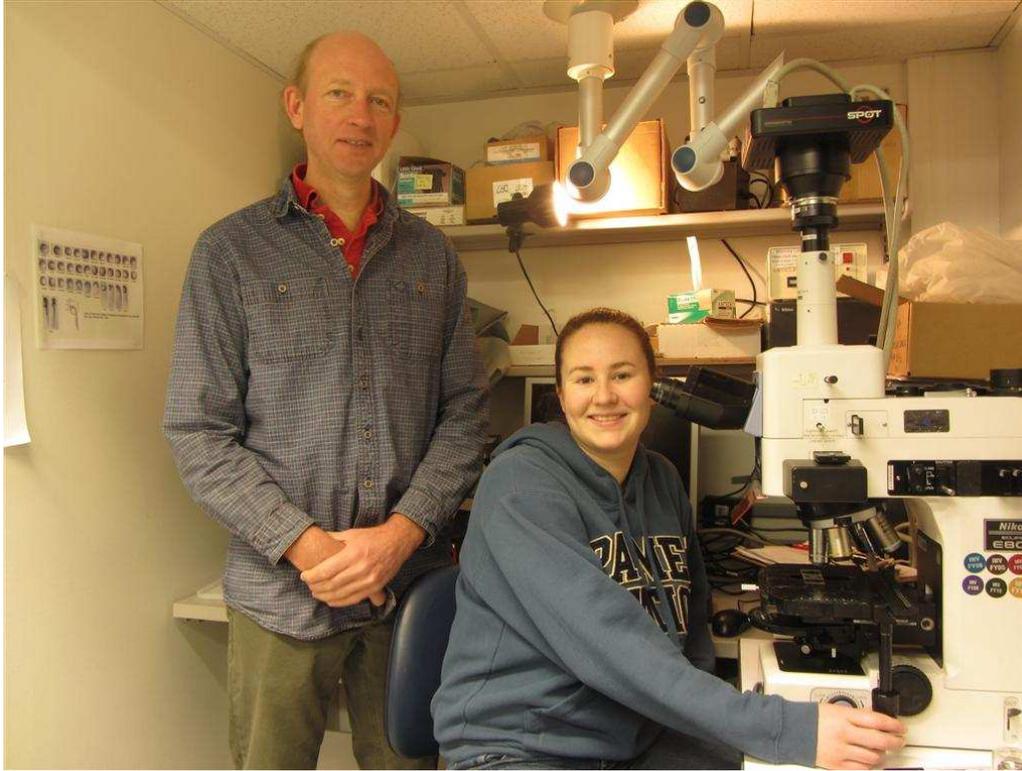


PALMER STATION MONTHLY SCIENCE REPORT

May 2012



Matthew Cottrell and Monica Stegman (B-026-P) visited Palmer Station in May to conclude the field sampling component of the "Photoheterotrophic microbes in the West Antarctic Peninsula marine ecosystem" project.

Image Credit: Janice O'Reilly

NEWS FROM THE LAB

By Janice O'Reilly, Winter Assistant Supervisor of Lab Operations

Science labs bustled with activity during the month of May. Members from B-027-P (McClintock/Amsler) and B-256-P (Lee) wrapped up their science projects for the 2012 season. Members of B-026-P (Cottrell) arrived on LMG 12-05 to complete the field sampling component of their study and departed on the same cruise. B-037-P (Detrich) was joined by one member from their home institution and three members from Spain. Departing from their group on LMG 12-05 was one member from B-037-P and one member from B-038-P.

The relatively mild weather conditions allowed for field work to continue during May. Members from B-256-P (Lee) and B-027-P (McClintock/Amsler) continued field sampling during the first part of the month. Members of B-026-P (Cottrell) successfully collected water samples on all, except one collection day. Four fishing cruises were completed by B-037-P (Detrich) onboard the *ARSV Laurence M. Gould* (LMG). Station personnel continued weighing giant petrel chicks for B-013-P (Fraser) through the last day of the study on 24 May.

Visiting Grantees and the new Instrument Technician gave four science lectures in May. Yuta Kawarasaki of B-256-P (Lee) gave a talk about *Belgica antarctica*, the only free-living insect found on Antarctica. He described the extreme stressors that larvae of *Belgica antarctica* survive, including freezing of body fluids and dehydration, and the underlying physiological and molecular mechanisms that contribute to their ecological success in the harsh environment of

Antarctica. Mary Chamberlin of B-038-P gave a talk that provided an overview of her research on aerobic metabolism in invertebrate and vertebrate ion-transporting epithelia and fish red muscle. She discussed a conceptual and experimental approach that can be used to understand how external factors (e.g. developmental stage; temperature) affect mitochondrial function. Dr. Matt Cottrell (B-026-P) presented an overview of microbial oceanography with a focus on the role of bacteria in carbon cycling in the ocean. Highlights included the recent discovery of new types of light harvesting metabolism in marine bacteria. These so called photoheterotrophic microbes have been demonstrated to be actively growing while relying on sunlight and organic material. New carbon cycle models will probably be required to fully explain how these abundant microbes fit into an already complex ecosystem framework that treats autotrophy and heterotrophy separately. The month's science talk series was concluded with a presentation by Graham Tilbury, the winter Instrument Technician, who shared his experiences working on the Ice Cube project at South Pole. He showed a DVD that gave an overview of several science projects currently being conducted at Pole.

Palmer Station felt the beginning of winter during May, as daylight hours shortened and temperatures dropped. However, populations of penguins could still be observed, some busily transferring pebbles. Interestingly, Adélie penguins were observed on the north and south sides of Torgersen Island on three different occasions. On 11 and 13 May more than 50 Adélies were counted, and on 20 May over 100 Adélies were counted, a fantastic photo opportunity for grantees visiting for the first time. Gentoo penguins were sometimes observed swimming in the open water between Arthur Harbor and Station E. On 2 May three chinstrap penguins were identified on Nightmare Island during a combined operation for the survival cache swap on Dream Island for OSAR operations, and science support field work for obtaining GPS reference points for T-434-P (Morin). Other bird populations observed during the month included blue-eyed shags, kelp gulls, Wilson's storm-petrels, snowy sheathbills, and giant petrels (adults and grown chicks). A small group of terns (unidentified) continued to congregate at the far shore of Arthur Harbor near the glacier. Seals still present in the Palmer vicinity included fur, elephant, crabeater and leopard. On 2 May a group of humpback whales was seen by the OSAR team near Halfway Island.

MAY 2012 WEATHER

By Neal Scheibe, Research Associate

May at Palmer Station saw a steady downtrend of temperatures, but this was counterbalanced by many great sunrises and sunsets that illuminated the mountains to the south. Except for some gusty days in the middle of the month, May was a fairly calm month. The coldest day was the 27th at -8.2°C. The warmest temperature was on the 13th at 6.4°C. The average temperature for the month was -2.0°C, which is just a little cooler than last year.

Sea surface temperatures averaged -0.5°C. Very little sea ice was seen this month, with only a couple of days of heavy brash ice passing through. One iceberg came into view near month's end. The glacier was heard calving several times during the warmer, rainy days.

There was 31 cm of snowfall throughout the month, often with snow being preceded or followed by freezing rain to create slick conditions around Palmer Station. A total of 21.9 mm melted precipitation fell during the month. There was a healthy coating of snow blanketing Palmer Station heading into June.

B-026-P: PHOTOHETEROTROPIC MICROBES IN THE WEST ANTARCTIC PENINSULA MARINE ECOSYSTEM

Matthew T. Cottrell, Principal Investigator, School of Marine Science and Policy, University of Delaware, Lewes, Delaware

Personnel on station: Matt Cottrell and Monica Stegman

The goal of this project is to examine the role of microbes that supplement their growth with light energy harvested from sunlight. About half of the bacterial cells in the surface waters of the ocean at lower latitudes are equipped with some form of light harvesting apparatus, but it is unclear if these photoheterotrophic microbes are also abundant in high latitude waters near the west Antarctic Peninsula as well. This month marks the final deployment for our project. The first three deployments in 2011 and January 2012 were highly successful and we are fortunate now to be in a position where we can now focus on tying up some loose ends. We are continuing our analysis of bulk measurements of in situ rates of metabolism, assays of photoheterotrophy gene expression and radiotracer experiments to follow the incorporation of inorganic C into microbial biomass in the light and the dark. We have now perfected a single-cell assay that enables us to assess the growth of on one type of photoheterotrophic microbe called aerobic anoxygenic phototrophic (AAP) bacteria. Monica Stegman is taking the lead on experiments focusing on the AAP bacteria. The work that she is doing here at Palmer Station will enable us to look at any differences between these high latitude waters and Delaware Bay where she already has collected comparable data. We are excited now to be able to utilize this new approach in the work that we are doing here in the coastal waters of the west Antarctic Peninsula.

B-027-P: THE EFFECTS OF OCEAN ACIDIFICATION AND RISING SEA SURFACE TEMPERATURES ON SHALLOW-WATER BENTHIC ORGANISMS IN ANTARCTICA

James McClintock, Charles Amsler, and Robert Angus, Principal Investigators, University of Alabama at Birmingham

Personnel on station: Kathryn Schoenrock and Julie Schram

In the month of May our group finished a six week long experiment investigating the effects of decreased pH and increased sea water temperature on growth and physiology of two species of marine invertebrates (the marine snail *Margarella antarctica*, and limpet *Nacella concinna*) and two species of marine encrusting algae (*Clathromorphum obtectulum* and *Hildenbrandia sp.*). We completed all water chemistry measurements and set up protocols for water sampling throughout the year. The end of experiment measurements for the invertebrates include tissue sampling for whole animal biochemical composition, calcification, shell morphology, escape response from a predator, gene expression (with a collaborator), and wet weights. Photosynthetic health, thallus size, chlorophyll *a* content, calcification, and gene expression were measured for the algae.

May brought many days of south swell and fog to the Palmer Station area, decreasing the amount of diving that we were able to do for specific collections. Despite this, we were able to collect sufficient amounts of fluorometry data using a pulse amplitude modulated diving fluorometer. This data was pertinent for comparisons to the algae in lab, and would not have been collected without the help of our amazing dive tenders, specifically Neal Scheibe and Steve Sweet. We were also able to do collections for these following experiments: 1) Examination of the effect endophyte presence has on photosynthesis in macroalgae, 2) Extraction of cell wall compounds from coralline algae species *Clathromorphum obtectulum*, to identify potential inducers of invertebrate larval settlement, and 3) Cell wall extractions of *Iridaea cordata*, to examine how different sexual life stages may differ chemically in response to endophyte infection. Diving also allowed us to photograph and document organisms and field experiments.

Over all we had a very successful season at Palmer Station and were able to complete our planned projects and more during our three month stay. We are extremely grateful to station staff for supporting us and our dive operations.

B-037 PROTEIN FOLDING AND FUNCTION AT COLD TEMPERATURE: CO-EVOLUTION OF THE CHAPERONIN CCT AND TUBULINS FROM ANTARCTIC FISHES

H. William Detrich, Principal Investigator, Depts. of Earth and Environmental Sciences and of Biology, Northeastern University, Boston, MA

Personnel on Station: H. William Detrich (B-037, B-029), Corey Allard (B-037), Leonardo Almeida (B-037), Sara Alvira (B-037), Lucia Quintana (B-037), Juan Carlos Zabala (B-037), Jeffrey Grim (B-038), Irina Mueller (B-038), and Mary Chamberlin (B-038)

N.B. Because B-029 and B-038 are projects affiliated with B-037, this report encompasses work by all three projects.

May began with great success as we obtained successful *in vitro* fertilizations with two “white-blooded” icefish species, *Champsocephalus gunnari* on May 1, and *Chaenocephalus aceratus* on May 4. To our knowledge, these *in vitro* matings are the first for the icefish family (Channichthyidae: Notothenioidei). By mid-May we had also obtained embryos of *Notothenia coriiceps*, the red-blooded species with which we have had success in prior field seasons. Typical clutch size for each species was 3,000-4,000 embryos, more than adequate numbers for initiating our acclimation and heat shock experiments for assessing the thermal sensitivity/resilience of embryonic development in the white-blooded icefishes and the red-blooded nototheniids. The long-term acclimation and short-term heat shock protocols are designed to evaluate changes in embryonic gene expression at defined developmental stages. Thus, we are preserving staged embryos in RNA later, a task that will continue throughout the winter. Gene expression will be evaluated in our CONUS laboratories by high-throughput DNA sequencing. We encountered some problems in temperature regulation of our early embryo chambers, but these have since been resolved by a successful redesign by Dr. Irina Mueller. Additional clutches of the three species were obtained during the remainder of the month.

During early to mid-May, we treated adult *N. coriiceps* ($n = 6$) with phenylhydrazine to induce anemia and a subsequent wave of erythropoiesis. Six animals were injected with Notothenioid Ringers as controls. These animals were bled five days post-injection to establish their hematocrits. On day nine post-injection, the hematocrits of the fish were measured and the 12 specimens were sacrificed for tissue harvest. The objective of these experiments is to examine the global program of gene expression that directs the formation of red blood cells, using high-throughput sequencing in our CONUS labs.

The ASRV *Laurence M. Gould* (LMG) returned to Palmer Station on May 7, 2012 (Cruise LMG12-05) after a smooth and scientifically successful crossing of the Drake Passage. En route to Palmer Station, the LMG conducted trawling operations near Low Island in support of projects B-029 (John Postlethwait, PI), B-037 (H. William Detrich, PI), and B-038 (Jeffrey Grim, PI). Nine trawls yielded a substantial collection of fish, including 26 *Gobionotothen gibberifrons*, eight *N. coriiceps*, and 57 icefishes of several species. New team members Dr. Juan Carlos Zabala, Mr. Leonardo Almeida, Ms. Sara Alvira, and Ms. Lucia Quintana arrived on this cruise. Supported by LMG and Palmer logistics personnel, we off-loaded our fish to the Palmer Station Aquarium.

The LMG then conducted three additional fishing cruises in support of our projects: 1) May 9-11 to Dallmann Bay (trapping) and Low Island (trawling); 2) May 16-18 for exploratory fishing within 50 nautical miles of Palmer Station; and 3) May 21-23, again to Dallmann Bay (trapping) and Low Island (trawling). The first and third cruises produced sufficient numbers of our three target species, *C. aceratus*, *G. gibberifrons*, and *N. coriiceps*, to support our research programs into early June. The second cruise revealed a productive fishing ground near Andvord Bay that yielded a wide diversity of notothenioid fishes not typically encountered at Low Island or Dallmann Bay. These included the icefishes *Chaenodraco wilsoni*, *Chionodraco rastrispinosus*, *Cryodraco antarcticus*, *Neopagetopsis ionah*, and *Pagetopsis macropterus*, and the notothen *Trematomus loennbergii* and *Trematomus hansonii*.

With the arrival of Alvira, Quintana, and Zabala, our studies of protein folding at low temperature commenced in earnest. Using testis tissue from *G. gibberifrons*, they prepared the chaperonin CCT and three heat-shock proteins, Hsp70, Hsp90, and Hsp96. "Heat shock protein" is a misnomer in the case of Antarctic fishes, which have lost the capacity to induce synthesis of these proteins in response to acute thermal challenge. Rather, they are expressed constitutively at low temperature along with the normal cellular chaperones that assist the folding of ~10% of cellular proteins. After the CCT and Hsp preparations are returned to our laboratories in the US and Spain, we will use them to examine the kinetics of protein folding at low temperature and to evaluate their network of interactions during the assisted folding process.

At Palmer, we also continued to sample tissues from the diversity of notothenioid fishes caught during the month to support research in our CONUS laboratories.

The LMG departed Palmer Station on May 27 en route to Punta Arenas, Chile. Drs. Jeffrey Grim and Juan Carlos Zabala sailed northbound, while Detrich, Allard, Almeida, Alvira, Quintana, Mueller, and Chamberlin remained on station to continue our research programs. We thank the Captain, crew, and ASC personnel of the LMG and ASC Palmer Station personnel for their excellent help in making our continuing field season very successful.

B-256-P: ROLE OF DEHYDRATION AND PHOTOPERIODISM IN PREPARING AN ANTARCTIC MIDGE FOR THE POLAR NIGHT

Richard E. Lee, Jr. and David L. Denlinger, Principal Investigators, Miami University, Oxford, Ohio and Ohio State University, Columbus, Ohio

Personnel on station: Yuta Kawarasaki

Most of the time this month was focused on completing a number of experiments started in April. One of those studies was designed to determine physiological responses of the Antarctic midge larva to extended periods of ecologically-relevant, exposure to low temperature. These larvae can survive low-temperature exposure by tolerating the freezing of their body fluids or by losing body water to environmental ice, termed cryoprotective dehydration. Both strategies appear to be effective for long-term survival in the cold. Follow-up analyses are planned to further investigate the difference in the energetic cost of these overwintering strategies.

We are grateful to station personnel for their support. Especially, we thank Janice O'Reilly and Ken Keenan for coordinating science support. We also thank Lily Glass and Graham Tilbury for assistance in the laboratory. The field sampling would not have been possible without boating support by Ryan Wallace. Sean Bonnette, Lily Glass, Paul Queior, and Neil Scheibe helped with field collection of midge samples.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
May 2012
Neal Scheibe

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 143 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.

A new STS-2.5 seismometer, host box, and cabling were received and installed. The new seismometer is running normally. The old STS-2.5 had failed soon after being installed in early March. This old seismometer has been brought inside to Terra Lab for troubleshooting prior to shipment. If the seismometer is not in the correct, locked state when shipped, excessive damage to the instrument could result.

A-109-P: ANTARCTIC EXTREMELY LOW FREQUENCY/VERY LOW FREQUENCY (ELF/VLF) OBSERVATIONS OF LIGHTNING AND LIGHTNING-INDUCED ELECTRON PRECIPITATION (LEP).

Robert Moore, Principal Investigator, University of Florida

ELF/VLF radio wave observations at Palmer Station are used to provide a deeper understanding of lightning and its effects on the Earth's inner radiation belt. The Research Associate operates and maintains on-site equipment for the project.

Data collection went as planned for the month.

A-132-P: FABRY-PEROT INTERFEROMETER (FPI)

Qian Wu, Principal Investigator, National Center for Atmospheric Research

The Fabry-Perot Interferometer observes mesospheric and thermospheric neutral winds and temperatures at Palmer Station. The Research Associate operates and maintains on-site equipment for the project.

The instrument ran well during the month with no issues to report.

O-202-P: ANTARCTIC METEOROLOGICAL RESEARCH CENTER (AMRC) SATELLITE DATA INGESTOR.

Mathew Lazzara, Principal Investigator, University of Wisconsin

The AMRC computer processes satellite telemetry received by the Palmer Station TeraScan system, extracting Automated Weather Station information and low-resolution infrared imagery and sending the results to AMRC headquarters in Madison, WI. The Research Associate operates and maintains on-site equipment for the project.

The data ingestor operated normally for the month.

O-204-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL TO 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 interannual 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 both TerraLab and the VLF Building.

Sampling occurred regularly throughout the month. The air collection procedure has changed to start sampling two flasks in Terra Lab and one flask simultaneously in the Clean Air building. The old procedure involved sampling two flasks simultaneously in both buildings. This change will allow fewer flasks to be kept on station at any given time.

**O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD
WORLDWIDE FLASK SAMPLING NETWORK**

James Butler, Principal Investigator, 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.

Carbon Cycle and Halocarbon sampling occurred normally during the month. The air sampling unit and flasks have been moved to a more permanent location in Terra Lab.

**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. Also collecting light spectra is a BSI GUV-511 filter radiometer, an Eppley PSP pyranometer, and an Eppley TUVR radiometer. The Research Associate operates and maintains on-site equipment for the project.

The UV monitor collected data normally for the month.

O-283-P: ANTARCTIC AUTOMATIC WEATHER STATIONS (AWS).

Mathew Lazzara, Principal Investigator, University of Wisconsin

AWS transmissions from Bonaparte Point are monitored using the TeraScan system and the Data Ingestor system. Data collected from this station is freely available from the University of Wisconsin's AMRC website. The Research Associate monitors data transmissions for the project and performs quarterly maintenance on the station at Bonaparte Point.

The weather station ran normally during 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 GPS operated normally for the duration of the month.

A-336-P: ELF/VLF OBSERVATION OF LIGHTNING DISCHARGE, WHISTLER-MODE WAVES AND ELECTRON PRECIPITATION AT PALMER STATION.

John Gill, Principal Investigator, Stanford University

Stanford University has been operating a Very Low Frequency (VLF) receiver antenna at Palmer Station since the 1970s. By receiving naturally and manmade signals between 1 and 40 kHz, the Stanford VLF group is able to study a wide variety of electromagnetic phenomenon in the ionosphere and magnetosphere. The Research Associate operates and maintains on-site equipment for the project.

Data was collected normally during the month. Several old pieces of hardware and four spools of cable were shipped back to Stanford University for disposal or retrograde.

T-312-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 system operated normally for the month.

A-357-P: EXTENDING THE SOUTH AMERICAN MERIDIONAL B-FIELD ARRAY (SAMBA) TO AURORAL LATITUDES IN ANTARCTICA

Eftyhia Zesta, Principal Investigator, University of California Los Angeles

The three-axis fluxgate magnetometer is one in a chain of longitudinal, ground-based magnetometers extending down through South America and into Antarctica. The primary scientific goals are the study of ULF (Ultra Low Frequency) waves and the remote sensing of mass density in the inner magnetosphere during geomagnetically active periods. The Research Associate maintains the on-site system.

The system collected data normally during the month.

B-390-P: THERMO-SALINOGRAPH

Vernon Asper, Principal Investigator, University of Southern Mississippi

Sea water is pumped continuously through a thermosalinograph (TSG) sampling system, recording the temperature, conductivity, salinity, and fluorescence. The data and webcam images are sent to a mirror site (<http://4dgeo.who.edu/tsg/>) at Woods Hole Oceanographic Institute, which is a collaborator on the project.

The TSG operated normally during the month.

T-434-M/P: POLAR GEOSPACIAL CENTER

Paul Morin, Principal Investigator, University of Minnesota

The Polar Geospatial Center provides geospatial support (in the form of mapping, data delivery, and GIS analysis) to science and logistics communities of the U.S. Arctic and Antarctic programs. The Research Associate has been requested to collect ground control points in the Palmer area throughout the 2011-2012 season.

The final ground point at Stepping Stones was collected during the month.

B-466-P: FLUORESCENCE INDUCTION AND RELAXATION (FIRE) FAST REPETITION RATE FLUOROMETRY (FRRF)

Deneb Karentz, Joe Grzyski, Co-Principal Investigators, University of San Francisco

The focus of this project is to identify and evaluate changes that occur in genomic expression and physiology of phytoplankton during the transition from winter to spring, i.e., cellular responses to increasing light and temperature. A Fast Repetition Rate Fluorometer (FRRF) with a FIRE (Fluorescence Induction and Relaxation) sensor was installed in the Palmer Aquarium. The Research Associate downloads data and cleans the instrument on a weekly basis.

The FRRF was cleaned weekly and data were sent to the PIs.

T-998-P: INTERNATIONAL MONITORING STATION (IMS) FOR THE COMPREHENSIVE NUCLEAR TEST BAN TREATY ORG. (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 RASA operated normally for the duration of the month. The quarterly shipment of filter media was sent.

TIDE GAGE

Tide height and seawater temperature are monitored on a continual basis by a gauge mounted at the Palmer Station pier. The Research Associate operates and maintains on-site equipment for the project.

The tide gauge operated normally during the month.

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 twice each 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 (PalMOS) and emailed to the NOAA for entry into the Global Telecommunications System (GTS).

The weather station operated normally throughout the month. Scheduled inspections were carried out at the Gamage Point tower. Weather updates and satellite imagery were forwarded to the *ARSV Laurence M. Gould*.