Winter research in Great Lakes will help scientists understand climate change and what happens when ice disappears

March 2 2022, by Morgan Greene

The Antarctic ice sheet. Credit: Stephen Hudson / Wikipedia

A group of scientists walked out on to frozen Lake Michigan to do something they've done time and again throughout the Great Lakes: collect water.

They drilled down past the shoreline of a park in Green Bay, Wisconsin, where it was quiet enough to hear the ice pop as sunlight warmed the frozen surface.

But back on land, everything started to freeze. Pens, people's hands. Most concerning, the water samples.

The work was part of the first coordinated sampling across all five Great Lakes to figure out what's happening in one of the world's largest freshwater systems in winter—something scientists know surprisingly little about.

The first attempt wasn't without challenges, but researchers see the work as an overdue and necessary step toward understanding a fast-changing season in which ice could become increasingly rare.

With sampling of more than 30 sites from Lake Superior to Lake Erie wrapped up, some Chicago researchers will now play a key role in making sense of the lakes' tiniest members—who pose some of the biggest mysteries.

Microbes—including bacteria and viruses—are generally smaller than the naked eye can see. Yet they wield significant power, especially as the Great Lakes respond to climate change.

"Maybe we projected that as humans, we sort of hunker down in winter, and stay indoors and watch Netflix. So maybe all the biology is hibernating," said Maureen Coleman, associate professor of geosciences at the University of Chicago. "But clearly it's not."

Coleman began the first long-term study of Great Lakes microorganisms in 2012, leading to the discovery of hundreds of new species.

Her lab will analyze samples from the Great Lakes sites to get a better picture of what the minuscule sentinels are up to. Analysis will likely take a few months once all the samples arrive, Coleman said, and then scientists will work together to make sense of the results.

"It's a great endpoint because we're going to have data," Coleman said. "It's also a great starting point for a lot of future work."

'Microbes doing their thing'

It can be hard to navigate the Great Lakes in summer, between weather conditions that change on a whim and the planning required to sail out. In winter, ice arrives, ships dock, buoys are pulled. Research involving humans is likely to require some bundling up, not to mention a strong constitution.

While conditions may be extreme for us, some microorganisms may be accustomed to the cold, Coleman said. In the depths of Lake Superior, for instance, microbes are actively growing all year round, even when they're enveloped in frigid water and darkness.

"That may seem inhospitable to us," Coleman said. "But that's what they're adapted for, so they don't mind. That's how they live."

When it comes to winter, Coleman said she's curious to see if there are cold specialists, and expects there will be "plenty of microbes doing their thing."

"We have a bit of a feel for who lives throughout the Great Lakes at different depths and in different lakes," Coleman said. "Now we're excited to see how the winter community compares to that spring and summer community."

Already, there have been some unexpected realizations.

"It was a surprise to me to realize that maybe there's actually more photosynthesis happening under ice than without ice," Coleman said.

Light can penetrate ice, and the ice calms water below, which can prevent photosynthetic organisms from mixing down to the lake bottom, or cloudy sediment mixing up. How much photosynthesis is happening has implications for how many fish can be supported later in the year.

At Green Bay, water under the ice was bright green, Coleman said, and although it was likely not a harmful algae bloom, photosynthesis was in full force.

Coleman's lab has collected samples for years with the U.S. Environmental Protection Agency in warmer months, which researchers can now use to make connections between winter conditions and what might happen later.

"It's not just confined to the winter," Coleman said. "There are these longer term impacts."

Among samples coming out of the freezer will be some taken near the Apostle Islands National Lakeshore, where unexpected algae blooms have turned clear water green. Bloom predictors would be a welcome development as scientists try to figure out why potentially toxic blooms are happening in a lake that has largely escaped human blight.

In Lake Michigan, the proliferation of invasive quagga mussels offers an example of why a baseline is important, Coleman said. "Our understanding is that the mussels have just completely changed the microbial community, but we don't have samples from pre-quagga mussel time, so it's hard to say."

As samples come in to the lab, analysis will involve steps including DNA extraction and sequencing a gene that serves as a bar code for different species, Coleman said. Sequences can then be compared between sites, as well as with spring and summer samples to see if there are, in fact, cold specialists.

'Oh my gosh, it's frozen'

A hole in the ice stretching a few feet in a lake with a shoreline that stretches more than 1,600 miles won't paint a complete picture. But the winter research was a first step, said Michael Henson, a postdoctoral researcher at the University of Chicago who was out on the ice at Green Bay.

"This is an active, living, breathing ecosystem under the ice, and it's time we start treating it like that," he said.

To get the clearest picture of what was happening at Bay Shore Park in Green Bay, with a temperature in the teens and some ice fisherman in the distance, the original plan was to filter on site.

U. of C. graduate student María Hernández Limón, used to sampling on the Lake Guardian, the EPA's Great Lakes research vessel, said the trip required more thinking on the fly.

"It's the technology, it's the protocols, but it's also we as humans are not meant to be out in chilling temperatures," Limón said. "You want to move fast but your fingers are just not responding."

Researchers set up a filtering apparatus on a nearby picnic table. But water froze as it moved through the lines. The group moved from the table to the back of a van, hoping some heat would help.

They ended up hand filtering the water, pumping it through syringes like you might see in a doctor's office—not the easiest task with water from Green Bay, an algae hot spot.

"There's a lot of living things there and they are quite active," Henson said, which can make filtering more difficult.

By the end of the hourslong stretch outside, the group collected its data, even if the process unfolded differently than imagined.

"Oh my gosh, it's frozen," Henson said. "The theme of the day."

Despite the cold, Limón spent some time marveling at the frozen expanse. But she was also filled with a sinking feeling, she said, "to think that there will come a time in my lifetime when there might not be ice."

'What's happening on the lakes hits home'

The sampling effort, coined the Winter Grab, reaches back to a 2019 summit on winter limnology—the study of lakes—which led to an article published last year on what's known about changing winter conditions and what could help grow existing knowledge.

With major climate shifts projected ahead as a result of human action, largely the burning of fossil fuels, winter warming is expected to lead to diminishing ice cover. Already, maximum ice coverage is decreasing at a rate of 5% per decade and there are fewer days overall with coverage.

"When we think about the effects of climate change, seeing what's happening on the lakes hits home," Limón said. "We're seeing less ice coverage. We're seeing that the winters are more mild."

What happens in winter can affect what's happening months later, and ice coverage plays a major role. But, the study noted, it's tough to say or understand those consequences with a lack of winter research.

"After all, how can we predict and manage the future of an ecosystem if we do not understand how it functions for significant portions of the year?" the study said.

Henson said he likes to tell people microbes are the first responders.

"They're going to best help us predict what the future water's going to look like, by understanding how they're changing and are impacted by the decreasing ice coverage," he said. "This work is critical for us to begin to understand what happens as ice coverage stops, and the waters warm."

For those living around the Great Lakes, a growing body of research could mean fewer surprises from a system that provides drinking water to millions of people, as well as an escape from hot summer days.

"You don't want to be walking around the lakeshore, looking to your left or right, and seeing a giant swath of green algae everywhere," Henson said. "And you can't swim. You can't actively participate. You can't drink that water."

Ted Ozersky, the organizer of the Winter Grab and an associate professor at the University of Minnesota Duluth, said sampling overall was surprisingly smooth, aside from hiccups like snowstorms that caused delays.

The University of Minnesota Duluth will hold on to some samples for analysis, and send others around the Great Lakes, including to Coleman's lab at U. of C.

Ozersky said a heartening outcome of the project is the collaboration between researchers with different specialties coming together to answer a yet unresolved question: "What the future of winter is going to be like here in the Great Lakes."

Citation: Winter research in Great Lakes will help scientists understand climate change and what happens when ice disappears (2022, March 2) retrieved 6 August 2024 from https://phys.org/news/2022-03-winter-great-lakes-scientists-climate.html