WINTER LIMNOLOGY ON THE RISE

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Winter lake ice presents unique challenges to limnological research and science outreach. Unfortunately, few aquatic scientists are trained for limnological work on frozen lakes, including ice safety, operating standard limnological gear in subzero temperatures, collecting samples from under snow and ice, or even dressing for the cold, windy, and wet conditions winter limnologists routinely encounter. This gap in training has slowed progress in understanding the responses of seasonally freezing aquatic ecosystems to climate change.

The Winter Limnology Network is a new project supported by the U.S. National Science Foundation to develop a network of winter-ready aquatic researchers with the goal of advancing understanding of year-round ecosystem function in the face of climate change. The research uses a team science approach, welcoming participation from researchers who want to engage in paired winter-summer sampling. It builds on the "Ecology Under Lake Ice" project and networks developed at the National Center for Ecological Analysis and Synthesis, a 2019 AGU Chapman conference, and an ongoing Winter Limnology working group in the Global Lake Ecological Observatory Network. The Winter Limnology Network investigators are actively collaborating with another NSF-supported winter limnology project—the "Thin Ice" group (Rebecca North, Isabella Oleksy, Meredith Holgerson, David Richardson, Mindy Morales).

To help build capacity for winter research, the Winter Limnology Network kicked off their work with a "Winter School" event in March 2024. Twenty-two early career limnologists and the Winter Limnology Network lead team gathered at the University of Wisconsin–Madison's Trout Lake Station for a comprehensive winter limnology training workshop. Participants conducted hands-on winter field research, and contributed to discussions about team science and science communication and outreach. Attendees included graduate students, postdocs, pretenure faculty, and practicing conservation scientists from the US and Canada.

The workshop was planned for mid-March to ensure adequate ice conditions in the Wisconsin Northwoods. Recorded since 1982, the average ice-off date for Trout Lake is April 25th. However, the strong El Niño–Southern Oscillation winter of 2024 brought with it mild temperatures and snow-drought, and left the group with one final week of strong ice before the ice thawed in early April. This early thaw, compounded with the latest freeze date on record, marks 2023–2024 as one of the shortest ice durations since 1982. Abnormal ice conditions are unfortunately becoming more common, which stresses the need for adequate training on safe ice practices.

The workshop began with a full day of ice safety training led by professional ice safety instructors who normally work with first responders (Fig. 1). Participants learned about managing risks while working on ice, assessing ice conditions, helping others in distress, and self-rescue. Students got the chance to put on float suits and jump into the frigid water to experience the shock of falling through the ice and pulling themselves to safety with their ice picks, with a crew on ice ready to assist. Understanding how to assess ice safety and learning how to respond in case of an accident was critical for enabling participants to engage in the science that followed. It was a learning experience for everyone, including the ice safety instructors who learned the word "limnology"!

FIG. 1. Ice rescue instructors demonstrate an assisted rescue from the ice. Photo credit: Steven Sadro.

FIG. 2. Demonstrating the use of an ice jigger for running lines underice. Photo credit: Steven Sadro.

In the following days Winter School students practiced working with augers and ice saws to create holes for sampling, and set up ice shelters for warmth. Participants also learned techniques for setting gillnets and horizontal instrument strings under the ice (Fig. 2). They brainstormed research questions that might be addressed by 2 days of intensive sampling during the workshop, set up the protocols to gather data, trained each other on using different instruments, and created data tracking and analysis pipelines. Participants worked with the workshop organizers to determine the safety of ice conditions at Trout Lake and Trout Bog, and then practiced deploying standard sensors under ice as well as collecting samples for water chemistry and plankton counts. A day was spent compiling and analyzing the data that were collected, during which participants also shared their data analysis and visualization skills with one another. Participants worked together under open science principles, and developed policies for collaboration, data sharing, and authorship. The participants are working with the Winter Limnology Network leads to develop a manuscript based on the data they collected during the highly unusual conditions they encountered this winter.

The Winter Limnology Network hopes to be able to offer this training again in future winters, and we look forward to our trainees contributing to winter knowledge in our project and beyond! If you are interested in joining our network effort and contributing paired summer-winter data from seasonally frozen lakes, please visit our project website (https://winter-ice.github.io/winter-ice/) or contact any of the authors.

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THE COVID-19 PANDEMIC AND ITS IMPACT ON NATIONAL SCIENCE FOUNDATION'S OCEAN SCIENCE DIVISION RESEARCH EXPERIENCES FOR UNDERGRADUATES

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The US National Science Foundation's (NSF) Research Experiences for Undergraduates (or REUs) are months-long, full-time, experiential learning programs run by host institutions within the United States—such as Universities, National Laboratories, museums, and others—where undergraduate students are given the opportunity to learn from and work alongside faculty and/or researchers on specific projects. This offers aspiring researchers paid, hands-on experience in their fields of interest from earlier stages in their scientific careers. REUs also facilitate networking interactions, exposure to the research process, and access to state-of-the-art equipment for passionate and hardworking individuals. The REU programs seek to recruit applications from students who attend institutions that do not offer research internships, who come from minoritized populations, or who otherwise would have a greater difficulty accessing these opportunities.

A longitudinal survey of student participation in the OCE REU sites carried out by NSF's Geosciences Directorate annually since 2009 has provided insight into the changes in the demographic composition of REU student cohorts that occurred in response to the COVID-19 pandemic. In the three years prior to the start of the COVID-19 pandemic in late 2019, OCE REUs had experienced an overall increase in the participation of students belonging to minoritized ethnicities. However, after March 2020, trends began to shift. The student demographic collected by REU Principal Investigators indicate that, although the overall REU participation increased from 332 students in the 2020–2021 academic year to 356 students in the 2021–2022 academic year, the percentage of participation by students from minoritized races and ethnicities decreased from 64% to 58% within that same period. This includes a reduction in participation by African American, Hispanic/Latinx, and Indigenous American students. In addition, participation by students identifying as Females decreased from 63% to 61%.

The country-wide lockdown issued by the United States in March of 2020 caused unprecedented logistical chaos in multiple sectors. As academic institutions and programs pivoted to adapt to the new social distancing requirements, roadblocks and challenges to student participation that had not yet been identified were brough to light. Many students, for example, experienced reduced access to technological resources and secure network connections, which were now essential for a successful REU participation. Others expressed not being able to participate in programs offering online or hybrid modalities due to pandemic fatigue and/or a lack of safe spaces within their homes that would allow them to focus on research. Many of these external factors disproportionately impacted students from minoritized groups within the United States and have been mentioned by REU leaders as potential contributors to the decrease in their participation.

Despite its adverse impacts, the COVID-19 pandemic has generated opportunities for better understanding the wider scope of limitations that underserved populations face participating in these programs. As the COVID-19 pandemic wanes and social distancing rules are lifted, OCE REUs are slowly regaining the momentum they need to continue to build a capable and diverse scientific workforce by shortening the gap between an early exposure to research in undergraduate programs and underserved populations in the United States. Moving forward, the