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Biology Student Goes ‘Fishing’ in Antarctica, Tin Can to the Rescue

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Graduate Student Amanda Biederman at Palmer Station (Antarctica)

By Kristin M. Distel

Graduate student **Amanda Biederman,** undergraduate **Elizabeth Evans ’16**, and **Dr. Lisa Crockett** spent April through June 2015 at Antarctica’s **Palmer Station**, where they studied the dominant fishes of the area and physiological and biochemical processes that limit their capacity to tolerate a warming climate.

Their journey to collect specimens near the Antarctic Peninsula took place during the colder months down under, and as icebergs blocked their way, a “tin can” saved the day.

The research trip was an integral part of Biederman’s doctoral research. Crockett, Professor of Biological Sciences at Ohio University, serves as Biederman’s dissertation adviser.

Palmer Station in Antarctica (Photo by Amanda Biederman)

The team is studying three species of icefishes:

- *C. aceratus* (the blackfin icefish)
- *P. georgianus* (the South Georgia icefish)
- *C. rastrospinosus* (the ocellated icefish).

They are also studying *N. coriiceps* (the black rock cod), a red-blooded species (i.e. "normal") from the same suborder (Notothenioidei).

Icefishes are extremely unusual animals. They represent the only adult vertebrate animals lacking the oxygen carrier hemoglobin, which is the pigment that makes the blood of all other vertebrates red. As a result the icefishes have white blood, and they can only circulate about 10 percent of the oxygen that their red-blooded Antarctic relatives can.

Trouble on the Water—And a 'Tin Can' Rescue

Preparation for the trip was complicated by the remote location of the Palmer Station research site, which is one of three U.S. research stations located in Antarctica. Check out the Palmer Station webcam.

"We had to foresee any challenges we might face," Biederman explains. Preparation for the research expedition took several months. The team had to bring precisely the right amount of chemical reagents and supplies necessary for their experiments.

The Laurence M. Gould, the team's research ship
(Photo by Cynthia Spence)

These challenges reached their pinnacle on the fifth day of the team's final excursion to collect fishes for their research, when several icebergs cohered and blocked their boat's path back to the research station. If the team did not return quickly to Palmer Station and transfer the specimens to tanks on land, the research would remain incomplete. Biederman explains that because of the cost of fuel and other materials needed to collect the fishes, the specimens themselves are valuable in both scientific and financial terms.

A rickety rescue boat, which Biederman notes was jokingly referred to as "the Tin Can," had to transport the team and their collected specimens safely back to Palmer Station. The boat, which is much smaller than the research vessel, the *Laurence M. Gould*, was able to weave between the ice floes. The team was able to preserve the life of many of the fishes and ultimately complete most of the experiments.

The "tin can" is one of the smaller boats on station used to support science, but it had never been used previously to offload fish from the *Laurence M. Gould*.

"The Tin Can" coming to assist researchers aboard the
Laurence M. Gould (Photo by Cynthia Spence)

"I think the success in overcoming this situation speaks to the small but incredible community that is Palmer Station," Biederman explains.

Next spring, the team will return to Antarctica to finish the second half of their grant and continue their research on thermal tolerance.

Climate of the Western Antarctic Peninsula

"The waters surrounding the Western Antarctic Peninsula are among the most rapidly warming regions on the planet," Biederman notes. "The temperatures in that region are increasing at a rate of about 1 degree Celsius per decade."

Over the four-decade span of her work there, Crockett has seen firsthand the dramatic changes that are evident around the Antarctic Peninsula.

Neumeyer Channel (Photo by Amanda Biederman)

“The Western Antarctic Peninsula is a different place than it was just 30 years ago. It is paramount that we gain a better understanding of how our warming planet is affecting the Antarctic marine ecosystem,” Crockett notes.

Due to these alarming changes, the Western Antarctic Peninsula is an important site for research concerning how and to what extent Antarctic organisms can tolerate increasing temperatures. Biederman explains that scientists are interested in whether the species of fishes that have adapted to such an intensely cold climate can survive in warmer temperatures.

In particular, the hemoglobin-less icefishes might be most vulnerable to warming.

“We want to know how the species adapted to that environment,” says Biederman. “In our collaborative project, we are looking at both cardiovascular and neurological function as potential physiological systems that may limit thermal tolerance.”

OHIO Team Focuses on Biochemical Function

The work that Ohio University’s lab team is doing examines biochemical function. In particular, Biederman’s research and dissertation are focused on membranes of heart and brain tissues. This research is part of the team’s larger interest in whether the animals can maintain heart and neurological functions as the fishes continue to warm with climate change.

“These fishes are living at temperatures that are at about -2 degrees Celsius,” Biederman says. “That’s one of the reasons people are so interested in these fishes. They function at body temperatures that most other animals on the planet cannot.”

Graduate Student Amanda Biederman in Lab at Palmer Station

“I am attempting to find out whether it is possible that the biological membranes associated with the heart and the brain themselves can function in a warmer environment,” Biederman explains. “Membranes can only work within a certain temperature range, so if the membrane becomes too cold it becomes gel-like and rigid. Different molecules can’t pass through it, and protein function and movement can be hindered. On the other hand, and this is true for all species, if the membrane becomes too warm, it becomes disordered. There’s too much movement. We’re curious about the point at which the membrane becomes too disordered to function.”

OHIO Researchers Joined by Other Scientists

Antarctica Research Team (Left to Right: Stuart Egginton, Amanda Biederman, Anthony Farrell, Theresa Grove, Lisa Crockett, Kristin O’Brien, Iskander Ismailov)

OHIO’s researchers were accompanied by several other scientists: Dr. Kristin O’Brien of University of Alaska Fairbanks, Dr. Anthony Farrell of the University of British Columbia, Dr. Stuart Egginton of the University of Leeds, Dr. Iskander Ismailov and Mr. Jordan Scharping of Virginia Tech Carilion School of Medicine, and Dr. Theresa Grove of Valdosta State University.

All members of the team were stationed in the Western Antarctic Peninsula. Crockett and O’Brien served as co-Principle Investigators for the team’s grant (NSF ANT 1341602 and NSF ANT 1341663), which was

funded by the National Science Foundation. **Dr. Donald Kuhn**, who is a research assistant professor at Ohio University, stayed behind to get a head start working on frozen samples that were returned to Athens halfway through the field season.