

LMG 24-01: PAL LTER Cruise 31
Weekly Science Report 5, 21– 28 January 2024

LTERR: Ecological Response and Resilience to “Press-Pulse” Disturbances and a Recent Decadal Reversal in Sea Ice Trends Along the West Antarctic Peninsula

Week 5 overview (Dr. Deborah Steinberg, Chief Scientist):

In Week 5, we conducted our last Process Study (PS4) near Charcot Island in the far south, coastal region of our sampling area at regular LTER grid station -100.000 and in the deep waters of Charcot Canyon (-138.-013). Final experiments were conducted on diel variability in phytoplankton physiology and on zooplankton physiology. We also did diel sampling of zooplankton vertical distribution in the canyon with the MOCNESS. Humpback whales were feeding along the canyon edge. Upon completion of PS4 near Charcot we did our long transit (~35 hr.) north to Prospect Point and the Fish Islands for a seabird survey. While the islands were being surveyed, the rest of the group had a well-deserved afternoon break at Prospect Point (on the actual continent of Antarctica) on a stunning, sunny, blue-sky, calm-water day. We all much appreciated the opportunity to go ashore, and several of our young scientists told me it was “the best day of their life”. The good weather continued and enabled us next to return to Hugo Island for a successful installation of a new weather station there and to conduct a sea bird survey. Then it was back to Palmer Station for a 2-day cargo, sample, and personnel transfer which had to be conducted by small boats, as the same iceberg that delayed our leaving Palmer Station a month ago was still blocking the dock, preventing the ship from tying up. We are grateful to Palmer Station and LMG personnel for their flexibility that made this unusual port call work. After leaving Palmer Station late evening on Jan 26, our last science operations were to re-locate the A-1 mooring (for a future recovery operation, we hope), and recovery of two NOAA gliders.

I would like to thank Captain Ernest Stelly and the other ECO officers and crew, and Kris Hartin and the other ASC staff for an excellent cruise. Their competence and can-do, friendly attitude made my job a pleasure.

Group Reports

C- 021: Physical Oceanography (Dr. Carlos Moffatt, PI; U. Delaware)

Field Team Members: Michael Cappola (lead), Jake Gessay

This week, we installed a weather station on Hugo Island and recovered two gliders for the NOAA AMLR Group. The weather station was installed on January 24 20:32 UTC at -64.96335 S -65.66907 W, and is approximately 27 m above sea level (**Fig. 1**). The station was constructed of a steel tripod and mast anchored directly into the rock and it was stabilized with 6 steel guy lines. It has sensors to record wind speed and direction, air temperature, and barometric pressure. It transmits the data every 10 minutes utilizing short burst data (SBD) transmissions on the Iridium satellite network. The site we chose was at the top of “Hugo3” which is a small rocky island directly east of Hugo proper (**Fig. 1**). Being on top of the furthest island from the large glacier on Hugo proper, it is in an excellent position to record the oceanic conditions of the western Antarctic Peninsula continental shelf. In addition to being available for LTER related research, the data are being reported and archived with the Antarctic Meteorological Research Center at the University of Wisconsin-Madison for the wider Antarctic research community and

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the public. On Jan. 27, we recovered two gliders for the NOAA AMLR group (Fig. 2). These gliders were recovered just south of Hoseason Island in sheltered water. They were running a transect off Livingston Island in support of their research there.

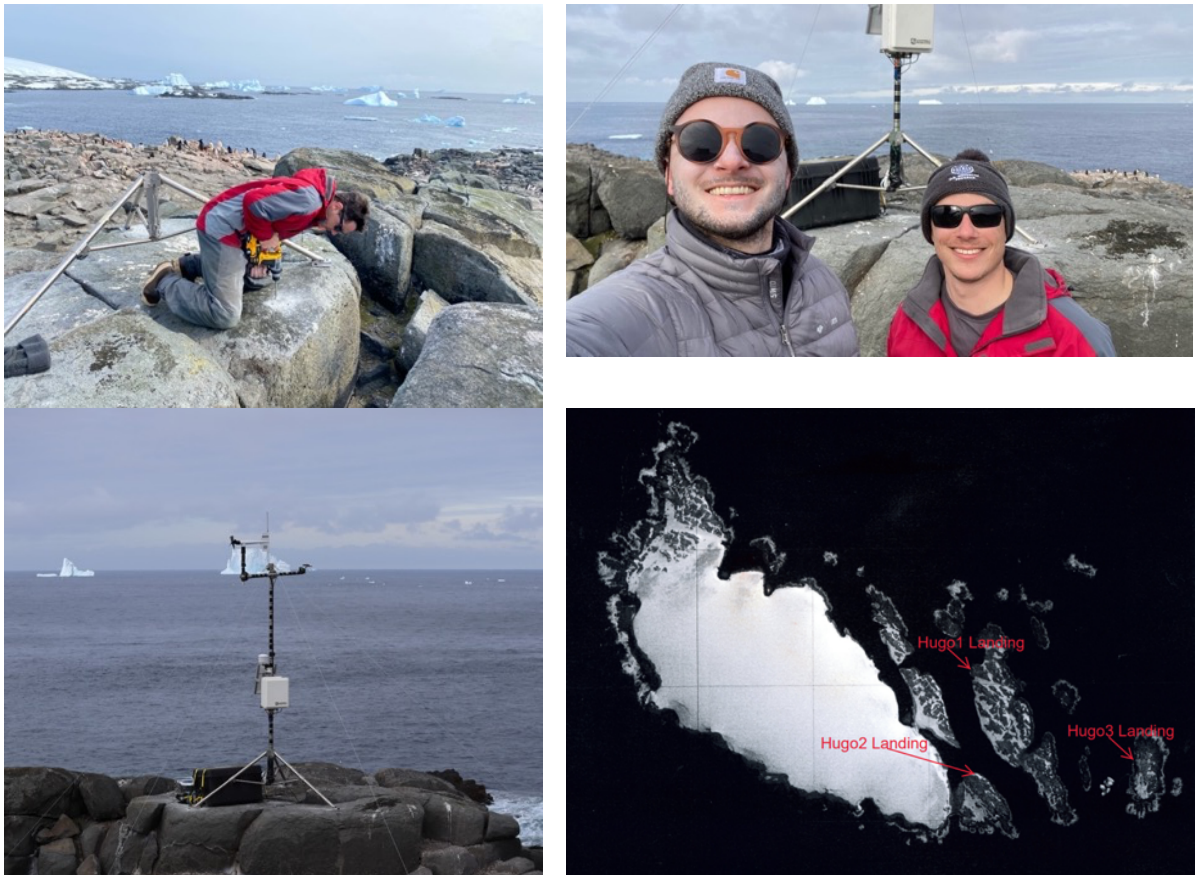


Figure 1. Installation of Hugo Island Weather Station. The station was installed on top of “Hugo3” (lower left panel). Photographs by Michael Cappola and Jake Gessay.



Figure 2. Glider recovery. Photographs by Michael Cappola.

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C-045: Biogeochemistry (Dr. Ben Van Mooy, PI; Woods Hole Oceanographic Institution)

Field Team Members: Zephyr Girard (lead), Hannah Goldberg, Dr. Laura Mota, Rachel Davitt

This week at the Charcot process station the biogeochemistry group did a two-day surface ocean diel cycle study sampling four times each day for carbohydrates, lipids, particulate organic carbon and flow cytometry. These data will help us answer questions about how organisms process energy at different times of day and light levels. We also collected more individual krill fecal pellets (adult and juvenile) for our high-resolution individual particle lipidome experiments. This was a great ending to a very productive cruise; we have collected over 2000 samples for analysis back at Woods Hole and we are excited to see what we find!

In addition to helping with the biogeochemistry sampling suite for this cruise, Dr. Laura Motta opportunistically collected samples to analyze mercury concentrations and stable isotopes. Mercury, a global pollutant of public health concern, is projected to increase in the poles due to climate change and globalization. To gain a better understanding of deposition, formation, degradation, uptake, and ultimately the bioaccumulation of methylmercury, Laura collected surface marine particles, fecal pellets, diatoms, and zooplankton along the WAP in collaboration with the Steinberg group. The mercury stable isotope composition of these biological matrices should provide clues about the formation and degradation mechanisms of methylmercury, the neurotoxic form of mercury that is detrimental to higher trophic organisms such as seals, whales, and penguins.

C-019: Phytoplankton (Oscar Schofield, Rutgers, P.I.)

Field Team Members: Heather Forrer (lead), Jake Gessay, Mya Sharpe, Dr. Ahmed El-habashi

This week the our group (**Fig. 3**) wrapped up the LTER sampling at Process Study 4 (-100.000), involving multiple CTD and optics casts, a 24-hour diel incubation, and micro-plastics sampling. These were in addition to the core measurements of chlorophyll-a, HPLC, discrete IFCB samples, photosynthetic quantum yields, and light absorption spectra of particulate phytoplankton pigments. This inshore Process Study site, having elevated productivity, will provide a fantastic final sampling point for our team and a great comparison site for the 24-hour diel incubations.

Additionally, we finished up data collection with the HyperSAS- hyperspectral measurements of ocean color. We collected spectra for the remainder of the transit north from Charcot to Prospect Point, Hugo Island, and Palmer Station, where we secured operations. During this transit, the weather was great, and the seas were calm. During the Palmer Station port call, we disassembled the HyperSAS and its frame; its sensors are prepared to be shipped back to the US for calibration. The great weather for hyperspectral data collection this cruise, along with some excellent bloom detections, will prove very useful for NASA's upcoming satellite mission PACE, which scheduled to launch Feb. 6, 2024, and our collaborators at the University of Connecticut COLORS laboratory are already working with the data.

All in all, this cruise was a great success for team C-019!

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Figure 3. The C-019 team. Left to right: Mya Sharpe, Jake Gessay, Heather Forrer; and right panel, Ahmed El-Habashi.

C-020: Zooplankton (Dr. Deborah Steinberg, PI; Virginia Institute of Marine Science)

Field Team Members: Deborah Steinberg (lead), Joe Cope, Meredith Nolan, Hannah Gossner, and Connor Shea

In this final week of operations, we completed sampling and experiments at Process Study 4 near Charcot Island. In this furthest south region of the LTER grid, juvenile Antarctic krill *Euphausia superba* still dominated the catch, but also the crystal krill *Euphausia crystallophias* and the smaller *Thysanoessa macrura* were abundant. Large copepods such as *Rhincalanus gigas*, *Calanoides acutus*, and the carnivorous *Paraeuchaeta antarctica* were also common. Day and night sampling of zooplankton distribution at discrete depth intervals using the MOCNESS to investigate depth distribution and diel vertical migration (DVM) of zooplankton were conducted in the deep Charcot canyon (-138.-013). This last MOCNESS completes the set of three coastal canyon MOCNESS tows for comparison that range the latitudinal gradient of the LTER sampling grid.

We continued to do live incubations of abundant zooplankton species to collect fecal pellets for various biogeochemical analyses and for physiology experiments. Concerning the latter, over the course of the cruise, Hannah Gossner ran a total of five respiration experiments on zooplankton. Using Pyroscience Firesting O₂ meters and oxygen optode dots, she measured the *in situ* oxygen concentration within sealed BOD bottles to calculate respiration rates (**Fig. 4**). She ran two types of experiments- one with 0.2um filtered seawater and a single individual to quantify only the

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respiration rate, and one with whole seawater and multiple same or similar species individuals for DOM excretion being investigated by graduate student Maya Thomas (conducting parallel DOM excretion experiments at Palmer Station). A broad range of taxa were incubated, including all three common species of krill, gymnosome pteropods, ostracods, copepods, amphipods, and polychaetes. The DOM excretion experiments were focused on copepods *Rhincalanus gigas*, *Calanoides acutus* (or similar), and juvenile krill *E. superba*. All animals used in experiments will be imaged and weighed (wet and dry weights) upon return to the lab for mass-based metabolic calculations.

It's been another successful LTER cruise, and our group (**Fig. 5**) is grateful for all the ASC and ship's crew support!



Figure 4. A juvenile krill *E. superba* in incubation bottle for a respiration/ excretion experiment at Process Study 4. Note port at bottom for oxygen sensor. Photo by Debbie Steinberg.



Figure 5. Steinberg C-020 group at Prospect Point in last week of science operations. Happy to be done with sampling! Left to right: Connor Shea, Meredith Nolan, Joe Cope, Debbie Steinberg, and Hannah Gossner.

C-013: Seabird Component-LTER (Megan Cimino, PI; UC Santa Cruz and NOAA)

Field Team Members: Allie Northey (lead), Helena Dodge

We had an incredibly successful final week of operations due to light winds, low swell, and blue skies. We processed most of our samples from Avian Island, tried to land at Charcot, and surveyed at Prospect Point and Hugo Island. The only downside was our inability to access Charcot Island for our Adélie penguin census. Brash ice was too tight around the area so it was decided that we would head north and try for another shot at Hugo Island following Prospect Point. We wrapped up our bridge-based surveys at the Charcot Process Study, conducting surveys during the MOCNESS deployments and CTD casts. Upon arriving at Prospect Point (the Fish Islands), we found perfect weather that allowed us to survey all 10 islands in the area with around 25 colonies of Adélie penguins (**Fig. 6**) and two colonies of Blue-eyed Shags

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(cormorants). These islands had not been surveyed in five years, so it was hugely successful for our long-term dataset. We were able to count all adult and chicks, GPS map all penguin colonies, collect fecal samples, and conduct our penguin diet study.

The following day, we were able to conduct full counts of Gentoo and Chinstrap penguin adults, chicks, and nests on the three islands that serve as our census area of Hugo Island (**Fig. 7**). Again, this area had not been surveyed since 2018 due to the exposed nature of Hugo. Big ocean swell tends to be a limiting factor but with the help of our experienced MTs, we were able to make safe landings throughout the day. We GPS mapped 80% of the colonies in those islands which will allow for more streamlined surveying protocols in the future. We couldn't have asked for a more successful LTER cruise as a team and would like to thank our Chief Scientist Dr. Debbie Steinberg, and all NSF, ASC, and Edison Chouest crew for helping us make things happen.



Figure 6. Prospect Point surveys of Adélie penguins on a bluebird day. Photo Allie Northey.

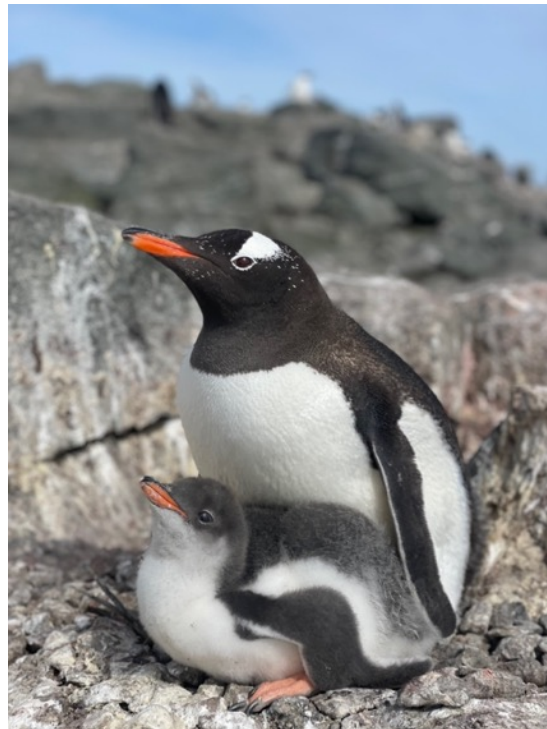


Figure 7. Gentoo penguin adult and chick from Hugo Island surveys. Photo by Allie Northey.

C-024: Cetacean Biology & Ecology (Ari Friedlaender, PI; UC Santa Cruz)

Field Team Members: Ross Nichols (lead), Dr. Jennifer Allen

This week, the Whalers continued their efforts to conduct bridge surveys of marine mammals. However, no boating operations occurred that resulted in sample collection. On Jan. 23, the whalers assisted the C-013 Cimino group in surveying the Fish Islands for bird species. During this time, we assisted in fecal sample collection and diet sampling.

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As of 1/28/2024, the whaler group has collected 24 biopsy samples from 2 Orca whale adults, 21 humpback whale adults, and 1 humpback whale calf. Additionally, we have collected 1 adult elephant seal skull through our collections permit. These samples were transferred to Palmer Station on 1/26/2024 for further storage, processing and collection.