PALMER STATION MONTHLY SCIENCE REPORT

NOVEMBER 2019

Transferring krill from the insulated Xactic tanks into the Aquarium Room for B-198-P (Weissburg). *Image Credit: Randy Jones*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

Ice conditions, specifically heavy brash ice, was the dominant conversation among grantee groups this month (Fig 1.). There were a few periods early in the month where ice cover near station allowed the C-013-P (Fraser), or bi-weekly LTER groups to sample, but only at islands close to Palmer Station or at Station B.

The arrival of the ARSV *Laurence M. Gould* on 16 November brought the B-198-P (Weissburg) group to Station, along with several hundred krill, which allowed them to start conducting experiments soon after their experimental setups were in place. Also, the B-005-NP (Kohut) group was on station for two weeks to install the high frequency RADAR (HFR) site at Palmer. B-005-P will return on the LMG20-01 cruise for ten weeks at station – more information from them then.

It should be noted that there was an error corrected in the Palmer Station Backyard Automated Weather Station anemometer data. Following the finding that the wrong anemometer propeller was in service, the correct propeller was installed. The period affected was 28 February 2019 – 20 November 2019. The data have been corrected on the AMRC data archive and in other reporting locations. Parties who had downloaded data from the AMRC site during this time have been notified of the correction.

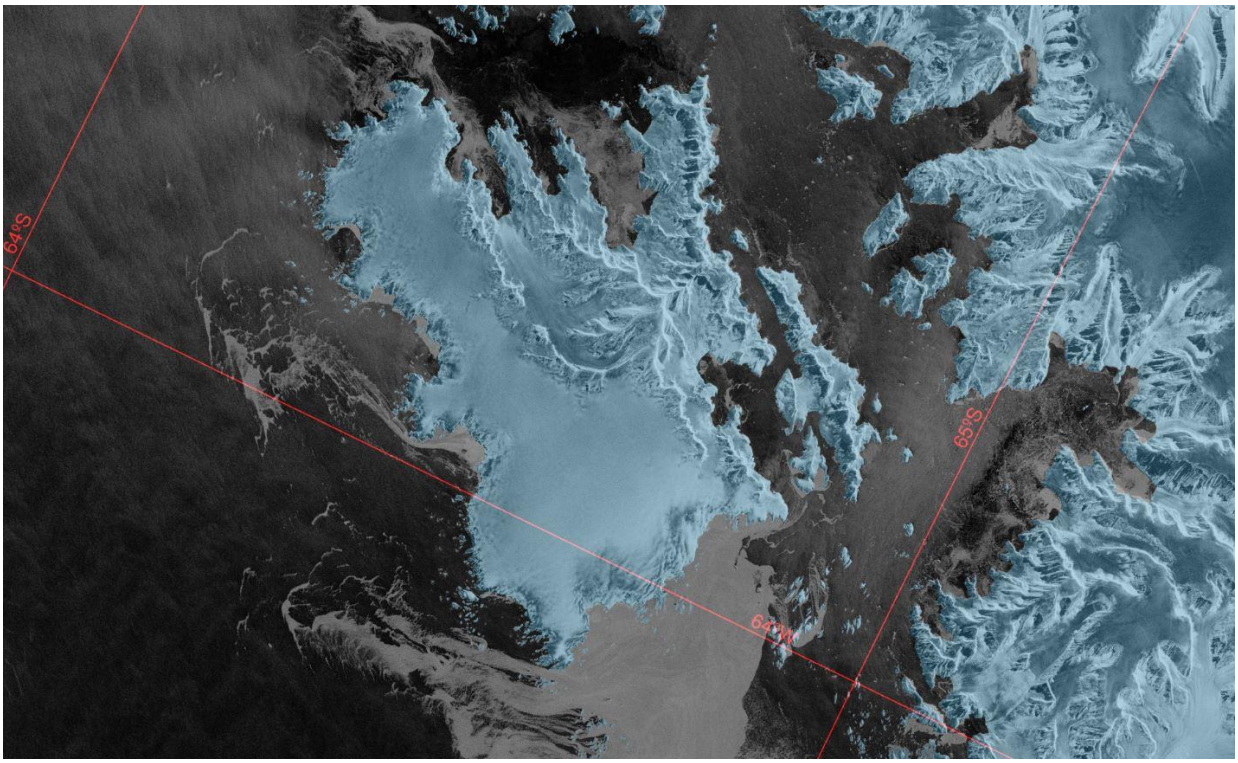


Fig. 1 – C-Band Synthetic Aperture Radar (SAR) satellite imagery, from the sun-synchronous, near-polar 'Sentinel-1' satellite. This image was captured on 9 Nov 2019 at 0818, for the region surrounding Anvers Island. Palmer Station is approximately located in the center, lower, middle of the image, amid the heavy brash ice. Image downloaded from https://www.polarview.aq/antarctic.

NOVEMBER 2019 WEATHER
Marissa Goerke, Research Associate

Temperature
Average: -1.0 °C / 30.2 °F
Maximum: 9.0 °C / 48.2 °F on 24 Nov 18:56
Minimum: -9.2 °C / 15.44 °F on 21 Nov 05:53
Air Pressure
Average: 983.3 mb
Maximum: 1003.4 mb on 9 Nov 10:23
Minimum: 959.8 mb on 5 Nov 12:14
Wind
Average: 10.9 knots / 12.6 mph (uncorrected data; pending re-calculation of average)
Peak (5 Sec Gust): 85.3 knots / 98.2 mph on 14 Nov 16:02 from SSW (209 deg)
Prevailing Direction for Month: NNW
Surface
Total Rainfall: 39.6 mm / 1.6 in
Total Snowfall: 43.0 cm / 16.8 in
Greatest Depth at Snow Stake: 113.2 cm / 44.1 in
WMO Sea Ice Observation: 3/10 nilas, ice rind, ice bergs, and young ice < 10cm thick
Average Sea Surface Temperature: -1.15 °C / 29.90 °F

November was warm with temperatures rising to 48.2° F and averaging 30.2° F. Sea ice remained in the area until mid-November when a three day north-wind event cleared the waters. We accumulated an additional 16.8 inches of snow. The snow pack has been melting quickly near the end of the month.

B-198-P: COLLABORATIVE RESEARCH: INDIVIDUAL BASED APPROACHES TO UNDERSTANDING KRILL DISTRIBUTIONS AND AGGREGATIONS.

Dr. Marc Weissburg, Principal Investigator, Georgia Institute of Technology

Personnel on Station: David Fields, David Murphy, and Marc Weissburg

The goal of the work is to investigate drivers of individual behavior of krill. We plan to apply the findings to understand the organization and disorganization of large krill swarms. Work on each of the three components (behavior of krill in response to horizontal flows and interactions with light and odor; krill responses to vertical flows and interactions; krill schooling behavior) all have progressed over the reporting period. The primary issue has been animal availability, which we have been addressing through onsite net tows and light traps. Sea ice conditions have limited our ability to obtain krill both during the LMG19-10 port call and in the period after vessel departure.

After roughly three weeks at station, all three flow devices have been assembled and two of them have been used to acquire data. We are set to begin trials with the vertical flume, which required some significant modification on site (Fig. 2).

Fig. 2 – David Fields and Laboratory Supervisor, Randy Jones, assembling the vertical flume (left) and the assembled flume (right).

The annular flume used to produce krill schools has been set up and tested with groups of 100-300 animals before David Murphy left the station (Figs. 3 and 4). Groups of krill were tested in response to annular flow, a predator mimic, and krill metabolites (crushed krill). Though the krill responded to these stimuli, a greater number of krill in the tank is likely required to elicit a true schooling response. Ice and sea conditions prevented us from obtaining a sufficient number of krill before David Murphy left, and we are working with marine techs to collect krill with the light traps and from the Rigid Hull Inflatable Boat (RHIB) using net tows as conditions allow. David Murphy also video-conferenced with an AP Physics class at Middleton High School in Tampa, FL (Figure 4).

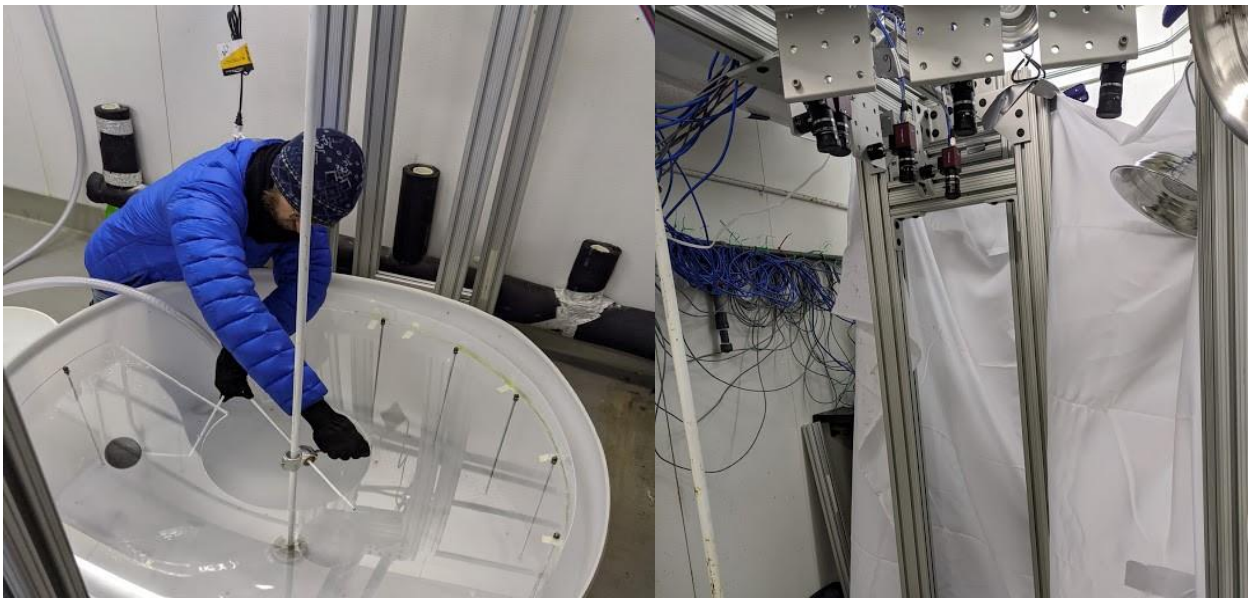


Fig. 3 – David Murphy assembling the annular flume used to produce krill schooling (left), and close up of the seven camera recording configuration (right).

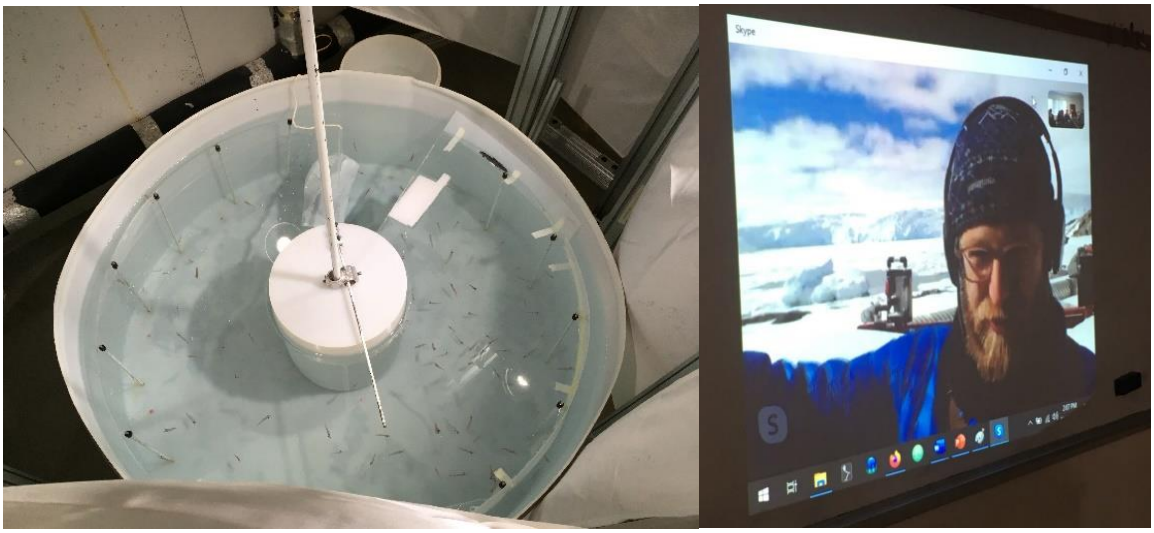


Fig. 4 – Initial tests of the annular flume with krill (left), and David Murphy video-conferencing with a classroom in Tampa, FL (right).

The horizontal flume (Fig. 5) has been used to obtain krill responses to flows from 0-8 cm s^{-1} in both light and dark conditions, with four replicate trials (35 total trials) using 4-6 krill each. The set-up records krill through time in horizontal and vertical planes to furnish XYZ coordinates of swimming animals (Fig. 6), which allows us to parameterize krill behavioral responses to these conditions once data have been analyzed off-site. Controlled lighting allows us to produce different intensities characteristic of krill at surface and at depth.

We also have performed trials to determine potential changes in swimming in the presence of phytoplankton food and predator metabolites (penguin guano collected by the C-013-P, Fraser group for us). Phytoplankton were collected by filtering raw seawater (from the Palmer Aquarium seawater intakes) with a 10 µm mesh net to produce a concentrated stock, and chlorophyll *a* levels assayed using standard fluorometric methods. We have performed four trials each in light and dark in still water and 0.6 cm s^{-1} flows at chlorophyll *a* concentration of roughly

5 µg L^{-1}. This was chosen to represent high levels in the open ocean as found in literature and is associated with dense krill swarms. We have tested penguin guano at estimated conditions in the field (100 millgrams L^{-1}) in still water in both light and dark conditions and will soon move on to trials in flowing water.

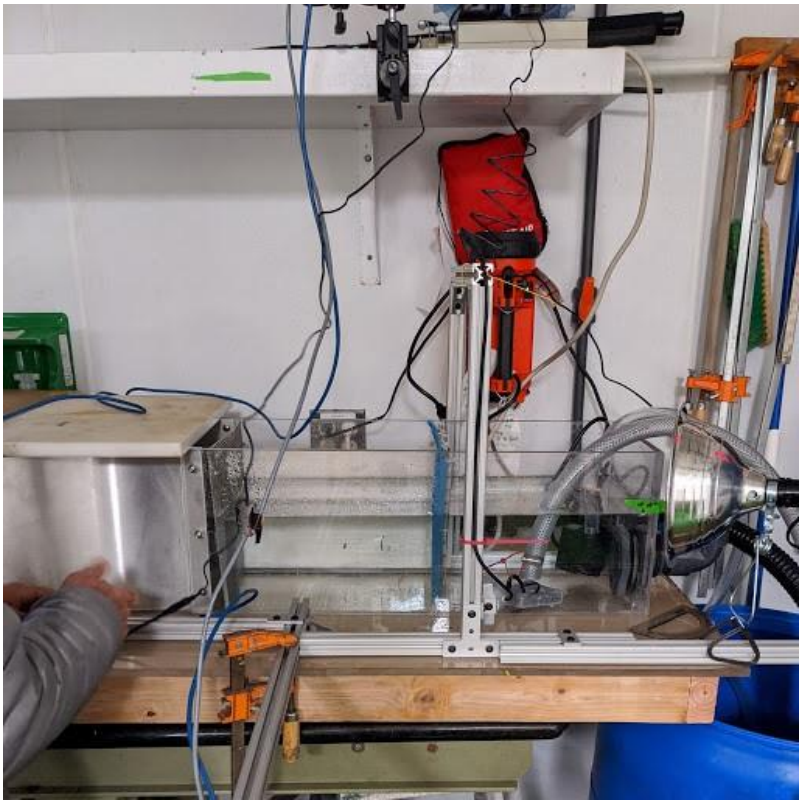


Fig. 5 – Horizontal flume showing working section, camera and light set up

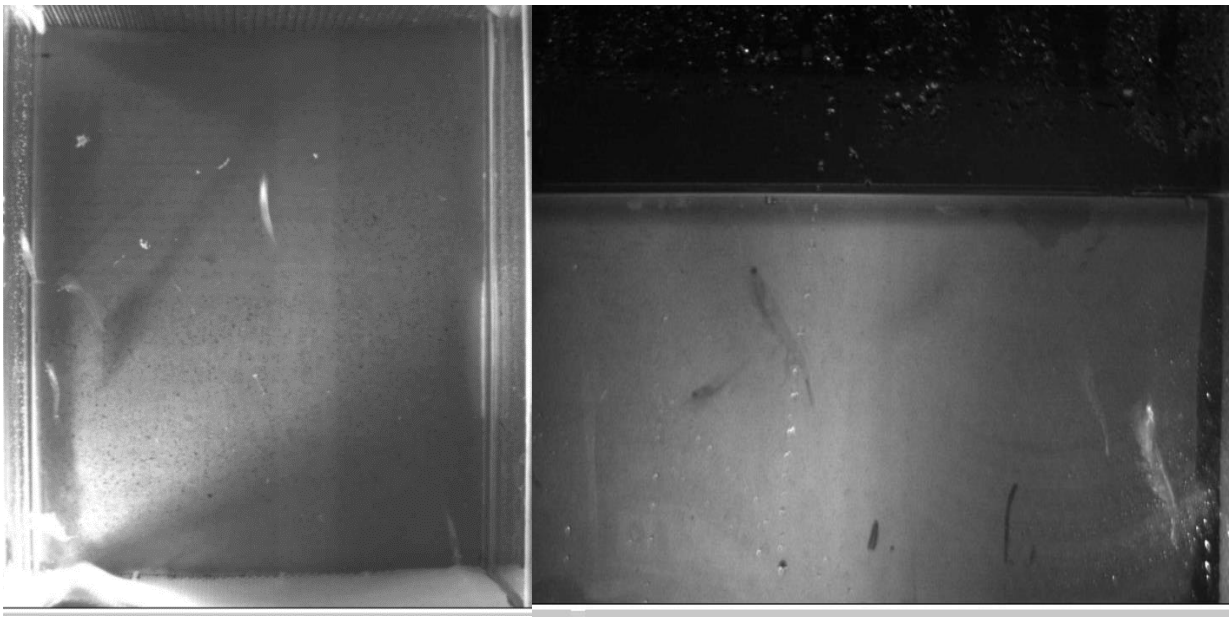


Fig. 6 – Horizontal (left) and vertical (right) planes from a krill trial, recorded at 30 fps with synchronized cameras. Flow rate was 0.6 cm s^{-1}.

C-013-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – APEX PREDATOR COMPONENT

Dr. William R. Fraser, Principal Investigator, Polar Oceans Research Group

Personnel on Station: Darren Roberts, Megan Roberts, and Leigh West

C-013-P (Fraser) personnel arrived at Palmer Station on 26 October. Heavy ice severely limited access to small boating for training and research throughout November. We were able to access study sites for a total of seven days in November. In comparison, in 2018 we arrived on 11 November, and accessed study sites on 16 of the remaining 19 days of the month.

Extensive ice was prevalent in November. *Image Credit: Megan Roberts*

We were able to use time indoors to complete two years of back-logged laboratory work. This included extracting fish otoliths and gastropod beaks from blue-eyed shag boli, south polar skua feces and regurgitate, and Adélie penguin feces.

Fish otoliths found in Adélie penguin feces. *Image credit: Megan Roberts*

Field work this month began with breeding chronology studies on a subset of Adélie penguin nests on Torgersen and Humble Islands. A portion of these nests were sampled at the 1-egg stage to obtain adult body condition and egg morphometric data. Timing of a peak egg census was also determined and completed for Adélies. Adélie peak egg census will be completed at Biscoe Point and Dream as soon as conditions allow.

Adélie penguin colony at Humble Island during peak egg census. *Image credit: Leigh West*

Brown skuas have arrived and we began their mark-recapture and breeding chronology studies, including leg band re-sights and monitoring nests in the local area. South polar skuas began arriving locally in the middle of the month and we began our band re-sighting and nest monitoring study of them on Shortcut Island. Satellite transmitter deployments on southern giant petrels have begun and will continue through February. An early-season census of giant petrel nests was completed on Shortcut and Humble Islands, and an extensive all-island census began in the last days of November. We also began monitoring the small blue-eyed shag colonies on Cormorant Island this month.

Marine mammal censuses of seals and whales began this month. Seal sightings this month included Weddell, crab-eater, leopard, and southern elephant seals. Minke whales were the most abundant whale observed in November. We also observed evidence of elephant seal pupping at Elephant Rocks.

Minke whales near Shortcut Island. *Image credit: Megan Roberts*

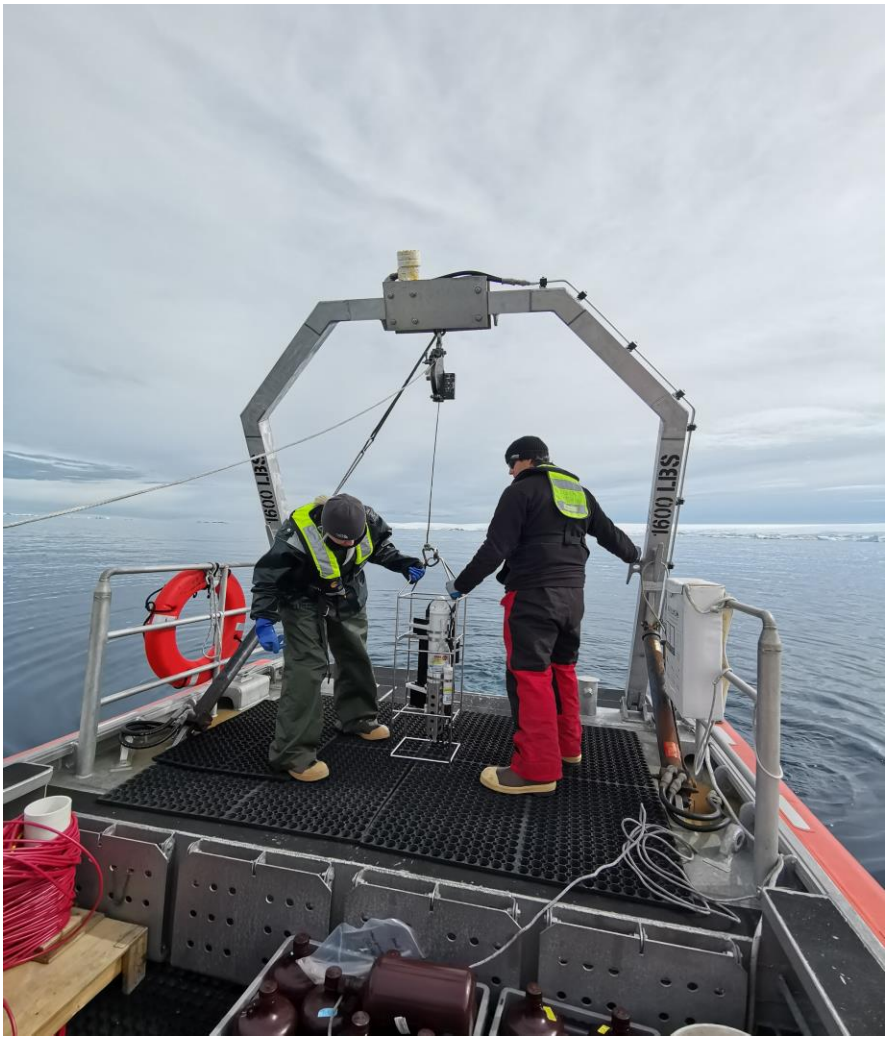
We would like to thank all of the personnel on station for helping us get the season moving. We would especially like to thank the Palmer Lab Manager, Randy Jones, and Instrument Technician, Carolyn Lipke, for intensive help with logistics and assistance with lab equipment.

C-019-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – PHYTOPLANKTON COMPONENT

Dr. Oscar Schofield, Principal Investigator, Rutgers University, Institute for Earth, Ocean, and Atmospheric Sciences, Department of Marine and Coastal Sciences

Personnel currently on station: Kelly Faller, Kasey Walsh, Rachael Young

With sea ice cover persisting throughout November, our bi-weekly sampling to Stations B and E as well as our collaborative sampling events have been delayed. However, on 29 November, open water allowed us to sample at both stations B and E. We deployed the CTD and C-OPS optical instrument, and collected surface water. This LTER data provides an overview of phytoplankton species diversity, chlorophyll concentrations, and light properties of the water column at each station.



Rachael Young (left) and Marine Technician Patrick Riley (right) deploying a CTD off the winch of RHIB Hadar, 29 November. *Image Credit: Schofield group*

The CTD casts show that the water-column is fairly well-mixed demonstrated by the profiles for temperature, salinity, and density (Fig. 7). The fluorescence maximum was located around 30m for Station E and extended between 20-40m for Station B. With the collected surface water, chlorophyll concentrations were at 0.311 µg L^{-1} for Station E and 0.355 µg L^{-1} for Station B.

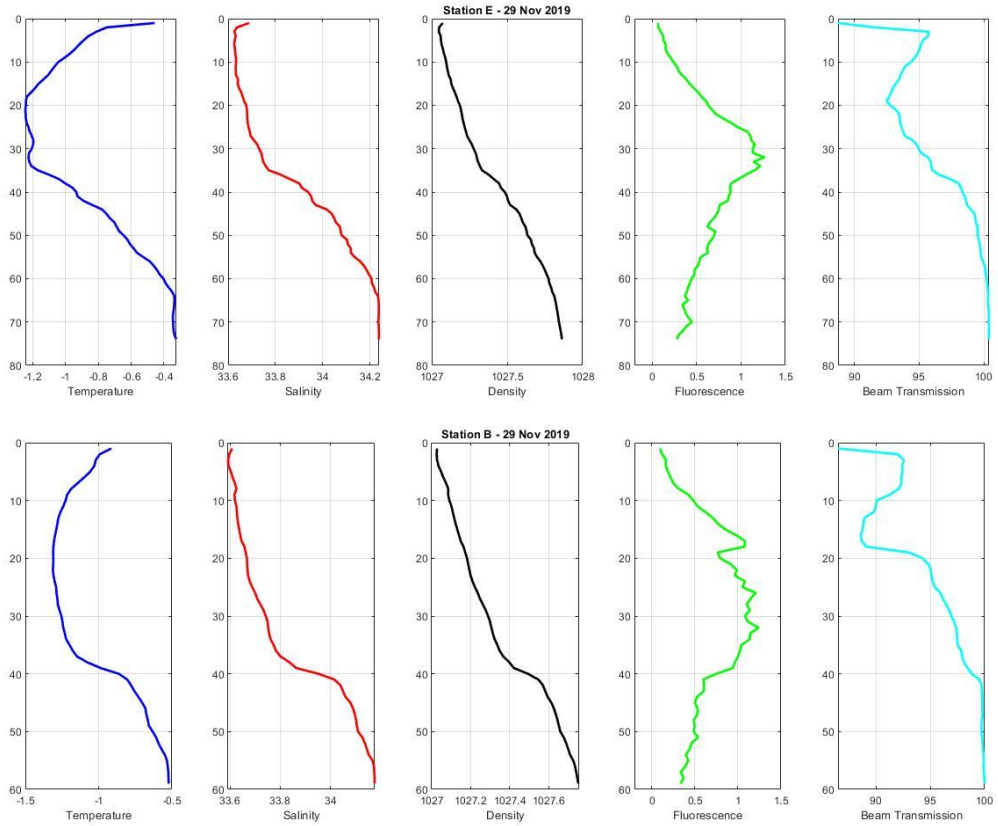


Fig. 7 – CTD profile at Station E (top row) and B (bottom row) for 29 November 2019. Temperature (°C), salinity (ppt), density (kg m^{-3}), and fluorescence (mg m^{-3}) profiles against depth in meters.

Along with bi-weekly sampling, daily pumphouse samples were processed for phytoplankton species diversity (Fig. 8). To get diversity, an Imaging FlowCytobot (IFCB) was used. The IFCB captures images of individual phytoplankton, which will then be positively identified and sorted in the program Ecotaxa.

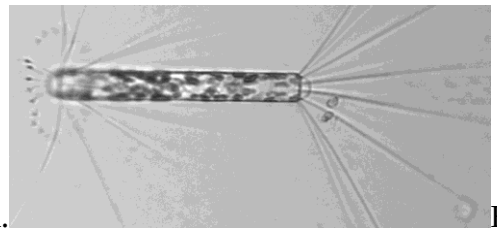
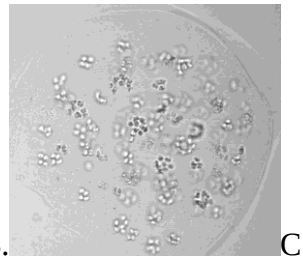
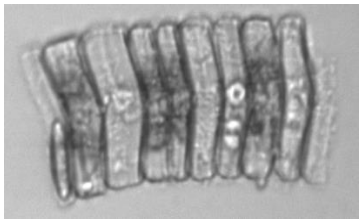
A.  B.  C. 

Fig. 8 – Images of species, A) *Corethron spp.* B) *Phaeocystis antarctica* and C) *Fragilariopsis spp.*, captured in daily pumphouse sampling by the Imaging FlowCytobot.

With the start of our bi-weekly sampling in addition to our daily sampling, November was incredibly productive! We want to say a huge thank you to our Marine Technicians, Michael Burns and Patrick Riley, for assisting us in getting to our sampling locations, and to Laboratory Supervisor, Randy Jones, and Instrument Technician, Carolyn Lipke, for being a constant

support and without whom sampling would not be possible. We are so grateful for the rest of the ASC staff as well, who keep the Station and science operations running smoothly. In December, we're excited to start consistently bi-weekly sampling and to begin our collaborative sampling!

C-045-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – MICROBIAL, BIOGEOCHEMICAL COMPONENT

Dr. Hugh Ducklow, Principal Investigator, Columbia University, Lamont Doherty Earth Observatory

Personnel on Station: Nick Mehmel

We arrived in late October to unusually strong winds, followed by several weeks of densely packed sea ice, obstructing sampling operations for over a month. During this period, time was dedicated to setting up the lab, calibrating instruments, and troubleshooting flow cytometer issues. Sea water intake (SWI) samples were collected weekly from the Palmer pumphouse for: particulate organic carbon (POC), flow cytometer (FCM), DNA, and nutrients. Weekly $\delta 18O$ SWI sampling responsibility was transferred from the Palmer Lab Supervisor (winter season) to grantee field team lead (summer season).

A SWI replicate experiment tested FCM variability between identical samples to constrain both human and instrumental uncertainty in datasets (Fig. 9). Three identical SWI samples were collected and measured twice each, for a total of six measurements. Autofluorescence data from samples measured prokaryotes to a mean of 1586 ± 69 counts, picoeukaryotes to 176 ± 17 counts, and nanophytoplankton to 589 ± 32 counts. Total counts from Sybr Green analyses measured to a mean of $16{,}163 \pm 630$ counts.

Fig. 9 – SWI replicates displayed relatively low variance, reflecting well on the sampling and analytical precision of our laboratory methods.

Our first sampling at sea occurred on 29 November. This first reliable sampling date came later than each of the past 5 seasons (2 Nov 2018, 14 Nov 2017, 25 Nov 2016, 17 Nov 2015, 13 Nov 2014; Fig. 10). Malfunctions in CTD equipment and extremely low tides produced time constraints that prevented us from collecting a full sample roster, and only surface samples were collected using GO-FLO bottles at Stations B and E. The second sampling event, which was far more successful, was completed on 2 December.

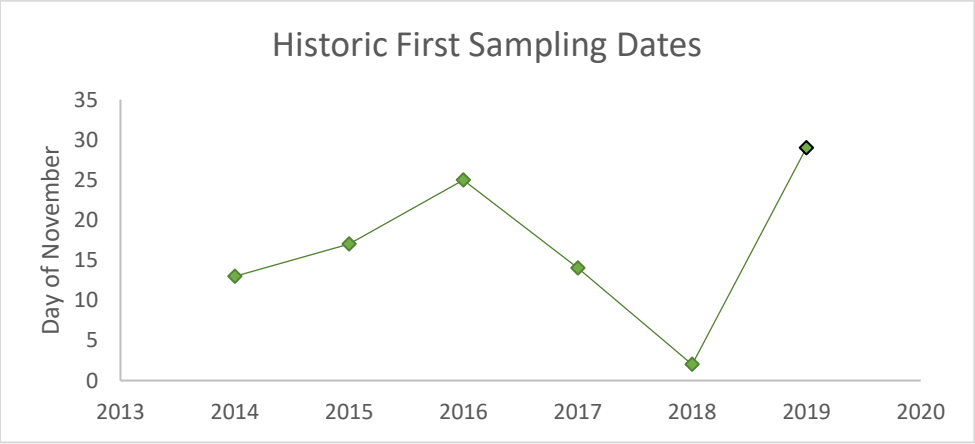


Fig. 10 – Dates of first sampling for bi-weekly LTER sampling at Stations B and E. The 2019 season began later than the previous five seasons due to heavy sea ice.

Dense ice prevented us from sampling for most of November, but it provided a nice place to rest for this leopard seal. *Image Credit: Nick Mehmel*

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT

November 2019
Marissa Goerke

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

Dr. 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 month. Hard drives reached capacity and were swapped out to continue logging data.

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

Dr. 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 camera and laptop have been shipped to Logan, UT for repair during the summer season.

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION

Mr. 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. The system observed 16 earthquakes above 6.0 on the Richter scale.

O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL DECADAL VARIATIONS IN TERRESTRIAL AND MARINE ECOSYSTEMS
Dr. 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 successfully taken twice this month.

O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD WORLDWIDE FLASK SAMPLING NETWORK
Mr. Don Neff and Dr. Steve Montzka, Principal Investigators, National Oceanic and Atmospheric Administration / Global Monitoring Division

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
Dr. James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division

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 with the occasional gap in data due to issues with the wavelength definition. 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.
Mr. 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.

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. The Palmer Station Research Associate sent a requested filter north on LMG19-10, as well as processing filters as needed.

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. Pursued collaborations to extend tide predictions beyond December 2020.

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) operated normally throughout the month. An issue was resolved with the anemometer. It was concluded that an incorrect wind bird propeller was installed when anemometers were swapped out on 28 Feb 2019. The propeller was replaced with the correct model (20 Nov 2019) and actions are underway to correct databases. Observations are archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/.