

PALMER STATION MONTHLY SCIENCE REPORT

August 2019



One of the many beautiful winter sunsets Palmer Station experienced over an ice-covered Arthur Harbor.

Image Credit: Hannah James

NEWS FROM THE LAB

Hannah James, Winter Laboratory Supervisor

The month of August flew by at Palmer Station. Long term winter projects for science staff continued, the Bernard group completed another Time Point Experiment (some results are discussed below), and preparation for summer science groups progress as the days continue to get longer and longer. It was a treat to hear some of the results of many hours of data analysis from PhD Student Kirsten Steinke. She presented a science lecture to station members on the condition of Antarctic krill; that is, an individual krill's wet weight divided by their total length- giving a quick look at their individual biomass and health.

Thanks to the cold, calm weather throughout the month, sea ice dominated both Hero Inlet and Arthur Harbor for most of August. With the sea ice covering almost all open water seen from the pier, overall wildlife sightings significantly dropped; though more Sheathbills have constantly been seen (and heard tapping on rooftops) around station for the past week. Snow Petrels and Antarctic Terns were only sighted a few times during the month, while Kelp Gulls and juvenile Giant Petrels remain a common sight. The wildlife highlight of the month was the flock of an estimated 250 cormorants transiting near station towards Litchfield Island in early August. Fur seals were seen on sea ice and land occasionally.

August 2019 WEATHER

W. Lance Roth, Research Associate

Temperature
Average: -4.8 °C / 23.4 °F
Maximum: 4.1 °C / 39.38 °F on 25 Aug 16:04
Minimum: -11.2 °C / 11.84 °F on 1 Aug 19:26
Air Pressure
Average: 992 mb
Maximum: 1014.6 mb on 21 Aug 01:43
Minimum: 955.4 mb on 6 Aug 01:54
Wind
Average: 11.7 knots / 13.5 mph
Peak (5 Sec Gust): 77 knots / 88 mph on 4 Aug 00:51 from ESE (122 deg)
Prevailing Direction for Month: NNW
Surface
Total Rainfall: 4.8 mm / 0.19 in
Total Snowfall: 30 cm / 11.7 in
Greatest Depth at Snow Stake: 62.6 cm / 24.4 in
WMO Sea Ice Observation: 8/10 Nilas, ice rind, ice bergs, and young ice < 10cm thick
Average Sea Surface Temperature: -1.68 °C / 29.00 °F

Temperatures in August dipped down well below freezing with an average temperature of 23.4°F and a minimum of 11.8°F on the 1st. The wind speed averaged 13.5 mph from the North-Northwest keeping the sea state calm enough to allow sea ice to form in Arthur Harbor. 8/10 of the harbor had nilas, ice rinds, icebergs, growlers, bergy bits, and young ice less than 10cm thick for 23 days. We accumulated 11.7 more inches of snow raising our total to 24.4 inches.

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 3 suite of experiments. As a reminder, after Time Point 2, the long-term feeding experiment moved into its second phase consisting of four separate dietary treatments. The table below shows the treatments in each tank.

Treatment	Phase 1 Diet	Phase 2 Diet	Name
1	Freeze-dried mixed zooplankton	Natural seawater	MZA-NAT
2	Freeze-dried mixed zooplankton	Freeze-dried mixed zooplankton	MZA-MZA
3	Diatom culture	Natural seawater	DIA-NAT
4	Diatom culture	Diatom culture	DIA-DIA

Time Point 3 Experiments – Preliminary Results

1. Respiration Rates

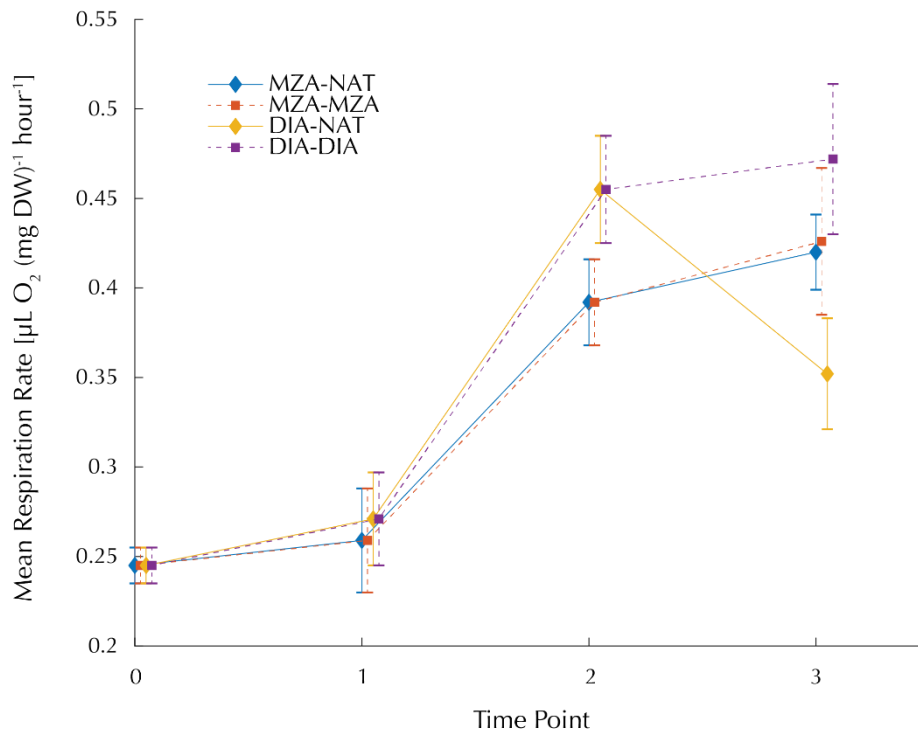


Figure 1. Mean respiration rates of krill measured at Time Point Zero (May), Time Point 1 (June), Time Point 2 (July) and Time Point 3 (August) in each of the four treatments (MZA-NAT, MZA-MZA, DIA-NAT, and DIA-DIA). Respiration rates of krill in DIA-NAT were significantly lower than those in DIA-DIA by Time Point 3. Respiration rates in MZA-NAT were not different from those in MZA-MZA. Note that values at each Time Point are offset for each treatment for clarity. Error bars are standard error.

The mean daily respiration rate standardized by krill dry weight has continued to increase for krill in treatments MZA-MZA, MZA-NAT and DIA-DIA (Figure 1). There was no significant difference between respiration rates of krill in any of these three treatments ($p > 0.05$). However, krill in the DIA-NAT treatment had significantly reduced respiration rates when compared to those in the DIA-DIA treatment ($p < 0.05$; Figure 1). This is an exciting result as it suggests that feeding on copepods in the autumn is important for juvenile krill as it allows them to cope with reduced food in the winter. Conversely, feeding primarily on diatoms in the autumn does not prepare the krill for winter starvation.

2. Ingestion Rates

The modifications we made to the Time Point experiments at TP2 (i.e. incorporating an ingestion rate experiment with the egestion rate experiments) have yielded interesting results. We have found that ingestion rates of juvenile krill increase significantly in response to food concentrations, following what appears to be a Type I functional response (i.e. a linear response; Figure 2). Concurrently, we observed an average clearance rate of 1.26 L day⁻¹ for Time Point 3, which was not significantly different from the average clearance rate observed at Time Point 2 (mean = 1.30 L day⁻¹ for TP 2; $p > 0.05$). Further, we found no change in clearance rates under increasing food concentrations.

These results suggest that juvenile krill have a relatively constant clearance rate at phytoplankton concentrations ranging from 7-21 $\mu\text{g Chl-}a \text{ L}^{-1}$, although we surmised it would be likely that at higher food concentrations, the effort required to digest the food cleared would result in a reduced clearance rate. This would cause a reduction in ingestion rate and a functional response curve more similar to a Type II (i.e. logarithmic) or Type III (i.e. logistic) response. We investigated this in an *in situ* food removal experiment and found the opposite to be true. When provided diatoms at high Chl-*a* concentrations of 49 $\mu\text{g Chl-}a \text{ L}^{-1}$, juvenile krill increased their clearance rates to 2.25 L day⁻¹ and ingested approximately 9 $\mu\text{g Chl-}a \text{ ind}^{-1} \text{ day}^{-1}$. The functional response remains Type I and we have not found any indication that juvenile krill reduce their feeding rates at high phytoplankton concentrations. This is an important finding because it suggests that juvenile krill will consume as much phytoplankton as is available to them in the winter.

3. Growth Rates

Given the marked change in respiration rates for krill in the DIA-DIA and DIA-NAT treatments, we conducted an additional growth rate experiment using 84 individuals from each treatment. We do not have enough krill in the MZA-MZA and MZA-NAT tanks, so these krill were not considered. Interestingly, there was no significant difference in the mean growth rates of krill from the DIA-DIA (0.052 mm day⁻¹; standard deviation = 0.02 mm day⁻¹) and DIA-NAT (0.018 mm day⁻¹; standard deviation = 0.05 mm day⁻¹) treatments ($p > 0.05$). Out of 84 individuals used for each treatment, only six molted in five days from DIA-DIA, while thirteen individuals molted from DIA-NAT in the same time period. These growth rate experiments will be useful for verifying our later calculations of growth rate using the energy budget model that we will derive from empirical data collected during our other Time Point experiments.

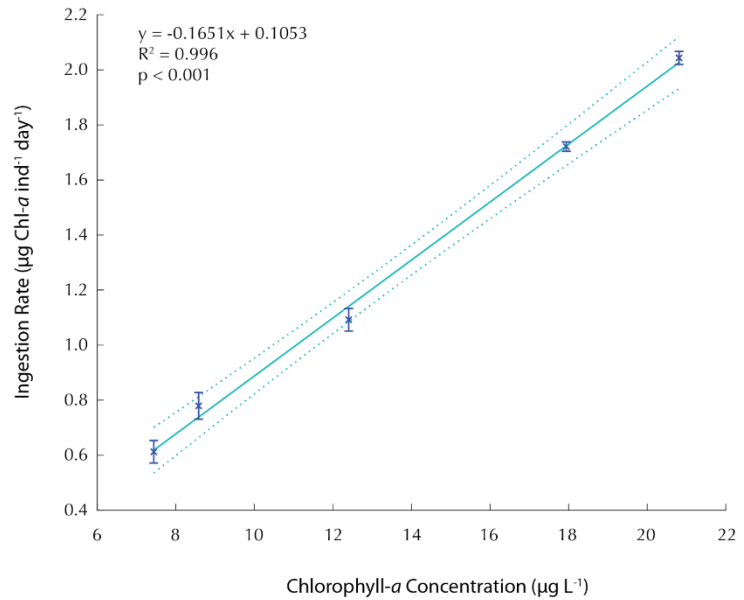


Figure 2. Average ingestion rates of juvenile krill in response to increasing food (Chlorophyll-*a*) concentrations. Error bars are standard deviation.

RESEARCH ASSOCIATE MONTHLY REPORT

August 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 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 program cannot detect the computer time correctly which may be due to a Windows 10 update. This issue has prevented the project from working properly this season.

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 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 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.

At times the CPU is overloaded, causing the system to lock up. A second mirrored Windows 10 hard drive was installed as an attempt to solve this issue. 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. UNAVCO sent a current version of Trimble Business Center which our IT department has installed on the Windows 10 RA computer. We should now be able to process the glacier terminus surveyed this past austral summer.

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.

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/>.