PALMER STATION MONTHLY SCIENCE REPORT

JUNE 2019

Searching for krill using the Garmin Echomap Transducer on the Landing Craft
Image Credit: Hannah James

NEWS FROM THE LAB

Hannah James, Winter Laboratory Supervisor

The month of June flew by but allowed station to get into the full swing of winter science. With the shortest days of the year throughout this month, many hands around station came together to get the B-459-P (Bernard) group out on the water to search for krill at the beginning of the month. Though no krill were found, there was still plenty of science that was conducted both in Bio Labs and Terra Lab.

The Bernard group successfully completed their Time Point 1 experiment, which is detailed below. Kim Bernard and Julia Fontana presented an excellent overview of their project and Julia's side project to the station during a Tuesday night science lecture. In addition to maintaining the suite of instrumentation and taking air samples, our onsite Research Associate Lance Roth has been working with the IT department to graph water wall data to our local intranet page, which, with a few minor details to tweak, is now online.

The weather in June provided a mixture of clear, calm days as well as a number of winter storms, with temperatures below freezing for nearly the entire month. Brash ice has come and gone, and with dropping temperatures pancake and grease ice formed in the harbors a number of times but was blown out with the ever-persistent wind. Kelp Gulls and Antarctic Terns were a common sight, and fewer and fewer Giant Petrels, Snow Petrels and Fur Seals were observed. On June 16th, a King penguin was found in the backyard, with a number of cuts from what we can only assume was a leopard seal. However, the individual had returned to the water the following day.

June 2019 WEATHER
W. Lance Roth, Research Associate

Temperature
Average: -3.3 °C / 26.1 °F
Maximum: 5.4 °C / 41.72 °F on 4 Jun 23:08
Minimum: -10.5 °C / 13.1 °F on 30 Jun 23:00
Air Pressure
Average: 989.3 mb
Maximum: 1018.8 mb on 1 Jun 00:20
Minimum: 967.0 mb on 23 Jun 23:45
Wind
Average: 14.9 knots / 17.1 mph
Peak (5 Sec Gust): 102 knots / 118 mph on 23 Jun 15:12 from NNE (32 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 18.3 mm / 0.72 in
Total Snowfall: 40 cm / 15.60 in
Greatest Depth at Snow Stake: 46.8 cm / 18.3 in
WMO Sea Ice Observation: No sea ice in sight, 1-5 icebergs, with growlers and bergy bits.
Average Sea Surface Temperature: -1.17 °C / 29.9 °F

June was another cold and windy month with the wind reaching 118 mph on the 23rd and averaging 17 mph. The prevailing wind direction was from the North-North-East. Temperatures reached a low of 13.1°F on the 30th and peaked at 41.7°F on June 4th. We accumulated 15.6 more inches of snow raising our total to over 18 inches. There has been some 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 conducted the Time Point 1 suite of experiments and processed the resulting samples and data.

Time Point 1 Experiments – Preliminary Results

1. Respiration Rates

The mean daily respiration rate standardized by krill dry weight has not changed significantly since Time Point Zero, nor was there a significant difference in this rate between krill fed copepods and those fed diatoms (Figure 1). The values are still marginally lower than those recorded for similar sized krill in August 2016 in the Bransfield Strait (Bernard et al. 2018).

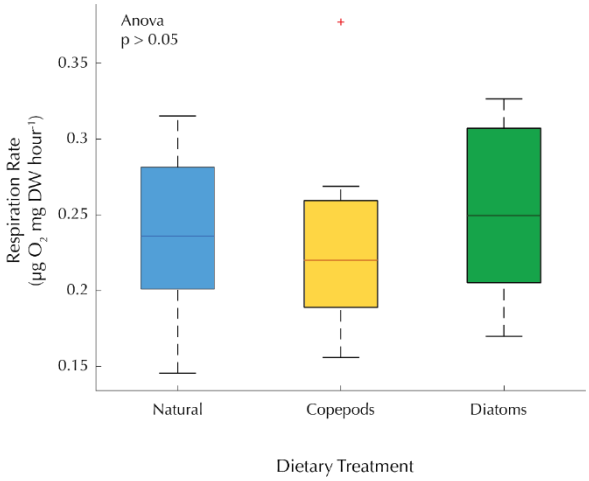

Figure 1. Mean respiration rates of krill measured at Time Point Zero (fed natural seawater) and Time Point 1 (fed copepods and diatoms).

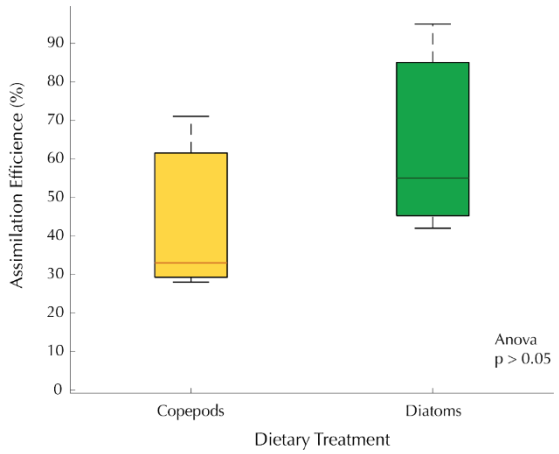

Figure 2. Mean assimilation efficiencies (%) of krill fed copepods and diatoms measured at Time Point 1.

2. Assimilation Efficiency

At Time Point 1, we estimated a mean assimilation efficiency (AE) of 44 % (standard error, SE = 13.6 %) for juvenile krill fed a diet of copepods and a mean of 64 % (SE = 15.7 %) for those fed a diet of diatoms. These means were not significantly different from each other (Figure 2).

3. Egestion Rates

We also calculated daily egestion rates for krill and found that the mass of pellets produced (mg of dry weight) ranged from a mean of 1.8 mg pellets krill^{-1} day^{-1} for those fed copepods to a mean of 2.6 mg pellets krill^{-1} day^{-1} for those fed diatoms (Figure 3). The mean values were not statistically different between dietary treatments.

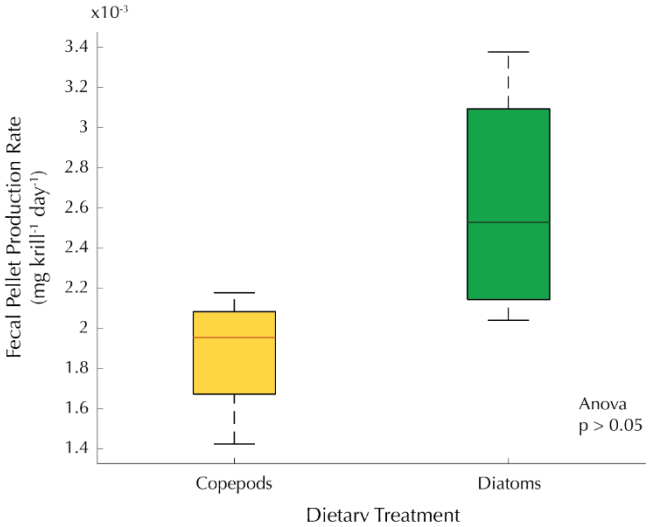

Figure 3. Mean fecal pellet production rates (mg dry weight krill^{-1} day^{-1}) for krill fed a diet of copepods and those fed a diet of diatoms. Measurements from Time Point 1.

4. Circadian Rhythms in Respiration

As was done for Time Point Zero, the respiration rate data for circadian rhythms were further analyzed for circadian rhythms. Interestingly, despite clear circadian rhythms identified for krill at Time Point Zero, the

krill at Time Point 1 showed no distinct rhythms in their respiration rates. We think that this might be due to the fact that they have spent over a month out of their natural environment.

Experimental Treatment Conditions

We have been monitoring the seawater temperature (see Figure 4), salinity and dissolved oxygen twice daily in each of the four experimental treatment tanks. Early-season temperatures were relatively warm ranging between 0.5 and 1.8˚C. As the season has progressed, temperatures have dropped to between -0.5 and 0.7˚C. Salinity has remained steady at an average of 34.5 psu, while dissolved oxygen has never dropped below 9 mg L^{-1}, with an average of between 10 and 10.6 mg L^{-1} across the tanks. We have also been monitoring the ambient chlorophyll-*a* (Chl-*a*) concentrations and seawater temperature measured on the intake seawater using the Water Wall. In April, Chl-*a* concentrations were relatively high (up to 2.7 µg Chl L^{-1}), indicative of a fall bloom. By May, the Chl-*a* concentrations had dropped and have remained low (Figure 5). Ambient seawater temperatures are considerably lower than those in our treatment tanks (Figure 5). However, since Antarctic krill over winter as far north as South Georgia, the temperatures in our experimental tanks are still representative of winter conditions experienced by a large proportion of the krill population. The seawater temperature in our experimental tanks is warmer because it is necessary to maintain heat in the Aquarium Room where our tanks are located. The heat is on at a very low temperature, but enough to ensure that the plumbing does not freeze.

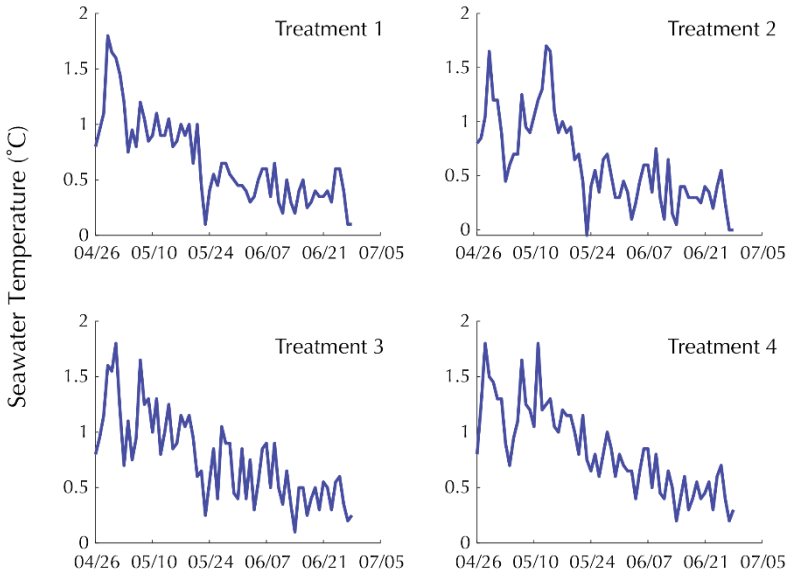

Figure 4. Average daily seawater temperatures in each of the four experimental treatment tanks from the start of the long-term feeding experiment in April until late June.

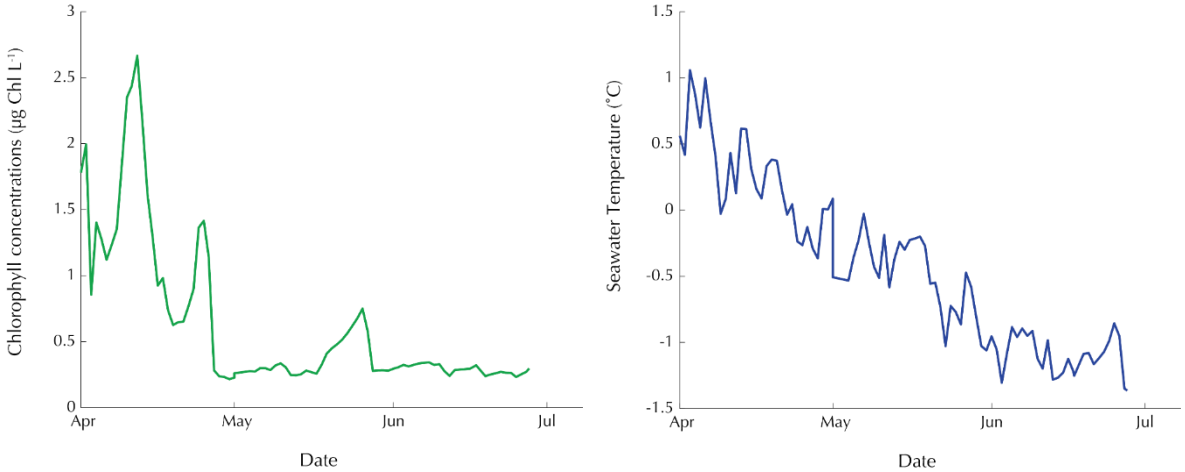

Figure 5. Average daily ambient chlorophyll-a concentrations (left) and seawater temperatures (right) from the seawater intake measured by the Water Wall between April and June.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
June 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 is still experiencing issues due to the new Windows 10 software upgrade.

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.

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.

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.

The system had a few issues, but is now operating 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.

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. Rime ice caused the anemometer to stop working twice this month. It was easily fixed by ascending the tower and clearing the ice. Observations are archived on the AMRC website:
ftp://amrc.ssec.wisc.edu/pub/palmer/observations/