been installed and is being field tested.