



TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC STEM Experience Report

Amy Osborne

Thermal Sensitivity of Embryos and Larvae of Antarctic Marine Ectotherms



PolarTREC Expedition Page

<https://www.polartrec.com/expeditions/thermal-sensitivity-of-embryos-and-larvae-of-antarctic-marine-ectotherms>



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Janet Warburton and Judy Fahnestock
Education Project Managers
Arctic Research Consortium of the US (ARCUS)
3535 College Rd. Suite 101
Fairbanks, AK 99709
(907) 474-1600
info@polartrec.com
www.polartrec.com

Getting Connected: The PolarTREC Field Experience

I looked closer at the nudibranch. This is a *Tritonia challengeriana*...I can tell by the pompon looking tufts along the side of its body. I think it's producing an egg case. Yes, it is! I need to tell Aaron, Graham, and Amy! I am so excited that, finally, after mornings and afternoons spent observing animals in the aquarium I'm discovering something directly related to our research. About 5 minutes later Amy walked into the Crary Lab Aquarium at McMurdo Station in Antarctica. "So, I think this *Tritonia challengeriana* is producing an egg case," I said, quite proud of myself that I remembered the scientific name of this particular nudibranch and even more excited that I discovered a nudibranch laying an egg case. "Let's take a look," said Dr. Moran. "Yes, that is what's happening, good find!!"



A nudibranch, *Tritonia challengeriana*, is producing an egg case in the Crary Lab, McMurdo Station, Antarctica.

PolarTREC (Teachers and Researchers Exploring and Collaborating) provides experiences like these for K-12 educators across the country. An opportunity to experience questioning, hypothesizing, collecting, observing, gathering data, analyzing, sharing information, and being immersed in the scientific process in a place where field research is the focus, is a rare educational opportunity for someone who spends their days teaching K-12 students. As a science educator, the ability to conduct field research and learn from and talk with university professors, who are also researchers, about science, science education, and research is invaluable. PolarTREC reinvigorated my love for science education, sparked a passion for field research and outreach, and connected me to a much larger science and education community.

During the five weeks in Antarctica that I worked with Dr. Amy Moran and her team, Ph.D. students Aaron Toh and Graham Lobert, I was able to:

- learn more about marine invertebrates and their watery stable habitat
- conduct field research by participating in collecting, observing, experimenting, and recording data adding to my knowledge of the scientific process
- recognize the importance of teamwork and collaboration in research
- learn more about Antarctica including its history, geography, natural history, and the science being conducted on the icy continent

- connect with Dr. Moran and her team as well as with researchers from around the globe to enhance my awareness of the important research that the polar science community is offering to the world
- share in the wonder and mystery of the polar regions and the valuable research being conducted in Antarctica with communities of educators and K-12 students from across the country. Hearing student questions and watching people's reactions when they see a slowly moving giant sea spider from thousands of miles away was a thrilling experience!



Amy Osborne looks through a microscope to determine stages of nudibranch eggs in the Crary Lab, McMurdo Station, Antarctica.

Looking Closer-Summary of the Science

As climate change is contributing to a rise in the [global ocean temperature](#) the impacts that this increase in temperature will have on ocean ecosystems are slowly being revealed. Dr. Amy Moran along with Ph.D. students Aaron Toh and Graham Lobert from the University of Hawaii are focused on the impact that increasing ocean temperature will have on the growth and development of marine ectotherms, more commonly known as cold-blooded animals. Antarctica is an important study site because, due to the Antarctic Circumpolar Current, the ocean surrounding Antarctica is fairly isolated. This isolation has resulted in a fairly stable habitat and animals that are highly adapted to living in a constant -1.8°C ocean. Even small temperature changes in this habitat may have large impacts on the animals that call this freezing habitat home.



A sea spider, Ammonothea, with egg cases in the Crary Lab, McMurdo Station, Antarctica.

Dr. Moran and her team are currently focusing their research on the eggs and larvae of sea spiders (Phylum Arthropoda, Class Pycnogonida) and nudibranchs (Phylum Mollusca, Class Gastropoda), also known as sea slugs. To conduct their research they first, determine what specimens they need and collect the specimens by diving through holes in the sea ice near McMurdo Station, Antarctica. The sea spiders, nudibranchs, and their eggs are brought back to the lab where the eggs and larvae are exposed to different temperatures and oxygen levels. The team then observes and records the growth of these specimens over time. They will eventually return to the lab in Hawaii to determine the way these eggs and larvae exposed to different temperatures are using their energy.



Science divers Amanda Frazier, Rob Robbins, Steve Rupp, Amy Moran, and Aaron Toh prepare to dive.



PhD students Aaron Toh and Graham Lobert identify and record stages of sea spider and nudibranch growth.

As a participant on the research team, I experienced first-hand the teamwork, problem-solving, flexibility, creative innovation, and knowledge of multi-disciplinary science and mathematics that goes into real-world research. I supported the collection of the specimens by dive tending, ensuring the science divers who were collecting the specimens were safe and had everything they

needed, and by taking temperature, oxygen percentage, and salinity levels of the water at the dive sites. I observed and recorded information, particularly noting signs of newly laid eggs, about the adult sea spiders and nudibranchs in the Crary Lab Aquarium. I also spent time observing, identifying, and recording the stages of eggs and larvae exposed to different temperatures. At times I participated in parts of the process to determine the ash-free dry weight of the eggs and larvae. Determining the ash-free dry weight will, eventually, help the team better understand how the eggs and larvae are using energy as they grow and develop.



Amy Osborne and an identification chart of the stages of nudibranch growth. Photo by Denise Hardoy.



Amy Osborne uses an electrobalance to determine the weight of eggs.
Photo by Aaron Toh.

Dr. Moran's research is in its first field season and, so far, the research team is seeing results they anticipated: as temperature increases, the rate of growth increases. Throughout the rest of this year and next season in Antarctica the team will be exploring questions related to the increased growth rate: What impact on metabolism and use of energy might this increase in growth rate have on these animals as they transition from juveniles to adults?

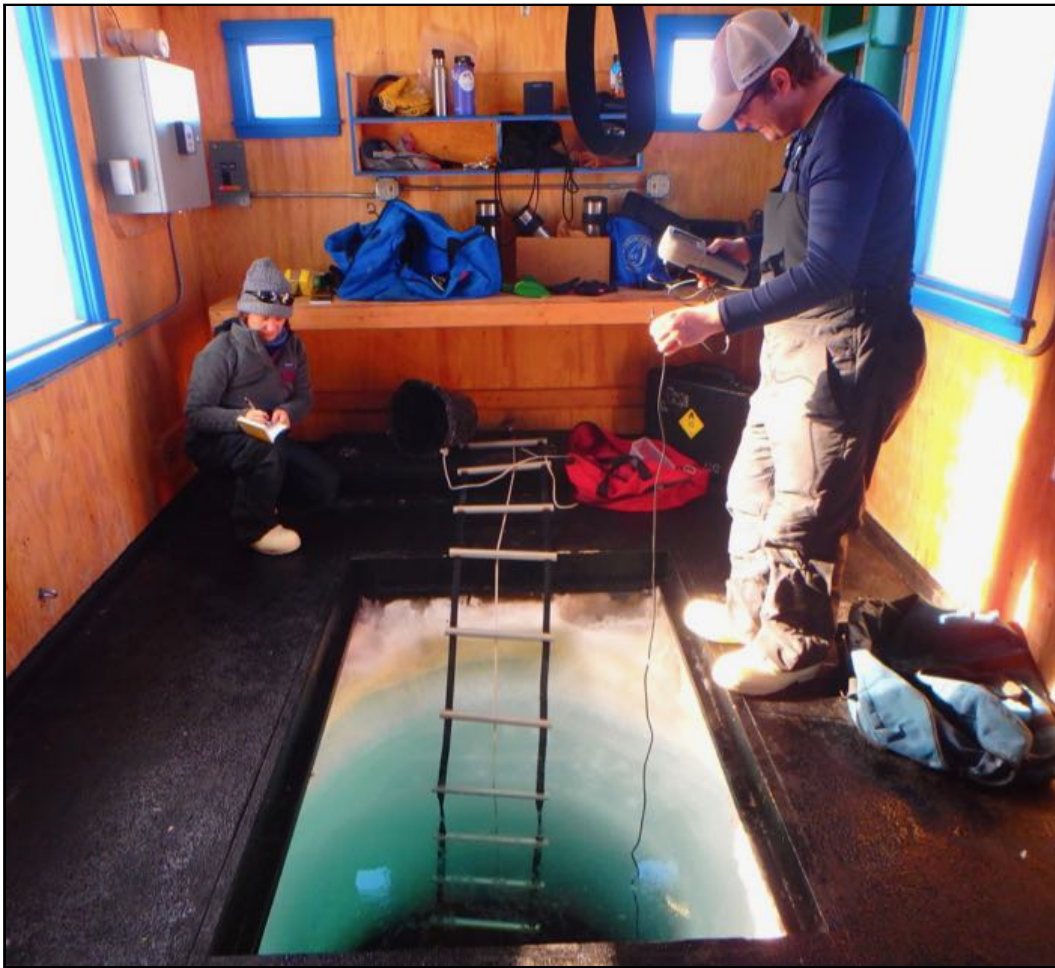
T.E.A.M. (Together Everyone Achieves More): The Importance of Educator/Researcher Collaboration

Together Everyone Achieves More (T.E.A.M.), a theme I commonly use as an educator, sums up my time spent in Antarctica. I enjoyed working with the research team both out in the field and in the lab. I appreciated the time they took to educate me about the animals they were researching, teach me the exact methods they were using in their research and how to do them, and I appreciated the amount of collaboration and communication they had with one another and with me.



The sea spider team: Aaron Toh, Graham Lobert, Dr. Amy Moran, and Amy Osborne standing on the sea ice near McMurdo Station, Antarctica.
Photo by Rob Robbins.

As a K-12 science educator, one of the most useful big-picture pieces of the PolarTREC experience was the opportunity to work alongside, learn from, and talk with researchers who are also educators at the collegiate level. As someone who frequently thinks about the intersection of scientific research, science communication, and education pedagogy, I appreciated moments when the research team and I had opportunities to talk broadly about science education. We discussed science education pedagogy and the need for K-12 education and collegiate level science education to be on the same page regarding expectations and terminology. As an outdoor science educator, I am conducting research with students on a much smaller scale than what is happening at the university level. Though the research I conduct with students is less intricate and in a shorter time-frame than the research I was involved with in Antarctica, Dr. Moran and I talked about the importance of K-12 students understanding the steps in the inquiry process and the need to have a common language around conducting research. Even finding commonality in the words used to describe the process (e.g. inquiry, investigation, research, experiment, scientific method) is important.



Amy Osborne and Graham Lobert measure salinity, temperature, and oxygen percentage of the sea water near McMurdo Station, Antarctica.
Photo by Anne Todgham.

As a field science teacher who doesn't have an extensive research background, being able to participate in field research provided an opportunity to experience authentic scientific research. Watching the research team navigate challenges from power outages to thinning ice, and seeing them use elements of engineering and design in their research process stood out to me. The team's ability to adapt and innovate are parts of the research process that I will carry with me as I continue to lead K-12 students through science investigations.



Graham Lobert and the thermal block the team designed to create a water temperature gradient.

In addition to the research, Amy, Graham, Aaron, and I all conducted outreach sessions with K-12 students. While I was there we presented, via Skype sessions, to over four hundred K-12 students and over 45 formal and informal educators from across the country and the globe. As a team, we talked to each other about what we wanted to share with outside audiences. Having all of us there for video meetings to show off the animals in the lab, share the research, and answer questions was extremely helpful. I, particularly, found creating videos about our research experience and embedding them into online journals a useful and engaging tool to communicate my Antarctic experiences and the work of the research team with a diverse audience.

Another amazing learning experience during my time in Antarctica was the opportunity to learn more about the history of the area. I attended training to learn to be a historical hut guide and took members of my own research team and other research teams to the Discovery and Terra Nova huts on Ross Island. As a place-based educator, this experience was yet another opportunity to practice the craft of melding together science and history and to share my knowledge with the research team and larger McMurdo community.



Amy Osborne stands in front of the kitchen in the Terra Nova Hut used by both Captain Robert Falcon Scott and Ernest Shackleton, Cape Evans, Antarctica. Photo by Denise Hardoy.

Everything is Connected: Linking PolarTREC to my Classroom/Audience/Institution and Community

As soon as people hear “Antarctica”, their ears perk up and they are eager to hear more. Sharing my experiences in the polar regions with K-12 informal educators and students who attend NatureBridge programming has already been a rewarding experience. Mixing the NatureBridge education pedagogy of experiential learning and communication through movement and visuals with my newly gained knowledge of the polar regions has exposed groups of K-12 students to the wonders of the poles. I’m excited to continue to share my experiences with the students I teach and the wider Marin County and San Francisco Bay area community.



Amy Osborne teaches 2nd graders at Reed Elementary School in Tiburon, California about the animals that live in Antarctica. Photo by Erica Leinbach.

As we are developing a climate lab at NatureBridge, the environmental education organization I work with, we are looking at ways to connect place and place-based education to the larger picture of global climate change. The impact climate change is having on the polar regions and the research being done there offers an engaging starting point to talk about climate change impacts locally.



NatureBridge outdoor environmental science educators learn about Antarctica.

Taking It Home: Bringing the Science Back to my Classroom/Audience/Institution and Community

As an outdoor environmental science educator for a residential education non-profit, NatureBridge, my primary audiences are the educators who work for the organization, as well as the students I interact with as an educator each week. NatureBridge serves over 35,000 students annually and focuses on connecting students to the natural world through hands-on outdoor science experiences including student-driven investigations. I'm excited to use my field research experience in Antarctica to enhance the field investigations NatureBridge does with students. I envision using my Antarctic expedition to introduce and deepen the way I engage students in the process of field research. I'm also excited to use Antarctica and the research going on there to instill in students the concept of how we are all connected through one big ocean. I'm excited to incorporate more chemistry, physics, and engineering into the lessons I do in the field. Additionally, I plan to use the concept of growth rates and temperature to create more robust long-term community science projects and long-term experiments for NatureBridge educators and students.

Similar to working with a research team, the team of educators at NatureBridge is constantly collaborating so I'm very excited to bring my learning back to my colleagues. As a team of educators, I know we will have even more ideas of what's possible.



NatureBridge educators Carolyn Harper and Andreas Ratteray and Education Manager Alex Taylor conduct research on Rodeo Beach, Golden Gate National Recreation Area, Sausalito, California.

A Broader Reach: Post-Expedition Plans

Now that my expedition is over, I'm looking forward to staying in contact with Dr. Moran, Aaron, and Graham and to continue to collaborate with them to create lessons for both outdoor environmental educators and classroom teachers.

I'm also excited to continue to share my Antarctic expedition and information about the polar regions with a larger audience. In addition to connecting with NatureBridge staff and students and working on related projects with NatureBridge, I plan to continue to present to organizations across the country. Before my expedition, I shared my upcoming science adventure with schools in California, Colorado, Ohio, and Arizona. In addition to following up with them, I plan to share my experiences with a broad range of audiences including Marietta, Ohio's Natural History Society, Grand Rapids Public Museum and School in Grand Rapids, Michigan, non-profit organizations in San Francisco, schools in Washington State and Spain, and other outdoor environmental education organizations. I'm hoping to share my experience with the wider Environmental Education community at the North American Association of Environmental Education during their annual conference in October.

I'm excited to continue being a life-long learner by participating in field-research whenever possible and seeking out courses and professional development that relate to marine science, the polar regions, and field research. I look forward to seeing how my PolarTREC experience continues to shape me and the work I do with students.



Amy Osborne conducting her own research related to plankton in Antarctica. Photo by Graham Lobert