# PALMER STATION MONTHLY SCIENCE REPORT

# JANUARY 2020

**First giant petrel hatch on Humble Island.** *Image Credit: Fraser group*

## NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

What a successful and busy month it has been! On 3 January 2020, the ARSV *Laurence M. Gould* returned to Palmer Station for the start of the month-long LTER cruise. The arrival brought a buzz of activity and several new grantee groups – we welcomed B-005-P (Kohut), C-020-P (Steinberg), and C-024-P (Friedlaender). There were also a slew of grantees who departed and arrived from other groups.

Additionally, we welcomed Andrew Thompson (W-222-P, Doherty/BBC) to station on 20 January 2020, a BBC Director of Photography working on a new series focused on the work of Dr. Bill Fraser of the C-013-P (Fraser) team. Andrew Thompson embedded with the C-013-P team, visiting islands to tell the story of the contrasting fates of Adélie and gentoo penguin populations in the region. He will wrap up filming and depart station in early February.

The C-020-P (Steinberg) group was able to sample at Stations B and E at local midnight on two occasions this month, in a trial of night sampling. On 16-17 January and 30-31 January, the group conducted their typical net tows and echosounder surveys between 2300 and 0300, with support from the ASC Marine Technicians, OSAR team, Communications Technician, Station Manager, and other members of ASC staff and ASC Centennial staff. The night samplings were paired with day samplings for local noon that were approximately 12 hours apart.

Overall, sea ice conditions were minimal this month, with increased influence of glacial calving creating frequent coverage of growlers and bergy bits in the Arthur Harbor, Hero Inlet, and surrounding areas, especially in the second half of the month. Weather conditions have been calm, and sea state resultantly similar, leading to very high success rates for grantee groups sampling in the field.

**JANUARY 2020 WEATHER**
Marissa Goerke, Research Associate

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|---|
| **Temperature** |
| **Average:** 3.0 °C / 37.4 °F |
| **Maximum:** 10.3 °C / 50.5 °F on 7 Jan 21:22 |
| **Minimum:** -1.2 °C / 29.8 °F on 17 Jan 08:20 |
| **Air Pressure** |
| **Average:** 985.4 mb |
| **Maximum:** 995.3 mb on 1 Jan 07:43 |
| **Minimum:** 974.2 mb on 29 Jan 19:27 |
| **Wind** |
| **Average:** 4.7 knots / 5.5 mph |
| **Peak (5 Sec Gust):** 42.0 knots / 48.0 mph on 25 Jan 05:21 from E (87 deg) |
| **Prevailing Direction for Month:** N |
| **Surface** |
| **Total Rainfall:** 29.5 mm / 1.16 in |
| **Total Snowfall:** 0.0 cm / 0.0 in |
| **Greatest Depth at Snow Stake:** 20.0 cm / 7.8 in |
| **WMO Sea Ice Observation:** 6 to 10 bergs, bergy bits, growlers |
| **Average Sea Surface Temperature:** 1.6 °C / 34.9 °F |

The high temperature in January was 50.5° F and averaged 37.4° F. Winds were calm and variable for most of the month with a few intermittent storms. All snow stakes have melted out.

**B-005-P: COLLABORATIVE RESEARCH: PHYSICAL MECHANISMS DRIVING FOOD WEB FOCUSING IN ANTARCTIC BIOLOGICAL HOTSPOTS.**

Dr. Josh Kohut, Principal Investigator, Rutgers University, Institute for Marine and Coastal Sciences; Dr. William R. Fraser, Co-PI, Polar Oceans Research Group; Dr. Kim Bernard, Co-PI, Oregon State University; Dr. Harper Simmons, Co-PI, University of Alaska, Fairbanks; Dr. Matthew Oliver, Co-PI, University of Delaware; Dr. John Klinck, Co-PI, Old Dominion University

Personnel on station: Ashley Hann, Josh Kohut, Matt Oliver, and Hank Statscewich.

This past month at Palmer Station, we have been able to fully deploy our polar ocean observing system. This network includes three autonomous underwater gliders, three moorings, three High Frequency Radar (HFR) stations, RHIB surveys, and a profiling LISST-HOLO holographic imaging sensor.

The first two weeks on station were very busy. With great cooperation and coordination with ASC, NSF, and the Palmer LTER grantees, our SWARM team quickly overcame the challenges of heavy ice conditions in November and December 2019. Within days of arriving on station, we were able to offload all our HFR cargo to the Joubin Island site from the ARSV *Laurence M. Gould* (LMG), and construct that site to full operation. The Joubin effort cannot be understated - our team and an enthusiastic team of LTER grantees and ASC staff were able to move 11,000lbs of gear from the LMG to a remote island site in half a day! In the middle of that install, we also deployed our three moorings along a line that transects the canyon (Fig. 1; yellow and red circles). These data will track relative changes across the canyon of the hydrography and zooplankton communities.

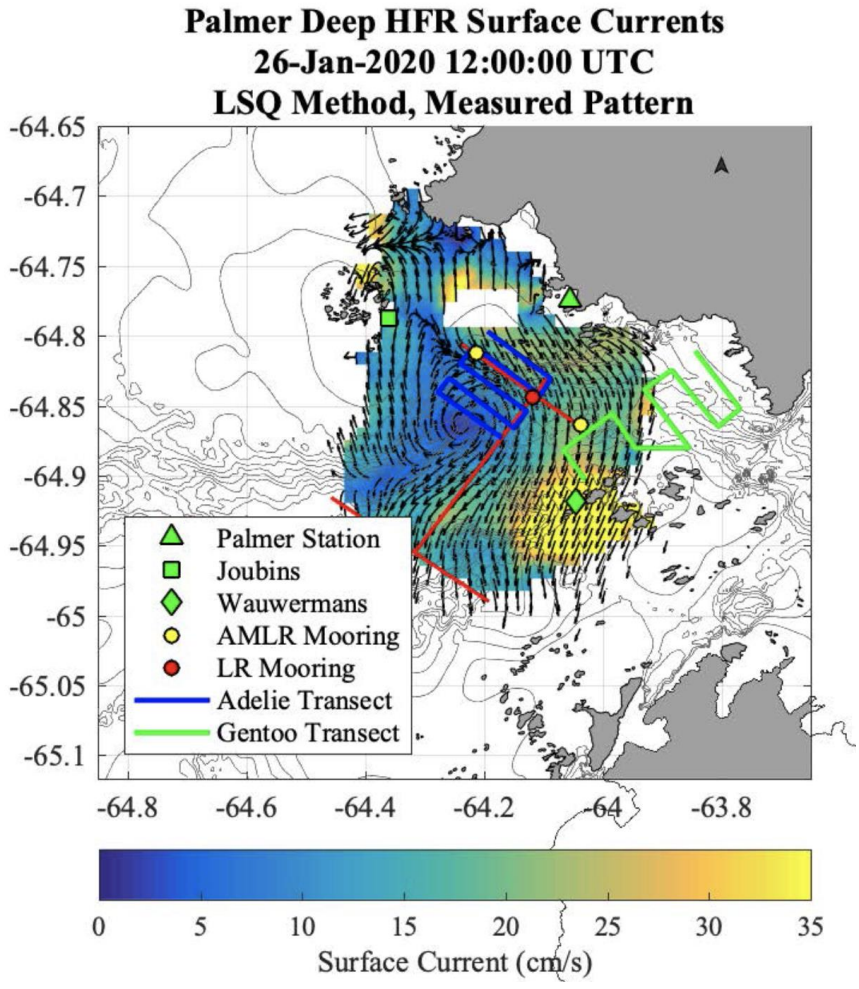


**Fig. 1** – An overview of the SWARM project deployed instrumentation and study sites, with a color-mapped overlay of the regional High Frequency Radar (HFR) derived surface currents (cm $s^{-1}$, color mapped data) from 26 January 2020 at 1200 UTC.

*HF Radar:* Since the installation of the third HFR site at the Joubin Islands in early January 2020, our three site network has operated continuously throughout the month. Data was delivered in real time to our central processing computer in Terra Lab. Real-time maps of surface currents were calculated each hour across the Palmer region (Fig. 1). Over the month, we visited each site in the network, and completed required maintenance and calibrations. Since the remote power modules were installed at the Joubin Islands (January 2020) and Wauwermans Islands (November 2019), the battery bank has not dropped below 25.5 volts at either site. This indicates there has been plenty of charging from the sun and wind to keep the systems running continuously.

*Glider AUVs:* On 8 Jan 2020, two gliders were deployed. The University of Alaska, Fairbanks (UAF) glider was tasked on a line that runs along the main axis of the Palmer Canyon. The University of Delaware (UD) glider was tasked on a cross-Canyon line. Each of these two gliders are equipped with a CTD, optics instrument, dissolved oxygen sensor, and a single frequency echo sounder. Additionally, the UD glider has a PAR sensor to correct for non-photochemical quenching effects on the fluorometers. Two days later, the Rutgers glider was deployed and tasked to station-keep at the intersection of the two glider lines above our long term mooring (Fig. 1; red circle). The Rutgers glider is equipped with the same CTD, optics instrument, and dissolved oxygen sensor as well as a 3-channel echosounder. All three gliders have lithium primary batteries with enough endurance to remain on our sampling grids until their planned recoveries in early March 2020.

*RHIB Surveys:* Coordinating with the LTER and Palmer Station MTs, we have been able complete six surveys of the combined Adélie and Gentoo Transects, and one additional Adélie transect (Fig. 1; blue and green lines). This survey is approximately 55nm long and centered on the historic foraging range of tagged Adélie and gentoo penguins. The survey includes the RHIB mounted EK80 echosounder and the UAF-provided towed ACROBAT system. These two allow us to survey the hydrography, phytoplankton, and zooplankton structure along these transects. An example of the data collected during these surveys is shown in Figure 2. The survey has revealed complex variability in the oceanography matched to the observed ecological variability. These survey data are coordinated with the mooring and glider lines discussed above. Through a collaborative effort with the Palmer LTER team, the RHIB has also supported multiple adaptive activities including net tows to ground truth the acoustics, night zooplankton sampling, and an along canyon LISST Holo survey to image particles below the mixed layer.

*Penguin Telemetry:* As part of the Palmer LTER project, the C-013-P (Fraser) group tagged 50 penguins (both Adélie and gentoo) with GPS positioned tags and time depth recorders. They will continue to switch out transmitters until the chicks fledge. In general the chicks are fledging earlier than expected this year. Consequently, tagging has stopped on Torgersen Island and will finish up shortly on Biscoe Point. The penguins have been foraging within the HFR range and occasionally, near the gliders in Palmer Deep.

*Broader Impacts:* To date we have published two data SWARM activities. These activities are designed to engage the middle and high school students in Delaware, New Jersey, and New York to investigate the same data plots we are looking at here at Palmer. The content of the first edition was focused on the RVIB *Nathaniel B. Palmer* transect of Palmer Deep conducted during our November 2019 cruise. The second was focused on the HFR surface current maps (i.e., Fig.

1). The students following the data SWARM activities interacted directly with the grantees through two 30-minute blackboard session VTCs.

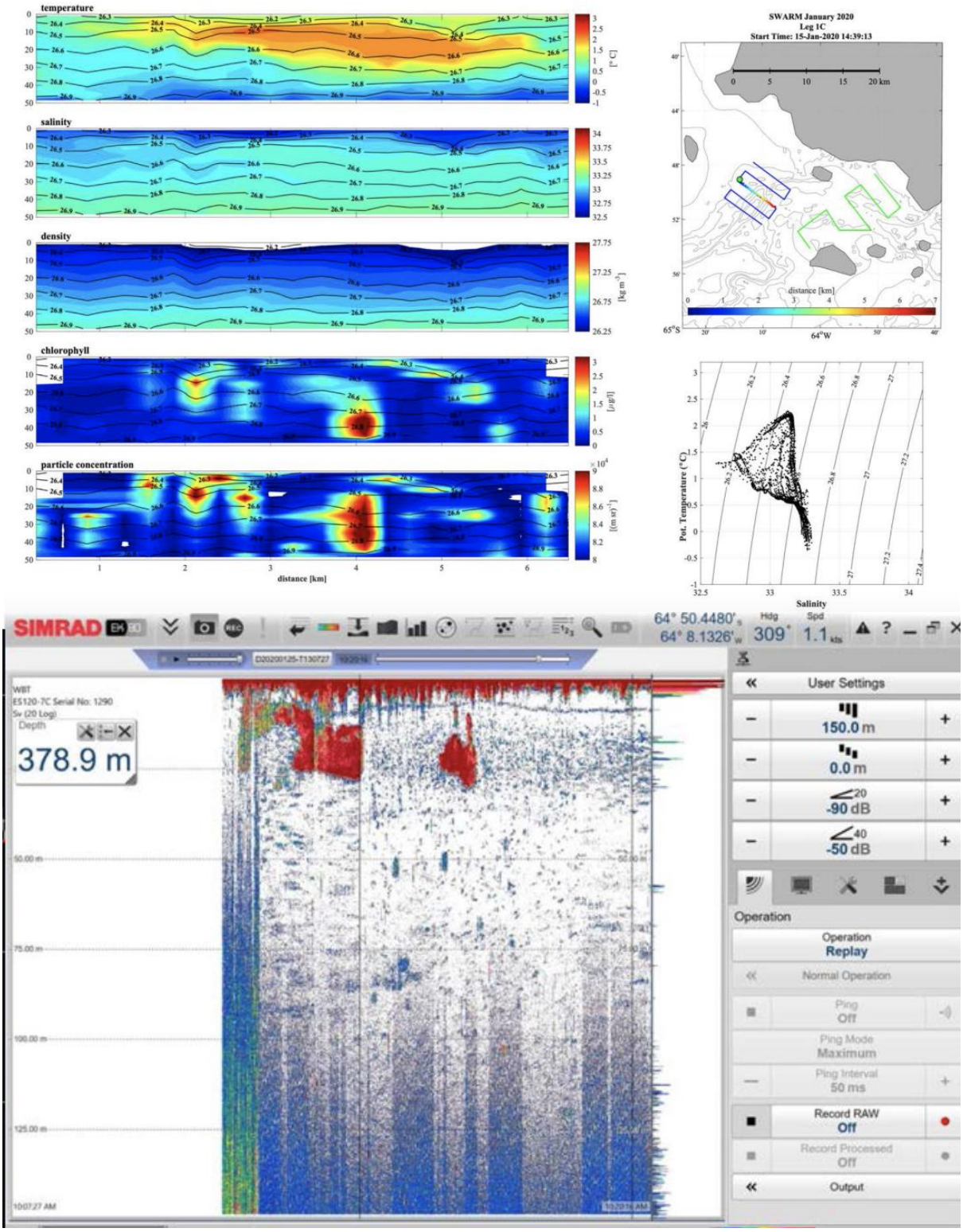


**Fig. 2** – An example of the data collected during the Adélie and Gentoo Transects aboard RHIB *Hadar*. ACROBAT survey data (upper left panel), cruise tracks (upper right panel), TS plots (middle right panel), and EK80 echosounder plot (lower panel).

We would like to thank all station staff for their support of our project. We recognize the significant logistical support required for our project, including boating, cargo, and information technology. We would also like to thank the Palmer LTER science team for their partnership and collaboration. This success we have accomplished so far this season would not have been possible without the coordination with the LTER team and ASC. All involved have been able to find every efficiency that enable the science objectives of both programs to be met. We are very happy to work in this collaborative environment and are seeing the direct benefits in what we have collectively accomplished. Through all the planning, the communication has been so critical to this success.

**B-027-P: ASSEMBLAGE-WIDE EFFECTS OF OCEAN ACIDIFICATION AND OCEAN WARMING ON ECOLOGICALLY IMPORTANT MACROALGAL-ASSOCIATED CRUSTACEANS IN ANTARCTICA.**

Dr. James McClintock and Dr. Charles Amsler, Principal Investigators, University of Alabama at Birmingham

Personnel on station: Charles Amsler, Margaret Amsler, Hannah Oswalt, and Julie Schram.

January was a busy month devoted to initiating our project's main ocean acidification experiment. The experiment uses the two northern (window-side) inside, round aquarium tanks to maintain temperatures as close to the natural, ambient Arthur Harbor water temperature as the heat-traced station seawater system allows. As illustrated in Figure 3, water for the experiment feeds into a header tank ('mesocosm tank' from prior B-022-P seasons) that is mounted in place of one of the upper cascade tanks. It flows through insulated tubing to individual water distributors in each round tank that in turn feed the water through mixing tanks into 12 experimental buckets.

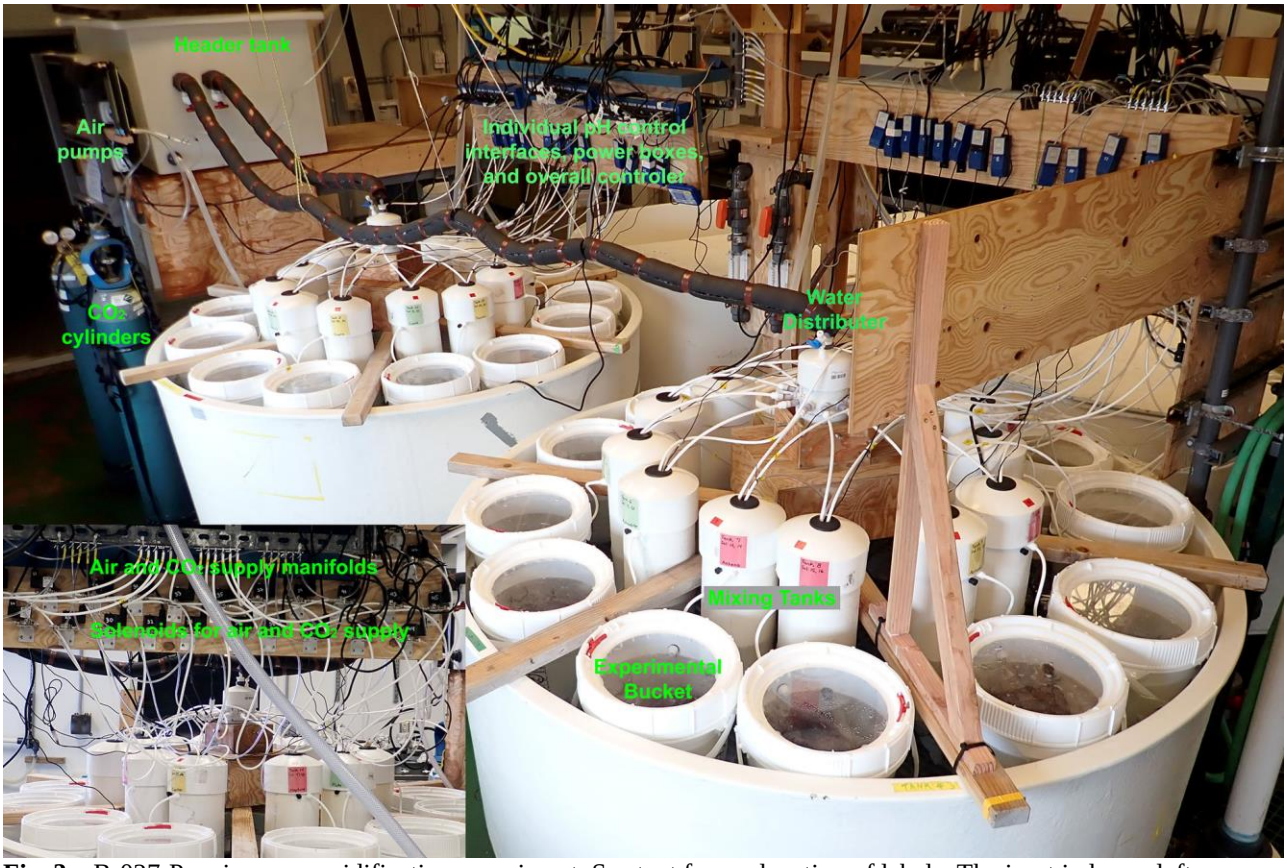


**Fig. 3** – B-027-P main ocean acidification experiment. See text for explanation of labels. The inset in lower left shows the back of the plywood panel labeled "Individual pH control interfaces…" on the main image.

In addition to tubing for water coming from the water distributors, each mixing tank has an air input line, a $CO_2$ input line, and a pH electrode. The pH electrode in each tank is connected to an individual pH control interface and through that to an overall pH controller for each set of 12 mixing tanks. The pH controller individually regulates the flow of air and $CO_2$ into each mixing tank via power boxes which turn on and off solenoids to maintain pH levels set in the overall

controller via a USAP-supplied laptop computer. The addition of $CO_2$ lowers the pH in the mixing tanks while the addition of air increases the pH (assuming it is below ambient), allowing pH to be maintained at set levels in the mixing tanks with only small, short-term temporal variations. These small temporal pH variations in the mixing tanks are dampened out in the larger volume experimental buckets, allowing precise pH control in the buckets. The experimental pH levels are ambient, near-future pH 7.7, and more distant future pH 7.3. The ambient pH is currently between pH 8.1 and 8.2 because of the recent phytoplankton bloom, but our previous work has shown that it should soon decrease to pH 8.1 and maintain that level for most of the year.

We had originally hoped to manipulate both pH and water temperature with two levels (ambient and near-future) for each. Unfortunately, our set-up did not provide sufficient water head pressure to enable us to plumb incoming water into the bottom of the experimental buckets. Consequently, we have had to add water at the top and drain it via tubes from the bottom of the buckets. The warm water coming in at the top did not mix quickly enough to prevent substantial thermal stratification in the buckets. Instead we have three pH levels and a greater sample size (eight vs. six) in each treatment. Our previous work showed that the impacts of pH were much greater than those of temperature (which had no effect at all except in combination with pH), so we are comfortable with this modified experimental design.

The experimental buckets each contain 80g of the overstory brown macroalga *Desmarestia menziesii* that was seeded with epiphytic diatoms for several weeks in 'mesocosm tanks' setup on the outside aquarium deck. We collected and weighted new, entire *D. menziesii* individuals from five different sites near Palmer, and gently but quantitatively removed their associated amphipod assemblage. The amphipods from the five sites were combined and divided with multiple splits in a plankton splitter into the equivalent proportion of amphipods that were representative of 80g of *D. menziesii* in nature. *D. menziesii*, like almost all of the macroalgal species here, is chemically defended from being consumed by amphipods, but the amphipods instead eat epiphytic algae on the larger macroalgae. The pre-seeding of epiphytic diatoms provides an ample supply of diatoms as food for the amphipods and we have also added several grams of *Palmaria decipiens*, a red macroalga that is unusual in being palatable to local consumers (although only some amphipod species have mouth parts that enable them to eat it). The experiment will be maintained until early April to determine which amphipod species are relative 'winners' and relative 'losers' under future ocean acidification levels.

In the laboratory, we have begun daily monitoring of seawater carbonate chemistry in the experimental buckets. We are using a grantee-supplied titrator to measure alkalinity. A USAP spectrophotometer with water-jacket-temperature-control is used to measure pH with high precision and accuracy for comparison with daily pH electrode measurements in the experimental buckets and the continuous measurements in the mixing tanks.

In support of these activities, we made 20 scientific scuba dives over 12 days in January. All dives were within the standard Palmer boating limits.

We are grateful for the generous and professional assistance of numerous ASC staff in meeting our goals. Laboratory Supervisor Randy Jones and Instrument Technician Carolyn Lipke have provided outstanding support in the aquarium and lab. The FMC crew provided valuable assistance in the construction of our experiment. The Palmer Marine Technicians, Mike Burns, Patrick Riley, and Otto Neumuth, facilitated our diving activities.

**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: Megan Cimino, Bill Fraser, Megan Roberts, Darren Roberts, Anne Schaefer, Leigh West

The arrival of Bill Fraser and Megan Cimino (LTER cruise participant) in early January 2020 briefly increased C-013-P personnel at Palmer Station to six. In early January, Anne Schaffer and Leigh West departed on the annual LTER cruise leaving four birders at Palmer Station for the remainder of the month.

We were able to conduct boating field work on 30 days in January 2020. Monitoring of Adélie, gentoo, and chinstrap penguin breeding chronology continued this month with indicator colony counts, as well as an all-colony chick census on local islands and on Dream and Biscoe Islands. Adélie chick measurements also occurred in conjunction with our LTER cruise team's measurements on Avian Island. Foraging ecology studies of Adélie and gentoo penguins continued this month with the deployment of presence/absence radio transmitters, GPS tags, and dive depth recorders at Torgersen Island, Humble Island, and Biscoe Point. We also began deployments of GPS tags and dive depth recorders on gentoo penguins in the Joubin Islands. We began diet sampling Adélie penguins on Torgersen Island. Diet sampling began with gentoo penguins at Biscoe Point. In total we were able to deploy a total of 64 tag packages on penguins. Fourteen of those were radio transmitters that are a part of our presence absence study.

**Indicator colony counts at Biscoe Point.** *Image Credit: Fraser group*

**Brown skua adults and chicks** *Image Credit: Fraser group*

Skua work continued this month documenting hatches and monitoring chick growth of brown skuas on local islands as well as on Dream, Biscoe, and the Joubin Islands. South polar skua nesting was also documented on Shortcut Island. Monitoring of the blue-eyed shag colony on Cormorant Island also continued this month. In January, we maintained GPS tagging effort on giant petrels and continued our local island giant petrel census and banding project that was initiated in December. Our annual Humble Island giant petrel study began in January, which closely records petrel chick survival and growth from hatching through fledging.

Monitoring of marine mammals continued in January with increasing numbers of molting elephant seals as well as an increase of Antarctic fur seals to the Palmer area. We also observed humpback, and minke whales. Lab work this month was dominated by penguin diet sample processing.

**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: Katherine Hudson and Schuyler Nardelli

This month we temporarily said goodbye to Rachael Young as she switched to the C-020-P (Steinberg) group. We welcomed Schuyler Nardelli, a PhD candidate in oceanography at Rutgers University, who returns for her fourth season at Palmer Station.

January 2020 was a busy month filled with lots of collaboration! Routine bi-weekly sampling and analysis continued at Stations B and E. The late December phytoplankton bloom, initiated by high winds and mixing of the upper water column (Fig. 4A), continued into early January and petered out around 10 January (Fig. 4B). Chlorophyll values remained low the rest of the month. Primary production followed similar trends to chlorophyll.

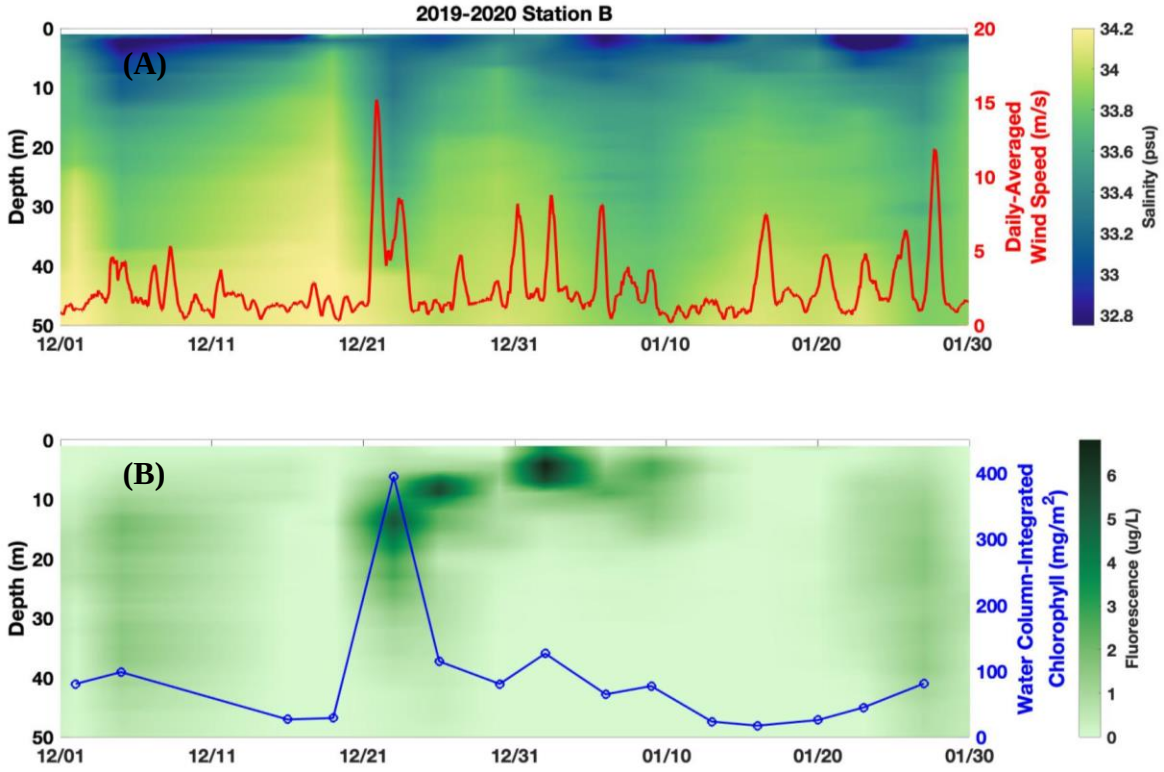


**Fig. 4** – (A) Time-series of Station B interpolated salinity (psu; color map data) from CTD casts overlaid by daily-averaged wind speed (m $s^{-1}$) from the Palmer Backyard Automated Weather Station (red line); and (B) time-series of Station B interpolated chlorophyll fluorescence (µg $L^{-1}$, color mapped data) from CTD casts overlaid by water-column integrated chlorophyll (mg $m^{-2}$; blue line).

The LTER acoustic surveys became a larger cooperative effort as we welcomed Project SWARM to station, bringing with them an ACROBAT tow body system equipped with temperature, salinity, and optical sensors. The ACROBAT is towed behind the RHIB while

simultaneously running the EK80 echosounder, collecting high resolution physics and optics profiles to accompany the krill distribution data (Fig. 5) and visual predator surveys. This month we completed seven surveys along the Adélie Transect across the Palmer Canyon region, and six surveys along the Gentoo Transect across the Bismarck Strait region near Biscoe Point, setting a new monthly record for these collaborative surveys!

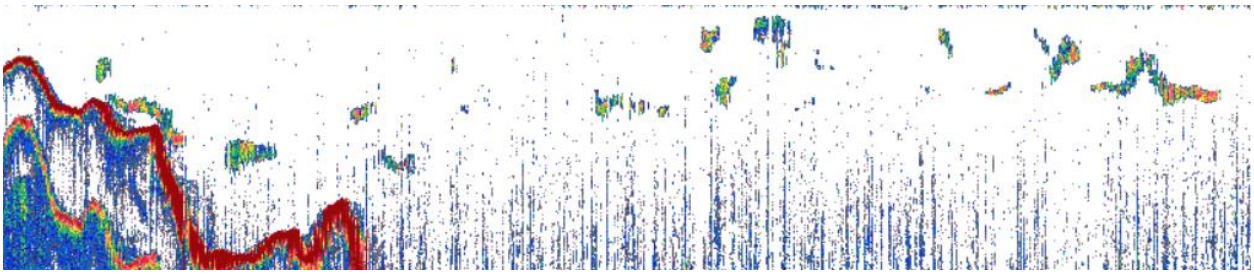

**Fig. 5** – 120kHz acoustic data collected with the EK80 echosounder on RHIB *Hadar*. The colored patches are krill swarms found just south of Outcast Island.

As always, all of our science would not be possible without the immense support from ASC. A special shout out to our Marine Technicians (Mike Burns, Otto Neumuth, and Patrick Riley) for supporting our busy boating schedule, and to Laboratory Supervisor Randy Jones and Instrument Technician Carolyn Lipke for supporting all our laboratory needs.

## C-020-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – ZOOPLANKTON COMPONENT

Dr. Deborah Steinberg, Principal Investigator, College of William & Mary, Virginia Institute of Marine Science

Personnel on Station: Jack Conroy and Rachael Young

Jack Conroy, a fourth-year PhD student at the Virginia Institute of Marine Science arrived at Palmer Station in early January 2020. Rachael Young, a field researcher with the Palmer LTER program, rotated from the phytoplankton component to the zooplankton component this month. This is the group's third consecutive field season studying zooplankton community structure and feeding ecology from Palmer Station. Repeated sampling from Palmer Station complements the spatial data collected by the Palmer LTER zooplankton team aboard ARSV *Laurence M. Gould* this month.

After arriving at Palmer Station on 3 January 2020, zooplankton field sampling began on 6 January. Fair weather along with stellar scientific and boating support led to a productive month. The zooplankton team conducted 97 net tows from RHIB *Hadar*. LTER time series Stations B and E were occupied on nine dates from 3 January to 3 February. No scheduled sampling days were missed. Samples were processed for taxonomic identification, biomass measurement, and gut pigment measurement. The gelatinous salp *Salpa thompsoni* dominated the zooplankton community, and the salp bloom led to very high numerical abundance, biomass, and grazing impact (Fig. 6).

**Fig. 6** – Cod end full of aggregate *Salpa thompsoni* individuals after a net tow. *Image Credit: Ashley Hann*

On two occasions, daytime zooplankton sampling was paired with night sampling. After sampling Stations B and E around local noon on 16 January and 30 January, the stations were re-occupied around solar midnight (Fig. 7). These paired sampling efforts revealed the extent and impact of zooplankton diel vertical migration. Despite 19 hours of daylight on 16 January and 17.5 hours of daylight on 30 January, vertically migrating zooplankton were more abundant at night than during the day. Some taxa collected at night were previously unobserved during day sampling throughout three summer field seasons.

Two feeding selectivity experiments were conducted with juvenile Antarctic krill *Euphausia superba* from 6 to 7 January and from 24 to 25 January. After acclimation, juvenile krill were incubated for twenty-four hours to assess their grazing selectivity and impact. Samples were collected for fluorometric analysis of chlorophyll *a* and preserved for microscopic and flow cytometric analysis of the phytoplankton community. The first experiment was conducted under relatively high phytoplankton biomass conditions while the second experiment provided a nice comparison with low phytoplankton biomass. This experimental data will be compared to eleven

**Fig. 7** – View from RHIB *Hadar* departing Palmer Station to LTER Station E for night zooplankton sampling on 16 January. *Image Credit: Jack Conroy*

other experiments conducted over the previous two field seasons. *In situ* grazing rates were also repeatedly estimated at Stations B and E by measuring phytoplankton pigment concentrations in krill. Finally, krill samples were collected throughout January for stable isotope analysis.

The zooplankton team conducted bioacoustic surveys in conjunction with net sampling. This work is tightly coupled with that of other Palmer LTER science groups and Project SWARM collaborators. Concurrent echosounder surveys and targeted net tows near Project SWARM's acoustic moorings and autonomous underwater vehicles suggests the sound scattering signal of *E. superba* krill may be readily distinguishable from salps (Fig. 8). Zooplankton team members participated on collaborative hydrographic, acoustic, and predator surveys in the Adélie and Gentoo penguin foraging regions.

Thank you to our Project SWARM and LTER colleagues for strong teamwork that made January a very productive and fun month. We particularly thank Ashley Hann who joined us for zooplankton sampling and processing.

Thank you to Palmer Station staff for enabling a jam-packed month of science. In particular, the preparation and hard work from science and boathouse personnel allowed us to fully capitalize on our time here.

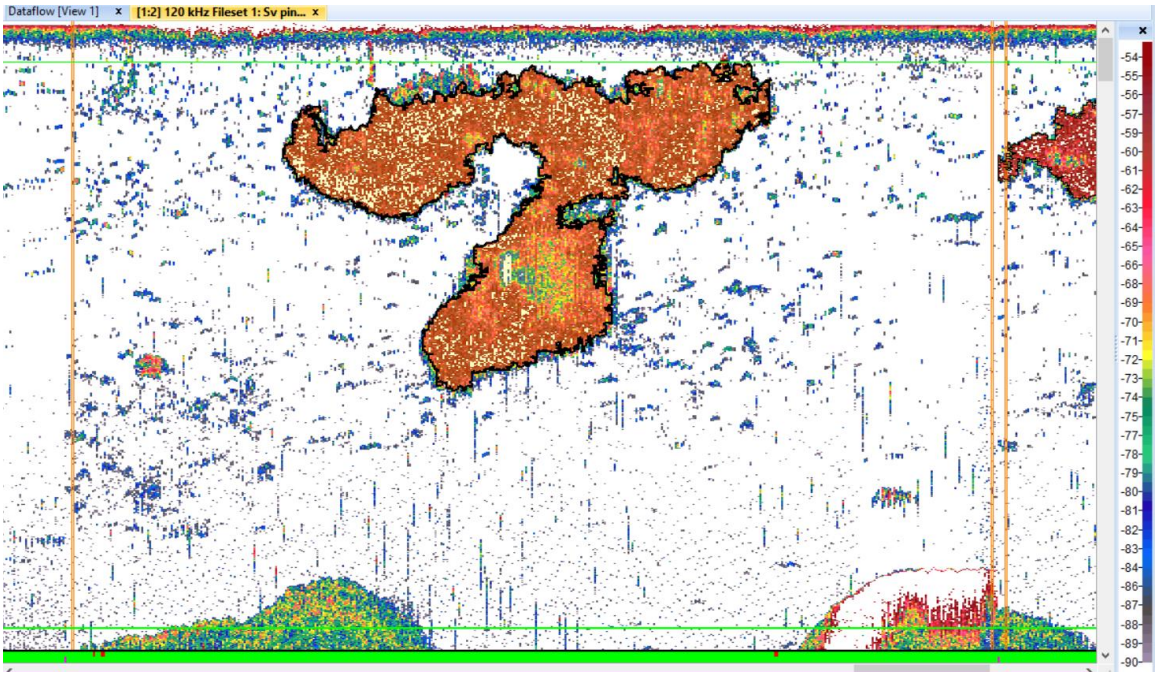


**Fig. 8** – Echogram collected during a net tow. The red shape indicates densely aggregated krill while blue streaks indicate diffusely distributed salps. *Image Credit: Schuyler Nardelli*

## C-024-P: PALMER, ANTARCTICA LONG-TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – WHALE COMPONENT

Dr. Ari Friedlaender, Principal Investigator, University of California, Santa Cruz, Santa Cruz, CA

Personnel on Station: Ari Friedlaender and Greg Larsen

*Whale Survey, Photo-ID, and Biopsy Efforts*: January marked the start of the 2020 season for the C-024-P group—PI Dr. Ari Friedlaender with additional field team members Greg Larsen on station and Ross Nichols and Amanda Lohmann on the ARSV *Laurence M. Gould*. The group's main research hypotheses are focused on understanding the behavior, ecology, life history, and demography of baleen whales in the waters around Palmer Station and, in the broader ecosystem, the potential for competition and partitioning between baleen whales and other krill predators. Primary research objectives are addressed through a combination of visual surveys, tissue biopsy sampling, photographic cataloging, drone-derived measurements, foraging and movement behavior from archival motion-sensing tags, and integration of these data with seasonal and oceanographic parameters (e.g., krill abundance measured from echosounders) and data on similar foraging and movement behavior of local penguins. The two field team members based at Palmer Station conduct research in the boating and extended boating areas, while the two additional team members on the LMG collect similar information across the LTER oceanographic sampling grid.

We, the station team, conduct daily visual surveys in the standard boating area around Palmer Station, and utilize the "extended" and "beyond-extended" boating areas whenever possible to expand our spatial range of observation. During these trips, photo-ID, biopsies, and drone-derived measurements are collected opportunistically whenever whales are encountered. Following a high abundance of humpback whales in late-December 2019 (as described by station personnel), January 2020 has yielded consistent but low numbers of humpback and minke whales. As of 31 January, we at station have conducted over 75 hours of surveys, during which time we have observed 83 humpback whales and 8 minke whales, collecting 64 biopsy samples (61 humpback, 3 minke), 69 individual animal flukes for individual ID (plus 37 photo sets collected by station personnel before we arrived), and drone-derived morphometrics for 19 humpback whales. We have also deployed two motion-sensing archival tags on humpback whales from station. A time-depth plot from one individual humpback whale shows an extended period of likely surface feeding (including bubble-net feeding) from the time of tag deployment at 1330 local time until approximately 0500 the following morning when the whale then stopped feeding and transited to the west side of Anvers Island before shedding the tag at approximately 1130 the following day (Fig. 9).

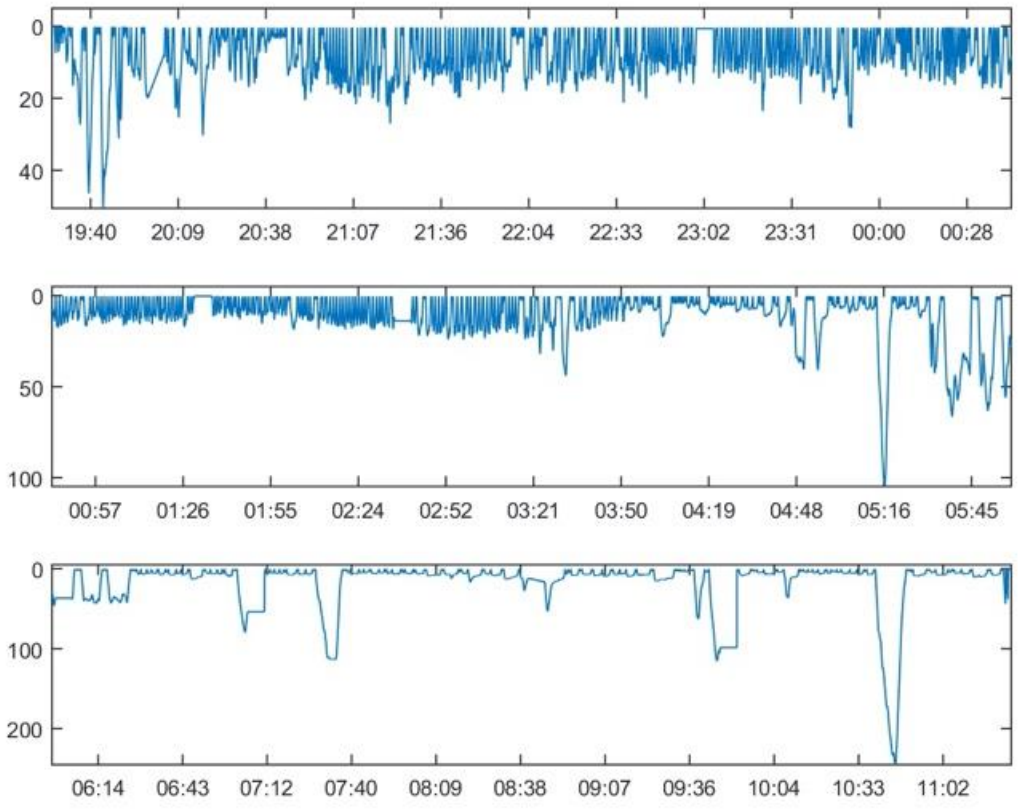


**Fig. 9** – Time-depth profile from a motion-sensing tag deployed on a humpback whale near Palmer Station in January 2020. The plot shows shallow feeding throughout the night hours until approximately 0500 when the whale then began transiting.

The biopsy samples (Fig. 10) will be used for a suite of analyses regarding the health, demography, and reproductive rates of baleen whales as they recover from commercial whaling (humpback whales) and respond to the ecological and environmental changes taking place along the Antarctic Peninsula (humpback and minke whales). Demographic parameters like pregnancy

rates will be contextualized relative to interannual variability of regional environmental conditions including sea ice and krill availability to better understand how changes affect the ecology and population dynamics of humpback whales. A subset of these samples will be used to test for persistent organo-pollutants and the presence of endocrine disruptors that may indicate exposure to microplastic pollution. These samples will also be evaluated to determine the breeding stock of the population of whales feeding around Palmer Station. This is done by comparison of haplotype frequencies with those collected from animals in Southern Hemisphere breeding grounds. Currently, we estimate that ~95% of the whales encountered around Palmer Station are from Breeding Stock G that winters on the west coast of Central and South America.

**Fig. 10** – Biopsy dart with biopsy visible at the time of collection from individual Mn20_029A_P, sampled on 29 January 2020. Samples of skin and blubber are used for a variety of analyses that characterize the health, structure, and status of whale populations near Palmer Station and elsewhere on the west Antarctic Peninsula. Image collected under ACA Permit 2020-016 and NMFS Permit 23095.

Cursory examination of our fluke catalog for this year has shown generally low residence times for humpbacks in the Palmer Station survey area so far, with only a few exceptions. One whale that was resighted and tagged four days after its first encounter (individual Mn20_021H_P) and another whale that was resighted 11 days after its first encounter near station (individual Mn20_30A_P). This matches our general understanding from previous seasons that most humpback whales do not reside near Palmer Station for continuous stretches of time. This low residency time is also corroborated by our historic tag data that shows whales using extended spatial areas for feeding during summer months before moving inshore and decreasing their home range sizes towards the end of the feeding season.

*Extended boating surveys:* The C-024-P team at Palmer Station this year has also completed several survey efforts in and beyond the extended boating area. These have included trips to Dream Island, Biscoe Point, Joubin Islands, and Wauwermans Islands, which have enabled us to access whales at times and places when they are sparse in the standard boating area. ASC staff and other science groups have provided the required support for us to boat in these areas, and we are grateful for this assistance.

*UAS Operations:* Unoccupied aircraft systems (UASs or drones) are a critical new tool in cetacean research at Palmer Station (and now in all areas where cetaceans are studied). Aerial photography, when paired with precise altitude measurements, enables analysts to measure

dimensions of a whale's body with high precision and accuracy (Fig. 11). These measurements contribute to analyses of whale anatomy and physiology, and comparisons across time and space can address broader questions of foraging ecology and prey consumption in different regions and periods of the feeding season. Though a secondary priority for our field team, occasionally aerial photography and video can also capture cetacean behaviors that are difficult to discern and describe from observations at sea-level (Fig. 12).

**Fig. 11** – UAS photograph of a solitary whale surfacing to breathe between feeding bouts in the Southern Boating Area near Palmer Station on 25 January 2020. A photograph like this is ideal for whale photogrammetry, showing the whale near the water's surface with a clear outline of the body and minimal distortion from the surf. Image collected under ACA Permit 2020-016 and NMFS Permit 23095.

In addition to whale photogrammetry (measurement by photography), drones can be used to map objects and regions in high resolution and three-dimensions for scientific analysis, yielding orthomosaic maps and digital surface models of habitats and their physical terrain. This is accomplished through photo stitching and a process called "structure from motion": a high volume of overlapping photographs are collected from different locations by an aerial platform (e.g., a drone flying a grid-shaped flight plan). Photos are then stitched together based on common features and the known GPS location of the drone and camera. Based on the displacement of objects when viewed from different known angles (parallax) their dimensions can be calculated. Here at Palmer, we are using drones to (1) locate seals and seabirds within their habitats by this mapping technique (Fig. 13), (2) determine relative changes in species abundance by repeatedly mapping select sites throughout the summer season, (3) quantify the topographic characteristics of these habitats from our three-dimensional maps, and (4) estimate

habitat affinities of these species based on their association and avoidance of different topographic characteristics.

UAS operations have been greatly successful this year, with two identical crafts being deployed for whale photogrammetry and pinniped habitat mapping flights, respectively, and each craft serving as a redundant backup system for the other. In the month of January 2020, our team conducted 58 successful UAS flights near Palmer Station: 4 test flights, 21 flights for whale photogrammetry, and 33 flights for pinniped habitat mapping. The whale photogrammetry flights have taken place throughout the standard and extended boating areas, and habitat mapping flights have taken place over 9 different sites of pinniped terrestrial occupancy near Palmer Station.

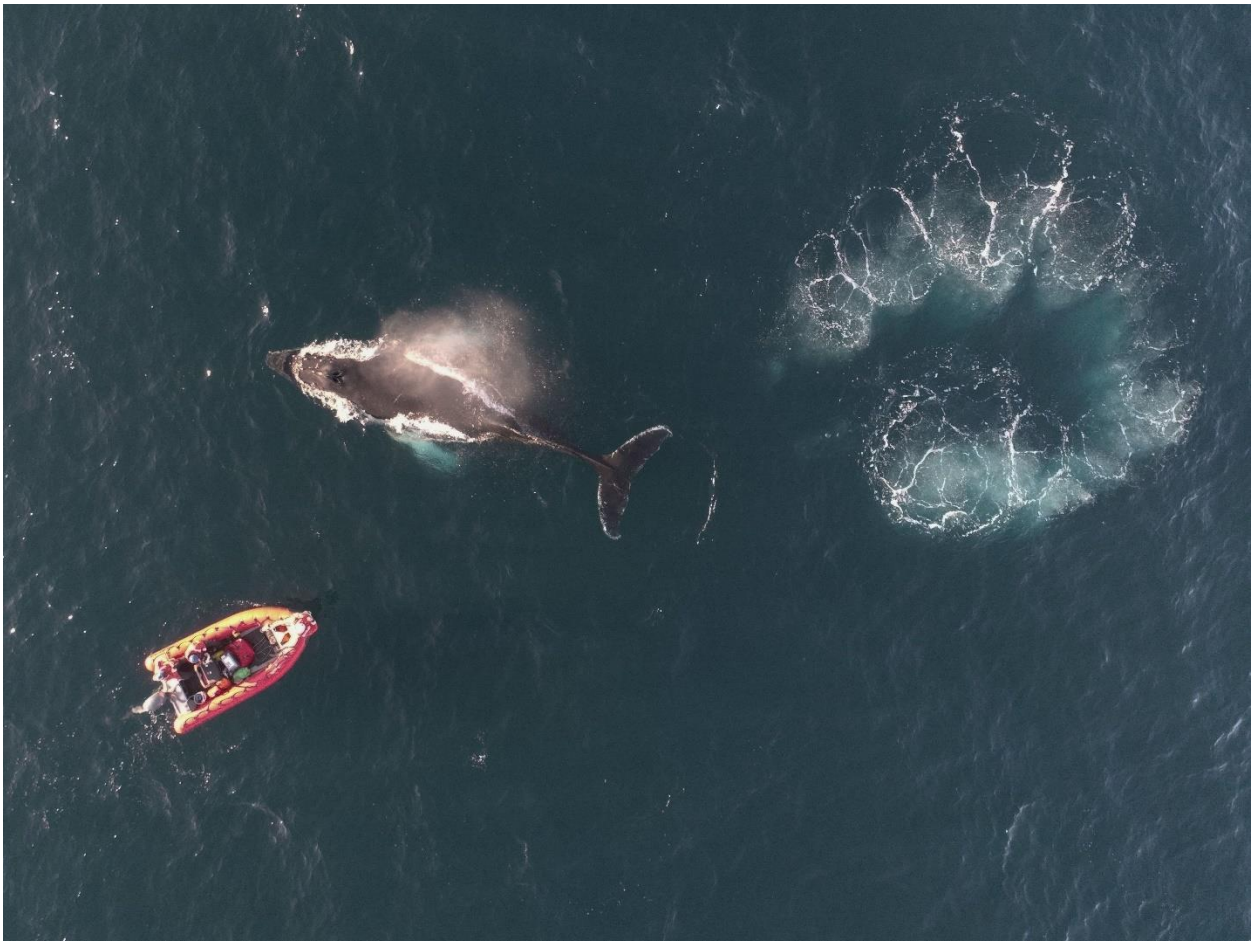

**Fig. 12** – UAS photograph of a solitary whale found bubble-net feeding in the Southern Boating Area on 17 January 2020, collected during a whale photogrammetry flight. Photographs and videos from drones can reveal aspects of this behavior (e.g., its timing and spacing) that would not be discernible from a boat. Image collected under ACA Permit 2020-016 and NMFS Permit 23095.

**Fig. 13** – UAS photograph of southern elephant seals hauled out in close proximity to a breeding group of Adélie penguins on Humble Island, collected during a habitat mapping flight. Image collected under ACA Permit 2020-016 and NMFS Permit 23095.

## 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: Pablo Cardenas and Nick Mehmel

C-045-P welcomed a new lab member, Pablo Cardenas, to Palmer Station this month. The LTER cruise spanned 4 January to 5 February 2020, which brought several members to C-045-L to conduct research along the western Antarctic Peninsula. The cruise took with it our most important resource: the Accuri flow cytometer, for almost the entire month of January. We have been preserving samples in paraformaldehyde until the instrument returns to station. As a result, we do not have any new data to present regarding autofluorescence or Sybr Green counts from Stations B and E.

Regardless, sampling Stations B and E continued as usual, and not a single scheduled day was missed due to weather or ice. In addition, our lab members served as LTER representatives on several Adélie and Gentoo Transect days, which just this month began using an ACROBAT CTD to obtain higher resolution water column data along a gridline in Palmer Canyon and Deep. It is worth noting that data from these two sampling schema indicated a marked decrease in marine productivity near Palmer. Fluorescence measurements from our CTD frequently sat below 1 mg $m^{-3}$ through the entire water column at Stations B and E, indicating relatively low photosynthetic productivity. Echosounder profiles from the Adélie and Gentoo Transects also recorded a marked decrease in krill swarm abundance this month, coinciding with a large decrease in the observable whale population within Palmer station's standard and extended boating areas. Recorded penguin sightings along the two transects remained high throughout the month.

During the upcoming February 2020 port call, the current lab members will depart station and hand off sampling responsibilities to another technician, currently working on the LTER cruise.

**While local whale sightings dwindled in the month of January, penguin sightings remained abundant.** *Image Credit: Ducklow group*

**PALMER STATION**
**RESEARCH ASSOCIATE MONTHLY REPORT**

**January 2020**
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. The system was removed from the network due to the Windows 7 operating system. The system has been “winterized” to continue 100% data collection while remaining off the network. The system will be upgraded to a new computer running Windows 10 to resolve this issue. System weathered a 20 minute power outage on 17 January 2020 without complications.

## 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. System weathered a 20 minute power outage on 17 January 2020 without complications.

**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 despite the light and variable wind conditions that are common in January.

**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 successfully taken within one week of their target sampling dates due to light and variable wind conditions that are common in January.

**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 this month except for a few software (spectralink) hang ups. Bi-weekly absolute scans were completed as necessary without complications. System weathered a 20 minute power outage on 17 January 2020 without complications.

**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.

After the full upgrade during the recent site visit, it was observed that roughly 25% of the satellite passes were being received with a 50% success rate, resulting in imagery reminiscent of a barcode. An attempt was made to roll back the system to its previous configuration, but more issues arose and the system was placed back into the 75% operational configuration while Sea Space contacts engineer a solution to the problem. System weathered a 20 minute power outage on 17 January 2020 without complications.

**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. The survey equipment was used for the annual measurement of the glacier terminus recession and the first measurement of the height reduction in the glacier profile since 2013. System weathered a 20 minute power outage on 17 January 2020 without complications.

**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. Processed filters and sent logs as needed. System weathered a 20 minute power outage on 17 January 2020 without complications.

**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) operated normally throughout the month. The Wauwermans AWS and Joubin AWS were visited for yearly status checks. Joubin AWS suffered a two day outage from a hung software problem, which was resolved during a visit to the site. Observations are archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/.