PALMER STATION MONTHLY SCIENCE REPORT
June 2018

The Boathouse in the Morning. *Images Credit: Ken Keenan*

NEWS FROM THE LAB
Jason Johns, Winter Laboratory Supervisor

The biggest change this month at Palmer Station was the departure of half the population on June 15th aboard the ARSV *Laurence M. Gould*. This included the entire Amsler/Baker/McClintok diving team B-022-P and most of the members of the Detrich team B-037-L/P. The *Gould* is not planned to return to Palmer until October. Before the big departure there were lots of science projects, samples, supplies, and instruments that needed to be wrapped up, boxed up and handed off to the logistics team for shipment. But after this departure there was a lot less activity everywhere on station as things calmed down and we headed into the actual winter season. The three remaining members of the Detrich team B-037-L/P have been busy taking care of a large quantity of fish eggs that are incubating well and slowly developing.

Shortly after the departure of the ARSV *Laurence M. Gould* the remaining station population celebrated Midwinter which marks the beginning of the return of more sunlight to our days. There was a large and delectable feast along with other celebrations.

The wind has also calmed down significantly from last month and the average temps are beginning to drop along with more snow as opposed to rain. The skiing has improved significantly as many surfaces are now blanketed at least lightly in a nice white color. The water is still largely open but small inlets and coves are beginning to clog up with ice and become more still and quiet.

Palmer Monthly Met summary for June, 2018

Temperature
Average: -3.2 °C / 26.2 °F
Maximum: 4.7 °C / 40.46 °F on 4 Jun 00:15
Minimum: -10.5 °C / 13.1 °F on 26 Jun 18:57
Air Pressure
Average: 989.9 mb
Maximum: 1008.8 mb on 13 Jun 01:02
Minimum: 962.4 mb on 19 Jun 10:37

Wind
Average: 10.7 knots / 12.3 mph
Peak (5 Sec Gust): 53 knots / 61 mph on 7 Jun 16:16 from NNE (20 deg)
Prevailing Direction for Month: N
Surface
Total Rainfall: 46.7 mm / 1.84 in
Total Snowfall: 30 cm / 11.7 in
Greatest Depth at Snow Stake: 37 cm / 14.4 in
WMO Sea Ice Observation: 1-5 icebergs with growlers and bergy bits
Average Sea Surface Temperature: -1.28 °C / 29.7 °F

Temperatures peaked at 40.5° F June 4th and reached a low of 13.1° F on June 13th. The winds peaked at 61 mph on the 7th with an average speed of 12.3 mph. The prevailing wind direction for the month was from the north. Several systems passed through bringing 11.7 inches of snow. There has been some grease and pancake ice and several large icebergs in the area.

B-022-P: THE CHEMICAL ECOLOGY OF SHALLOW-WATER MARINE MACROALGAE AND INVERTEBRATES ON THE ANTARCTIC PENINSULA

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

Bill Baker, Principal Investigator, University of South Florida

Personnel on station: Charles Amsler, Margaret Amsler, CJ Brothers, Michelle Curtis, Sabrina Heiser, Andrew Shilling, Keith Smith.

Personnel movements this month: Our field team ended our season and redeployed with LMG18-05 NB on the morning of 15 June.

Our two weeks of June was spent finishing laboratory bioassays and season-long experiments in addition to packing up the lab and dive locker. We completed 10 dives spread over six days including three dives over two days with support from the R/V *Tin Can* to retrieve the concrete substrates from our year-long transplant experiment which ended in May. We also completed the last of our planned transect dives collecting our focal red alga, *Plocamium cartilagineum*, from multiple depths. Overall, we met all of our fieldwork goals for the season. To that end, we completed 143 buddy team dives over the course of the season. Since several of our tasks were most efficient with three-diver teams, that equated to 313 individual diver dives.

Divers recovering concrete substrates from our year-long transplant experiment. The divers entered and exited the water from our dive Zodiac, bringing the substrates to the surface using a lift bag. The divers then attached the substrates to a line from the R/V *Tin Can* which used its davit arm to hoist the substrates aboard. Photos by Maggie Amsler.

We also had a very productive and successful season in the lab. We completed all of our central lab work objectives in addition to most of the second-level projects we had hoped to be able to do. This included several kinds of growth and feeding bioassays examining the relationship between *P. cartilagineum* and the unique amphipod, *Paradexamine fissicauda* and growth assays with *P. cartilagineum* which elaborate different mixtures of defensive metabolites. We also concluded lab experiments looking at the effects of different gastropod species on epiphytes of one of their macroalgal hosts, *Himantothallus grandifolius* and at the potential for *H. grandifolius* to provide a refuge for gastropods from sea star predation.

We are grateful for the generous and professional assistance of numerous ASC staff in assisting with our activities throughout our four months at Palmer. Jason Johns, Hannah James, Andrew Purves, and Joe Left deserve special thanks for facilitating our laboratory and field efforts in June.

B-037 ANTARCTIC NOTOTHENIOID FISHES: SENTINEL TAXA FOR SOUTHERN OCEAN WARMING

H. William Detrich, Principal Investigator
Marine Science Center, Dept. of Marine and Environmental Sciences, Northeastern University

Personnel on Station June 1-15: Nathalie Le François, Thomas Desvignes, Juliette Auvinet, Jacob Grondin, Henrik Lauridsen, Maggie Streeter, and John Postlethwait
Personnel on Station June 16-30: Nathalie Le François, Jake Grondin, and Maggie Streeter

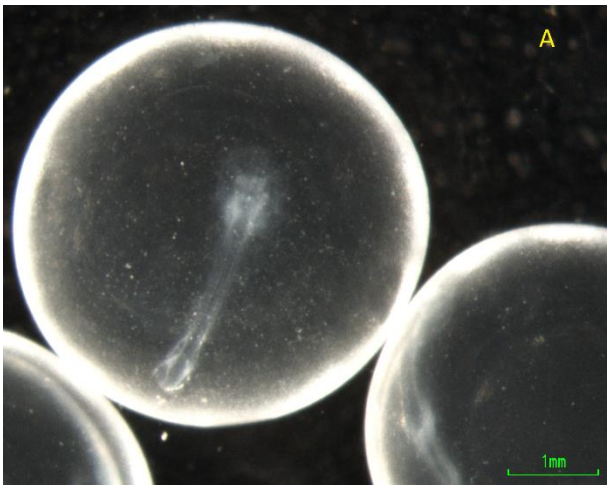
Antarctic notothenioid fishes have evolved a remarkable suite of characters, including the acquisition of macromolecular antifreezes by most species and the loss of red blood cells and hemoglobin by the "white-blooded" icefish family, as the Southern Ocean (SO) cooled to the freezing point of seawater (–1.9°C) over the past 25-40 million years. Today, these cold-adapted stenotherms are threatened by rapid warming of the SO, the temperature of which is likely to increase by 2-4°C over the next two centuries. The major goal of the B-037 research program is to assess the molecular and organismal consequences of this warming by analyzing the effects of elevated temperature regimes on gene expression in developing embryos of red- and white-blooded Antarctic notothenioids (notothens and icefishes, respectively). In addition, B-037 is exploring the genomic basis for the loss of red blood cells and hemoglobin by Antarctic icefishes and the compensatory adaptations that have ameliorated these losses.

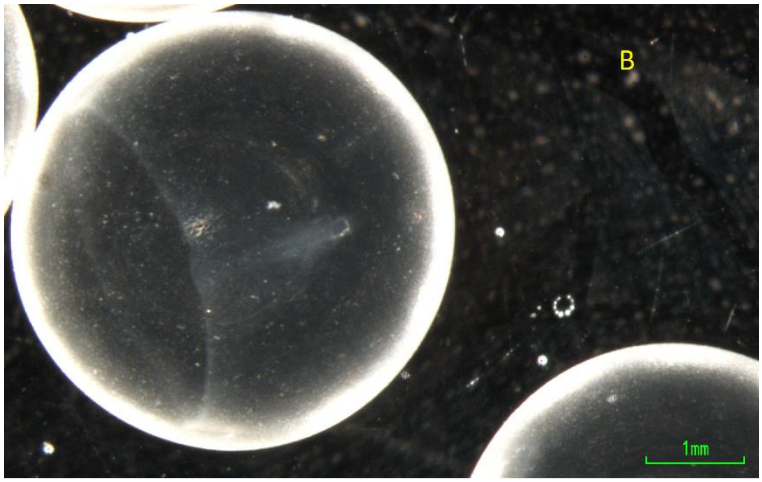
As the winter officially begins, our operations shift focus from fishing, dissections, and establishing embryo cultures to the care and sampling of embryos and general maintenance. Currently, we are compiling dissection logs, taking care of remaining adult fish specimens, using microscopy to document embryonic development, and troubleshooting experimental designs.

All *Notothenia coriiceps* (https://www.youtube.com/watch?v=ZFOHr0p-TUg) have spawned, giving us nearly 200,000 eggs total for experimentation. These spawning events occurred over the course of two weeks and happened naturally in the aquarium tanks, often after 10:00 pm. We took turns checking for spawns during the night, looking for characteristic sperm surfactant bubbles in the tanks at 10 pm, 12, 2, and 4 am. The eggs, once fertilized, floated to the surface. The quality of these embryos was determined to be very high, in contrast to those from 2016, when artificial *in vitro* fertilization was used. It is likely that more than one female and/or male was involved in each spawning event. We collected the eggs, then observed and characterized them by weight and diameter. The first five spawning events were compiled for use in Experiment I, and the next 6 were compiled for use in Experiment II (one spawn was discarded due to poor egg

quality). Both of these experiments examine the effects of elevated temperatures on embryonic development. The first focuses on early and continuous temperature elevation vs. ambient [one group heated to 4°C after 15 days, controls at ambient seawater temperature (approx. 0°C)], whereas the second examines the importance of developmental timing of heat treatment [0, 60, 90 days post fertilization groups (dpf) heated to 4°C; controls were maintained at ambient temperature]. Currently, the most developed eggs are in the Experiment II group heated from 0 dpf. They were found to have heartbeats on 6/25/2018! Since then, the Experiment I heated embryos had heartbeats as of 6/30.

The following images were taken on a dissecting scope and show the developmental stages of each group at 20 days post fertilization. The first image (A) shows the Experiment I heated embryo, which has developed somites and unpigmented eyes. In comparison, the ambient embryo from experiment I (B) shows a partial epiboly (~50%) with the beginnings of the embryonic axis forming.





We are developing a third experiment with the *N. coriiceps* embryos. Experiment III will examine the thermal resilience of embryos at 50 dpf that are exposed to more extreme temperatures. This experiment will have groups at 0, +4, +6 and +8°C. For this experiment, we will examine the effect of elevated temperature on embryonic survival, metabolic and antioxidant enzyme activities, oxidative damage (lipid peroxidation), and the induction of transcription factors that regulate the expression of genes encoding enzymes involved in controlling reactive oxygen species (ROS).

This season, as in 2016 and 2014, we were not able to capture synchronously fertile individuals of the icefish *Chaenocephalus aceratus*, our second target species for the temperature experiments. However, we do have three large, healthy icefish of the species *Pseudochaenichthys georgianus*, including one gravid female (See https://www.youtube.com/watch?v=-EUI6z7bm9c). They are eating other small icefish in the tanks, indicating good physiological health. We are

currently injecting them with GnRH intraperitoneally every week to stimulate gametogenesis, with the objective of obtaining sperm and/or eggs for us to study and for the generation of embryos for our thermal experiments.

We thank the personnel of the Antarctic Support Contractor and the crew of the *Laurence M. Gould* for their excellent support of B-037 throughout our field season.

PALMER STATION

RESEARCH ASSOCIATE MONTHLY REPORT

June 2018

W. Lance Roth

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-111-P: THE NEXT GENERATION OF GEOSPACE RESEARCH FACILITIES AT PALMER STATION

Andrew Gerrard, Principal Investigator, New Jersey Institute of Technology

The ionosphere-thermosphere-magnetosphere (ITM) region of Earth's atmosphere, which is part of the larger geospace environment, is the portal through which the solar wind can enter and impact our planetary system. Though space weather research over the past decades has greatly increased our understanding of a wide variety of phenomena associated with ITM physics, the sum of these individual processes occurring in the geospace environment does not replicate the rich diversity and scope of this complex region. Thus, a more holistic approach to ITM research is necessary, one that integrates clustered instrumentation at multiple locations to simultaneously look at the interactions within the entire system. Using coordinated and collaborative instrumentation currently installed in Antarctica, researchers will study interrelated ITM phenomena observed at

high latitudes. The goal of this research effort is a better understanding of the energy transfer and modulation of the geospace system.

The system operated normally throughout the month.

A-119-P: CONTINENTAL-SCALE STUDIES OF MESOSPHERIC DYNAMICS USING THE ANTARCTIC GRAVITY WAVE INSTRUMENT NETWORK (ANGWIN)

Michael Taylor, Principal Investigator, Utah State University

The Antarctic Gravity Wave Imaging Network (ANGWIN) is a cooperative effort of six international Antarctic programs to collect continent-wide gravity wave measurements. This network capitalizes on existing optical and radar measurement capabilities at McMurdo, Palmer, South Pole, and six other research stations: Halley (UK), Syowa (Japan), Davis (Australia), Rothera (UK), and Ferraz (Brazil). Infrared (IR) all-sky mesospheric OH (hydroxyl) imagers are installed at Davis, McMurdo, and Halley stations. The network quantifies the properties, variability, and momentum fluxes of short-period (less than one hour) mesospheric gravity waves and their dominant sources and effects over the Antarctic continent. An all-sky near-IR imager is also installed at Palmer Station to augment the existing instrumentation and create a capability for studying gravity wave properties at each site.

The system operated normally throughout the month.

A-373-P: TROPOSPHERE-IONOSPHERE COUPLING VIA ATMOSPHERIC GRAVITY WAVES

Vadym Paznukhov, Principal Investigator, Boston College

The goal of this project is to enhance the comprehensive research understanding of troposphere-ionosphere coupling via Atmospheric Gravity Waves(AGWs) in the Antarctic region. Both experimental and modeling efforts will be used on the Antarctic Peninsula to investigate the efficiency and main characteristics of such coupling and will address several questions remaining in the current understanding of this coupling process.

The system operated well throughout the month.

O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL 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 Terra Lab.

Air samples were taken twice this month.

O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD WORLDWIDE FLASK SAMPLING NETWORK

Don Neff and Steve Montzka, Principal Investigators, 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.

CCGG samples were taken once a week in favorable winds and HATS Air samples were taken every other week.

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. Bi-weekly calibrations were completed as necessary.

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 system has 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 system has operated normally throughout the month.

T-998-P: INTERNATIONAL MONITORING STATION (IMS) FOR THE COMPREHENSIVE NUCLEAR TEST BAN TREATY ORGANIZATION. (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 has operated 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.

Observations of sea ice around station were made daily and the tidegauge worked well throughout the month.

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 once per 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 and emailed to the National Weather Service for entry into the Global Telecommunications System.

The local weather station (PAWS) is working well. Both remote AWS systems are no longer operational due to the lack of sunlight. Observations are archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/