PALMER STATION MONTHLY SCIENCE REPORT

May 2017

Members of B-022-P (Amsler/Baker/McClintock) utilize Rigil's diving platform for the RHIB's first science mission on May 10th. *Image Credit: Maggie Amsler*

NEWS FROM THE LAB

Emily Olson, Winter Laboratory Supervisor

May was a busy month for the Palmer Station laboratories. We had both B-022-P (Amsler/Baker/McClintock) and B-036-P (O'Brien) running at full-steam, with 13 grantees between these two groups putting the resources of the labs and station to good use. Both groups had successful field components despite the challenges that the weather often presented. The weather almost prevented Rigil's first scientific mission, but due to the efforts and support of Marine Technician Nikki Chalten, B-022-P (Amsler/Baker/McClintock), and many members of FMC and the wider Station community who helped facilitate the launch, on May 10th we celebrated the successful deployment and recovery of the Divers from Rigil.

On May 24th LMG17-04NB departed Palmer Station and we said goodbye to all of B-022-P (Amsler/Baker/McClintock) and to Lisa Crockett, Lars (Michael) Axelsson, and Elizabeth Evans of B-036-P (O'Brien). Three members of B-036-P (O'Brien) remain on station to continue their research over the *Laurence M. Gould*'s drydock period and utilize the bounty of fish specimens brought back by the four fishing cruises the *Gould* completed over the past five weeks.

The hours of sunlight here at Palmer are growing noticeably shorter every day, with the sun now just barely peeking up over the glacier for a brief visit in the afternoons. The giant petrel chicks have fledged. A few wayward penguins have been spotted along some of the islands and the occasional seal still pops its head up in Arthur Harbor. The chorus of elephant seals chattering

away on Amsler and Torgersen Islands has been growing softer. For now, we savor the perpetual "golden hour" and starry nights that clear days grace us with, and learn to appreciate the strength and beauty of nature even in the storms.

Palmer Monthly Met summary for May, 2017

Data from Backyard AWA System

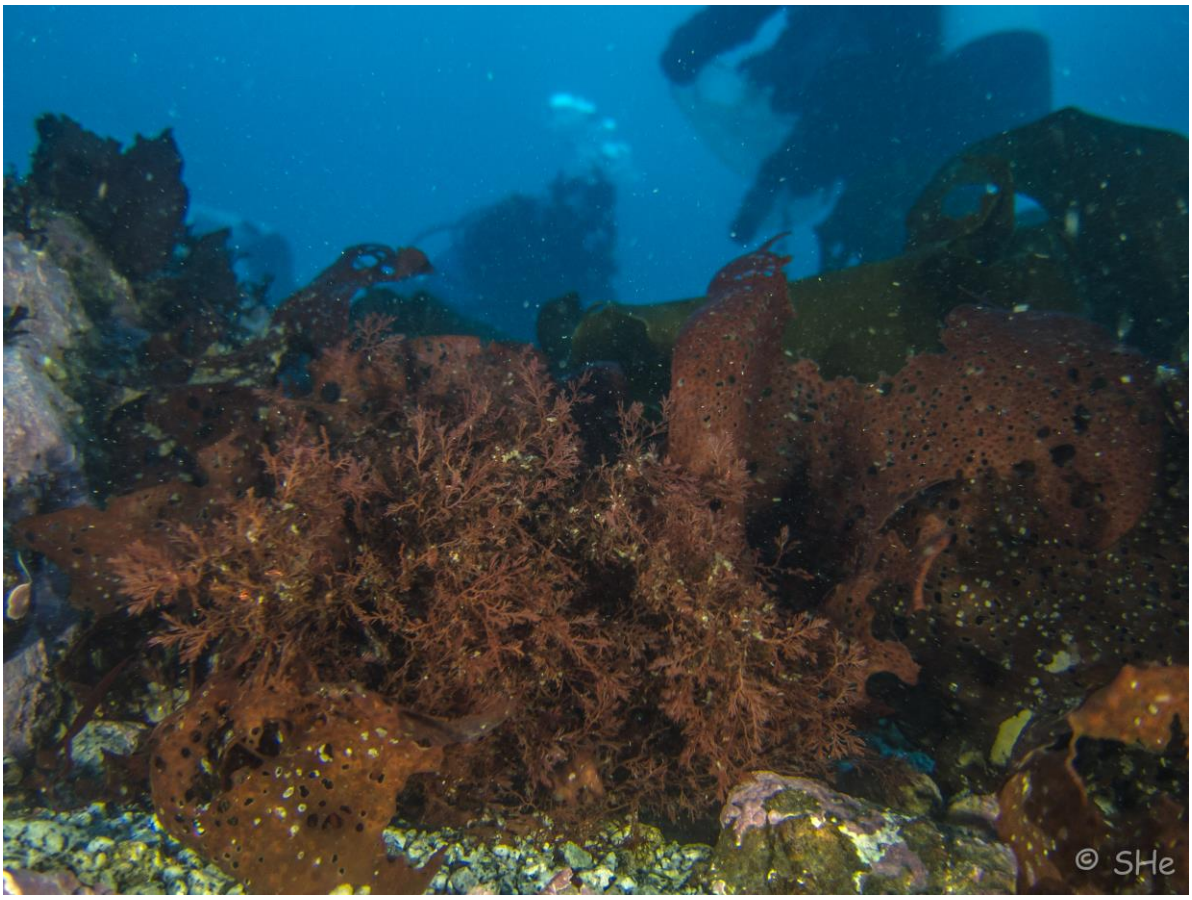
Temperature
Average: -.8 °C / 30.6 °F
Maximum: 6.3 °C / 43.34 °F on 14 May 15:27
Minimum: -8.6 °C / 16.52 °F on 27 May 09:55
Air Pressure
Average: 985.7 mb
Maximum: 1007.2 mb on 28 May 22:26
Minimum: 958.7 mb on 20 May 01:19
Wind
Average: 12 knots / 13.8 mph
Peak (5 Sec Gust): 55 knots / 63 mph on 20 May 00:11 from N (350 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 82.6 mm / 3.25 in
Total Snowfall: 37 cm / 14.6 in
Greatest Depth at Snow Stake: 29 cm / 11.4 in
WMO Sea Ice Observation: No Sea Ice in sight, only ice of land origin, 1-5 bergs, with growlers and bergy bits.
Average Sea Surface Temperature: -.49 °C / 31.1 °F

The month of May was rather warm and rainy. The average temperature was just below freezing and we received over 3 inches of rain. The wind speeds averaged 12 knots and peaked at 55 knots on May 20th. Arthur Harbor and Hero Inlet have been clear of sea ice, but have been occasionally filled with growlers and bergy bits from local glacier calving.

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, Bill Baker, Sabrina Heiser, Leucas Miller, Andrew Shilling, Santana Thomas



An *in situ* shot of algal study subject *Plocamium cartilagineum* as members of B-022-P (Amsler/Baker/McClintock) dive in the background. *Image Credit: Sabrina Heiser*

The weather in May continued to frustrate us somewhat compared to our earlier Palmer field seasons, with winds and seas allowing us to get out for at least part of only 10 of the 22 possible dive days preceding our May 24th redeployment. Nevertheless, we managed to pack 26 dives into the time we had which allowed us to complete our most mission-critical dives, if not to make all the collections and observations we had hoped.

A major focus of May was initiating a combined common-garden and transplant experiment with individuals of the red alga *Plocamium cartilagineum* that have different combinations of defensive chemical compounds. Collections and subsequent chemical characterization of *P. cartilagineum* using the station gas chromatograph earlier in our season indicated that variation in their chemical diversity is occurring at a relatively small spatial scale. We performed a spatially-intensive series of multiple transects at four locations. Chromatographic analyses from those collections informed our choice of a specific transect and depth at three of the sites (with two depths at one of the sites) for the common-garden/transplant experiment which will run until next year's field season. Early in the month we collected algae from the sites for the experiment. On May 10th we were able to use the new Palmer Rigid Hull Inflatable Boat (RHIB), *Rigil*, to deploy eight concrete substrates for the transplants at two of the sites. This was the first science mission for the Palmer RHIBs and we were proud to have this opportunity. Over the next several

days we were able to deploy the remaining six substrates needed for the experiment from our Zodiac and also to make dives at all the sites to position the substrates. Working around the weather, we were able to successfully outplant racks containing 350 individual pieces of *P. cartilagineum* (attached to 98 short ropes, seven ropes per rack) on all 14 substrates by the end of the field season.

Season-long studies measuring growth of the amphipod *Paradexamine fissicauda,* which commonly associates with and eats *P. cartilagineum*, on different chemical groups of *P. cartilagineum* were finished in May. This involved daily maintenance of the experiment and periodic photographs of the individual amphipods to track their growth. Studies of short term feeding rates of *P. fissicauda* on the different chemical groups were also completed for the season.

Collections of algal-associated gastropods on large or otherwise ecologically-important macroalgal species continued through May with the gastropods being preserved for shipment to our home institutions for analysis after the field season. These data also set the stage for longer-term mesocosm tank experiments that will be initiated early in our 2018 field season. Feeding rate trials to determine if the gastropods consume their hosts were performed throughout the month.

We are grateful for the generous and professional assistance of numerous ASC staff supporting our activities. Emily Olson, Matt Boyer, and Nikki Chatelain deserve special thanks for facilitating our laboratory and field efforts.

B-036-P: THE PHYSIOLOGICAL AND BIOCHEMICAL UNDERPINNINGS OF THERMAL TOLERANCE IN ANTARCTIC NOTOTHENIOID FISHES

Kristin O'Brien, Principal Investigator, University of Alaska Fairbanks, Lisa Crockett, Principal Investigator, Ohio University

Personnel on station: Lars Axelsson, Amanda Biederman, Lisa Crockett, Elizabeth Evans, William Joyce, Anna Rix

During this period, two fishing trips were made to ensure that we will have enough animals to complete experiments during the months of June and July. In early July we will also begin to prepare samples and conduct experimental work on animals from the thermal acclimation treatments. The fishing team consisted of Lisa Crockett, Amanda Biederman, and Anna Rix. Lars (Michael) Axelsson, William Joyce, and Elizabeth Evans remained on the station to start the *in vivo* cardiovascular experiments, begin preparations of biological membranes with marker enzyme analyses, prepare for later experiments, and perform daily fish care (i.e., monitoring water quality, temperature, flow rates, feeding amounts, and cleaning tanks). The Xactics tanks for the *in-vivo* experiments were readied and all the electronic recording equipment was set up and calibrated. The two custom build respirometers were installed in the tanks and tested.

Fig. 3. An icefish wrapped in goatskin on the surgery table (above) and Michael inserts a cannula (below).

Initially we focused our work on the icefish, *Chaenocephalus aceratus*, since they do not survive extended periods in the tank system at Palmer. We had the first two instrumented fish in the respirometers on the 27th of April. Surgeries to implant flow probes and catheters are done in one of the environmental chambers, where the room air temperature is set to 4^{o}C so that animals do not warm up during surgery. When the fish reach surgical anesthesia, they are moved to the operating table and the gills are flushed with 0^{o}C seawater. The bodies of the animals are cloaked in goatskin (i.e., chamois) to prevent the fish skin from drying, and also to protect against mechanical damage to their very fragile skin (Fig. 3). Surgery takes approximately 60-80 minutes, and the fish is then allowed to recover in the respirometers while the team warms up their hands in preparation for the next surgery.

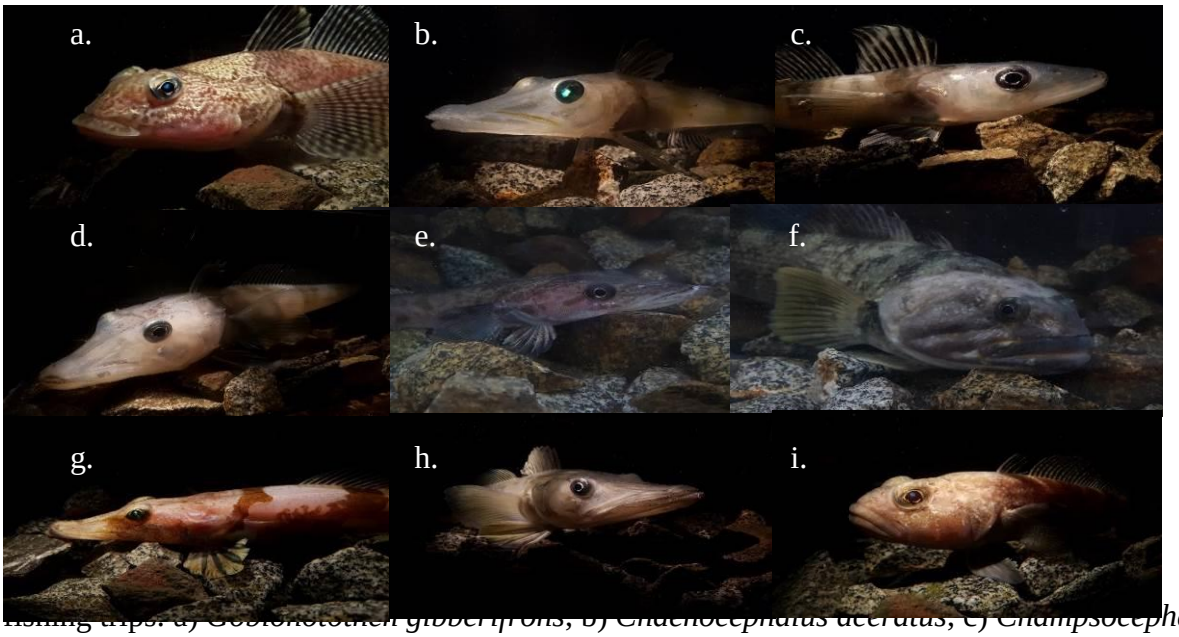
The experimental protocol for this part of the study is to monitor oxygen consumption, cardiac output, dorsal aortic pressure and central venous pressure at rest (i.e., after approx. 48 hours post-surgery), and after short periods of stress at ambient temperature, followed by subsequent recordings at 4^{o}C and 8^{o}C to determine how the cardiorespiratory system responds to an acute temperature challenge.

Fig. 4. Recordings of cardiac output from two icefish. Elevated cardiac output (left) is from a stressed animal (minutes post surgery), while lower cardiac output (right) is from an unstressed animal (several days post surgery).

We have found that cardiac output is indeed very high in icefish species compared to red-blood notothenioids. During recovery from surgery and at 8^{o}C, we recorded cardiac outputs that peaked at over 100 ml/min (Fig. 4, monitor on left) with heart rates of around 25-30 beats/min, giving these notothenioids a very high stroke volume of around 3-4 ml/beat per kg body mass. (For comparison, humans have a stroke of around 1 ml/beat per kg body mass.) In addition, the team measured dorsal and ventral aortic blood pressures, which are remarkably low in *C. aceratus* compared to red-blooded species. Central venous pressure is surprisingly low given the high cardiac output in the icefishes, and is in line with other fish species.

We have done surgery and implantation of catheters numerous times on many different notothenioid species thus far, but the icefish have very thin and fragile blood vessels so we had to modify both the catheter design and the surgery protocol. We have found that the modified catheters work well, with minimized risk of damaging the blood vessels. We also found a way to record total cardiac output without rupturing the pericardium. This is particularly noteworthy in that we do not have to estimate the cardiac output as has been done in previous studies. During the month of June, B-036 will complete the *in vivo* study on *C. aceratus* and then start working on other fish species, both from the family Channichthyidae (the icefishes) and from species that have red blood cells.

On May 24th, the LMG left Palmer Station to return to Punta Arenas. Lisa Crockett, Lars Axelsson, and Elizabeth Evans all redeployed on this vessel.



fishing trips: a) Gobionotothen gibberifrons, b) *Chaenocephalus aceratus*, c) *Champsocephalus gunnari* d) *Chionodraco rastrospinosus*, e) *Gymnodraco acuticeps*, f) *Notothenia coriiceps*, g) *Parachaenichthys charcoti*, h) *Pseudochaenichthys georgianus*, i) *Trematomus hansoni.*

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
May 2017
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.

During a Power outage the system's UPS failed causing a short period of data loss. 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 system's C drive filled to the point of program failure. All External Hard drives were replaced in order to fix the issue. The VLF/ELF system has operated well throughout the month.

A-119-P: DEVELOPMENT OF ANTARCTIC GRAVITY WAVE IMAGER.

Michael Taylor, Principal Investigator, Utah State University

The Gravity Wave Imager takes images of the night sky in the near infrared, observing the dynamics of the upper atmosphere. The camera takes one 20-s exposure image every 30s of a very faint emission originating from a layer located at ~55 miles of altitude.

The IR camera has operated well throughout the month. Some adjustments to the lens were made to improve focus and image quality.

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 was operational all month, but is no longer on the Network and awaiting a new RSP.

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. An external hard drive was sent to Vadym Paznukhov.

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 computer system has been operating normally all 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 regularly and HATS Air samples were taken twice this 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.

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.

The system operated well 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 Terascan system worked well 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 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 tide gauge 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 (PalMOS) and emailed to the National Weather Service for entry into the Global Telecommunications System.

The local weather station (PAWS) is working well. The Joubin and Wauwerman sites have been experiencing outages due to the lack of sun.

A bull elephant seal with several females on the shore of a local island. *Image Credit: Leucas Miller*