PALMER STATION MONTHLY SCIENCE REPORT

MAY 2019

Calm weather allowed science support personnel on station to visit both G-094-P (Yu) climate stations on Amsler Island and Joubin Island No. 4. Both stations were intact and data was successfully retrieved and sent to the PI. *Image Credit: Hannah James*

NEWS FROM THE LAB

Hannah James, Winter Laboratory Supervisor

The month of May brought a close to the LMG19-04 cruise, and the final port call before winter. Science groups B-236-P (Amsler) and B-303-L/N (Sanders) returned all borrowed equipment to station, and gave an excellent presentation to personnel on station highlighting their work aboard LMG19-04. Many thanks go out to Bouvard Hosticka of T-998-P (General Dynamics) for his two science lectures while on site working in Terra Lab on the International Monitoring Station for CTBTO. He sailed north after a successful annual site visit. Also aboard was the winter Instrument Technician Jason Johns, who was key in setting up the B-459-P (Bernard) group with a successful season. On May 23rd, the R/V *Laurence M Gould* left Hero Inlet for the final time this season, leaving 20 winter-overs at Palmer Station.

The wintering B-459-P (Bernard) group was busy in the labs monitoring their juvenile krill, finishing up their Time Point 0 experiment, and processing some preliminary data which is detailed below. Though many windy days dominated the month, a number of calmer days allowed visits to field sites for bi-annual visits. The two G-094-P (Yu) climate stations were visited for structural inspections and data download, the AWS in the Joubins was visually inspected, and C-013 (Fraser) bird weighing and tracking wrapped up with the final Giant Petrel chick fledging around May 24th.

Wintery mixtures of snow, rain, and wind dominated throughout May. Brash ice has come and gone, and with dropping temperatures the snow is finally sticking around. Kelp Gulls, Antarctic Terns, Snow Petrels, and Fur Seals were a common sight, and fewer and fewer Giant Petrels and Wilson Storm Petrels were observed. Crabeater and Leopard seals were occasionally seen from station, and Humpback whales were spotted a handful of times off of Janus Island.

May 2019 WEATHER
W. Lance Roth, Research Associate

Temperature
Average: -3.0°C / 26.7°F
Maximum: 5.5°C / 41.9°F on 6 May 18:58
Minimum: -11.8°C / 10.76°F on 26 May 11:06
Air Pressure
Average: 983.7 mb
Maximum: 1022.2 mb on 31 May 10:50
Minimum: 943.0 mb on 11 May 05:44
Wind
Average: 20.9 knots / 24 mph
Peak (5 Sec Gust): 102 knots / 117 mph on 10 May 18:45 from NE (43 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 71.4 mm / 2.81 in
Total Snowfall: 35.0 cm / 13.7 in
Greatest Depth at Snow Stake: 31.8 cm / 12.4 in
WMO Sea Ice Observation: No sea ice in sight with 1-5 icebergs and bergy bits.
Average Sea Surface Temperature: 0°C / 32°F

May was another cold and windy month with the wind reaching 117 mph on the 10th and averaging 24 mph. The prevailing wind direction was from the Northeast. Temperatures reached a low of -11.8°F on the 26th and peaked at 41.9°F on May 6th. We accumulated 14 inches of snow. There has been brash ice in the area occasionally as well as several large icebergs.

B-459-P: CAREER: "THE OMNIVORE'S DILEMMA": THE EFFECT OF AUTUMN DIET ON WINTER PHYSIOLOGY AND CONDITION OF JUVENILE ANTARCTIC KRILL

Dr. Kim Bernard, Principal Investigator, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Personnel on Station: Kim Bernard, Kirsten Steinke and Julia Fontana

This month, we have focused on processing data from our initial time point experiments that started April 29th and ran through to May 3rd and which were described in the April Monthly Report. Below, we highlight the preliminary results of our initial time point experiments.

Initial Time Point Experiments – Preliminary Results

1. Length Frequencies

The krill used in our experiments thus far have been dominated by 25-30 mm individuals, which are indicative of Age-Class 1 krill (our target stage).

2. Respiration Rates

We measured the respiration rates of juvenile krill using a PyroScience FireStingO2 oxygen meter. After two sets of respiration rate experiments and a sample size of 31 juvenile krill (mean length = 30.12 mm; SD = 3.65 mm), we determined that the mean daily respiration rate was 10.11 µL O_2 ind.$^{-1}$ hour^{-1} (SD = 2.66 µL O_2 ind.$^{-1}$ hour^{-1}) for juvenile krill. Respiration rates ranged between 6.15 µL O_2 ind.$^{-1}$ hour^{-1} and 19.13 µL O_2 ind.$^{-1}$ hour^{-1} (Figure 1). Since the lengths of krill varied and respiration covaries with body size, we also calculated a mean daily respiration rate standardized by krill dry weight of 0.23 µL O_2 (mg DW)$^{-1}$ hour^{-1} (SD = 0.049 µL O_2 (mg DW)$^{-1}$ hour^{-1}). These values are marginally lower than those recorded for similar sized krill in August 2016 in the Bransfield Strait (Bernard et al. 2018).

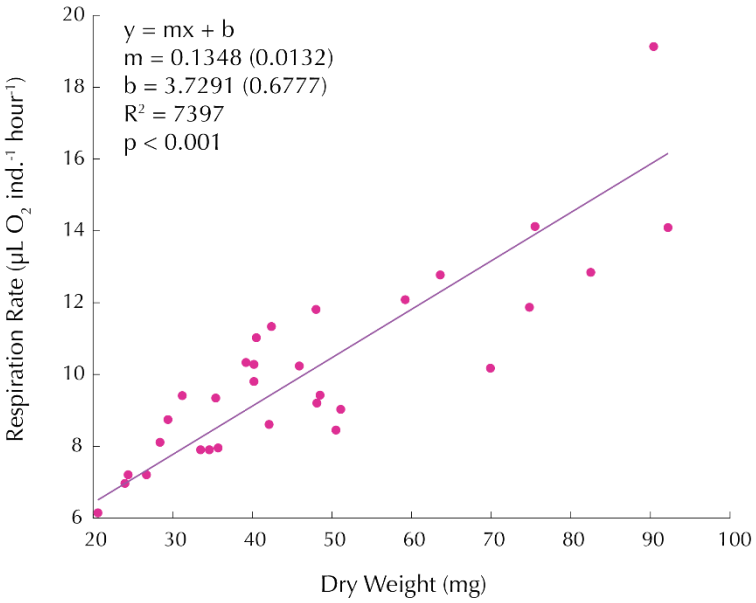

Figure 1. Respiration rates (µL O_2 ind.$^{-1}$ hour^{-1}) plotted against individual dry weight (mg).

3. Assimilation Efficiency

Assimilation efficiency (AE) is a measure of the amount of organic matter consumed that is retained by the organism after egestion occurs. For these experiments, we determined AE using the ash-ratio method (Båmstedt et al. 2000). Using this approach, we estimated a mean AE of 81 % for juvenile krill at the start of our long-term feeding experiments.

4. Growth Rates

Daily growth rates (DGR) were be determined using the instantaneous growth rate (IGR) method, described by Ross and Quetin (1991) and adapted after the method of Tarling et al. (2006). At the start of our experiment, we ran a growth rate experiment using 202 juvenile krill that we collected on the southbound voyage. Over the period of 5 days, 78 krill molted and 3 died. By measuring the length of the uropod on the molt and the individual krill, we calculated a mean DGR of 0.005 mm day^{-1} (SD = 0.08 mm day^{-1}) for juvenile krill (< 35 mm). This corresponds to an intermolt period (IMP) of approximately 17 days. Winter growth rates of adult krill are known to be extremely low. Meyer et al. (2010) reported DGR of 0.0014 mm day-1 and IMP ranging from 55-102 in the Lazarev Sea. Our DGR values are higher than this and our IMP is substantially shorter, though this difference is most likely because juveniles tend to have higher growth rates than adults. Interestingly, about 51 % of juvenile krill had shrunk during the 5-day period. Along the Western Antarctic Peninsula, Quetin and Ross (1991) found evidence of shrinkage in krill.

5. Circadian Rhythms in Respiration

Undergraduate student Julia Fontana further analyzed the respiration rate data for circadian rhythms and found that there was a significant rhythmicity in respiration rates of the juvenile krill investigated (see Figure 2). Peaks in respiration rate occurred consistently between 06h00 and 09h00, with some krill exhibiting secondary peaks at night.

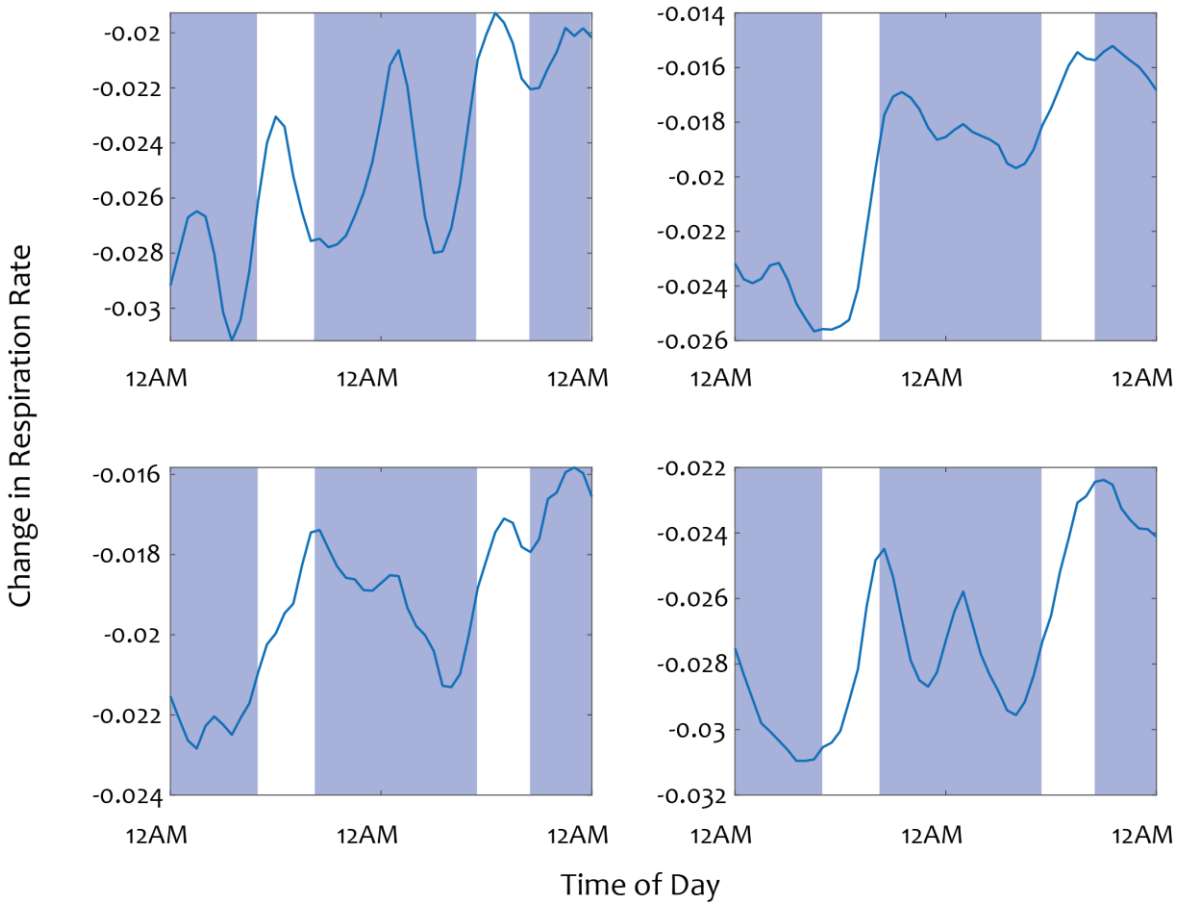

Figure 2. Circadian rhythms in respiration rate of four juvenile krill. Troughs in the line represent elevated respiration rates, while peaks represent periods of reduced respiration. Shaded blocks represent approximate night times.

Long-Term Feeding Experiments – Maintenance

For the last ~3 weeks, we have been maintaining the long-term feeding experiments. This involves taking twice-daily measurements of seawater temperature and salinity in each treatment tank to ensure that the tanks do not vary significantly from each other. Although both parameters vary daily, the variability is small and there is no significant difference in temperature and salinity between the tanks. Dissolved oxygen measurements are also taken, though this is to ensure that the oxygen concentrations do not fall too low. So far, we have not had any issues with this. In addition to checking the environmental parameters of each tank, our daily maintenance schedule includes sustaining a growing phytoplankton culture and feeding the krill in treatment tanks at regular (3-4 days) intervals. Despite the initial set-back with the phytoplankton culture, we now have a healthy culture that appears to be growing well.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
May 2019
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.

Both the ELF/VLF operated normally through the rest of 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 was turned back on with the return of darkness. The system is still experiencing some issues with Windows 10.

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 inter-annual 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. A shipment of sampled flasks was sent on the northbound vessel.

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 during favorable winds and HATS Air samples were taken every other week. A shipment of CCGG sampled flasks was sent on the northbound vessel.

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 absolute scans were completed as necessary.

R-938-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 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 normally throughout the month. The glacier terminus has been surveyed, but has not been processed due to issues with Windows 10.

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.

Bouvard Hosticka was here for an annual site visit. The system operated normally.

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. The tide data transfer to the SQL database is still an issue.

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. Observations are archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/