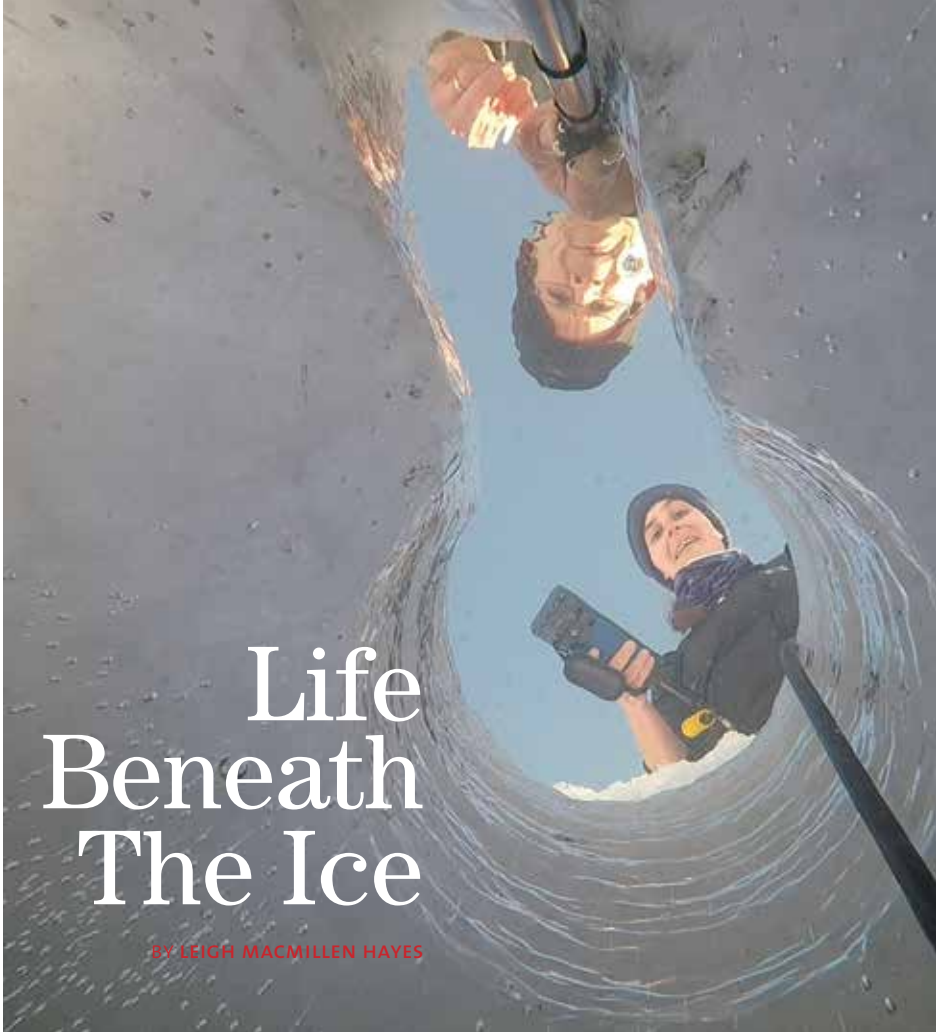

Life Beneath The Ice

BY LEIGH MACMILLEN HAYES

A calm winter day. Freezing temps. Thickening ice. A lid is placed on the ecosystem below. And all aquatic life goes dormant. Or does it?

Water is unusual in that its solid form is less dense than its liquid form (Think: ice cubes float in a glass of water). For most substances, the solids are denser (heavier) than the liquids. If that were the case for water, when it freezes the ice would sink to the bottom and then start to pile up, thus crushing all aquatic life in our lakes and ponds.

Thankfully, that's not how water chemistry behaves. Instead, in late fall, the atmospheric temperature starts to dip below freezing. This causes the upper layer of water to cool. When the surface water temperature falls to 4˚C (39.2˚F), the water acquires maximum density and sinks. The water that sinks displaces the water below and the lower layers simultaneously rise toward the surface, get cooled to 4˚C, and the process repeats. As the surface water cools below 4˚C, density starts to decrease and the water no longer sinks. The surface water finally freezes at 0˚C, while the water below remains at 4˚C.

The ice that forms creates an insulated cover that actually helps the water underneath to retain its relative warmth throughout the season, relative meaning 4˚C, except the water immediately below the ice is on the order of 0.5˚ to 1˚C. Also, oxygen gets trapped beneath the ice. As a result fish, and other aquatic animals find it possible to survive.

But it's what is going on below that intrigued Dr. Ben Peierls, Lake Environmental Association's research director, to take a closer look. Early in his career, Ben participated in a trip to study below-ice conditions. That project remained on his mind and subsequent research by the scientific community further compelled him to conduct a study. LEA has compiled extensive data regarding the annual cycles of our area's lakes and ponds, but Ben notes that there is a gap in that knowledge when it comes to winter.

According to Ben's 2022 Winter Monitoring Report posted on LEA's website: "Climate change plays a large role in the increased interest in winter lake conditions. Long-term records of lake freeze and breakup dates show that ice cover periods have decreased significantly for many places. Less time with ice cover has and will lead to a reduction or loss of cultural and recreational activities. The impact on water quality throughout the year from a reduction or loss of ice cover is not as well known. So to fill that void, researchers have increased efforts to study lakes during winter and improve basic understanding of winter conditions and how those might link to open water periods."

"That gap and the neat factor were the impetus," he says. And so, in 2018, he and a couple of other LEA staff members trudged across Highland Lake in downtown Bridgton to reach its deep spot. That's where summer water quality tests are conducted.

Using an ice auger, a seven-inch hole was created, big enough to lower a multi-parameter sonde connected to a handheld data logger into the water column and measure a depth-based profile, dissolved oxygen, temperature, conductivity, pH, and turbidity. They also measured the thickness of the ice, amount of snow on it, and noted its layered structure, sometimes clear, other times black or mushy depending on recent weather events.

Over time and subsequent years, Ben added new tricks to the research, such as sawing dumbbell or key-shaped holes to accommodate larger gear like a Secchi Disk (flat disk with two black and two white quadrants) to measure water clarity.

In addition, he measured light levels above and at several depths below the ice using an underwater quantum sensor. That meant covering the hole with layers of window screens to prevent any ambient light from affecting the reading.

One of the surprises," Ben notes, "was learning how snow played a role. Light is an important resource that algae need to grow. Without light, they sometimes won't grow."

Snow melt or slush on top of the ice, which occurs more frequently with warming winter temperatures, make the ice less transparent and therefore allows less light to reach the water below.

Overall, however, Ben is quick to point out that the data he and his team have gathered so far is only a baseline and Secchi readings have been comparable to summer; they have not noted any major changes in winter water quality.

The basic conditions were confirmed. There's still a healthy algal community and the zooplankton, like copepods, seem happy.

By winter 2022, Ben was visiting thirteen local lakes and ponds two or three times (LEA conducts testing on 42 ponds in the summer). He was a bit surprised to discover the the oxygen in some declined to zero.

Backswimmer

"Organisms that use oxygen for respiration are going to use it up if there isn't aeration," he explains to me. "If we see a period of low oxygen in the winter, does that have an implication for the next season?" That question still remains to be answered.

Though he tried to choose days with low wind and less brisk temperatures to conduct the research, he's grateful to the people who live closest to the deep holes because it can be a long trudge from a boat launch as you drag a sled full of equipment. On board the sled: the ice auger, sonde, Secchi, and light meter, plus a saw to widen the hole into that key or dumbbell shape, a homemade ice measuring gauge, portable depth finder,

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Ptilostomis and case


Salamander larva

GPS, Aquascope to look into the water and spot the Secchi Disk, collection bottles for chlorophyll and phosphorus water samples, core tube to collect water, ladle to keep ice chips out of hole and ice picks in case someone accidentally falls in.

In addition to the water quality data collection, Ben has seen springtails, aka Collembola, in the middle of a hole, and occasional high density of zooplankton and algae.

"This is all information that's not been collected in the lakes region previously," says Ben. "We're not the pioneers, but we're following the steps of others. That's how science works." And hey, he gets to gather important data in a variety of beautiful winter settings.

Since it's not uncommon by mid-winter to see a near absence of oxygen in bottom waters, ice fishermen are well aware of the manner in which many fish species rise to higher levels in a lake.

Bill Robblee, co-owner with his wife Coreen of Willy C's Bait and Tackle shop in Brownfield explains, "The water is the same temperature throughout most of the column so the fish can move around more. You can catch multiple species with a jig pole."

Lovewell Pond in Fryeburg is one place that he enjoys fishing with family and friends because it's easy to catch Pickerel, Perch, and Black Crappie there.

"Once," he says, "I had a camera in the water and had a piece of dead bait on the jig line. When I turned the camera on, the bait was gone. I could see a puff of dirt where the fish had grabbed the bait off the bottom. Someone used a jig pole with a piece of bait, started jigging and caught a lake trout."

Likewise, Dr. Edwin Barkdoll, veterinarian of Surry, Maine, chose to examine pond life in the winter, a project which he turned into a twenty-minute film entitled "Pond Life: Under the Ice" for his Maine Master Naturalist capstone in 2017.

"If you are anything like me," says Edwin, "you might have thought that as winter deepened, pond life enters a dormant phase under the frozen surface just waiting for spring to start a renewal cycle."

In early February of 2017, Edwin cut a two-by-four foot hole in the ice of a local pond. The air was -6°C (20°F) and ice 8-inches thick. The temperature of the water below the ice was 1°C (34°F), just right for cold blooded animals (their internal temperatures adjust to match the temperature of their environment). At this low temperature, their metabolism slows down, they don't need as much energy, they move more slowly, and they require less oxygen—all adaptations, but life still goes on and predators still find prey.

Having heard Edwin give his presentation several times, I can only imagine his initial delight and surprise when he looked at the photographs and videos captured on a waterproof Olympus Point and Shoot Camera that he'd attached to a long pole. Also cobbled onto this home-made piece of equipment were two underwater lights.

Suddenly the world below came into view and he watched micro-invertebrates such as copepods and Daphnia swarming through the water column in a show of their own. The copepods' movements ranged from drifting to rapid jumps and the Daphnia used rhythmic beating of many small legs to capture food.

Another time he took a photograph of a one-square foot section and with keen eyes noted between ten and twenty macro-invertebrates partially camouflaged on the bottom sediment—admitting he may have missed a few. Most abundant among his findings: Caddisfly larva feeding on organic matter or detritus on submerged rocks, logs, and plants. He even found one foraging on the underside of the ice.

Water Boatmen, Back Swimmers, and Whirligig Beetles, all species we observe frantically moving about on the water's surface in the summer, swam more slowly in the colder water. Leeches were present as well, though Edwin is quick to note, "Not all leeches are blood suckers. Many are predatory—eating mosquito and other larvae."

Among the vertebrate species he observed larval salamanders, Bullfrog tadpoles, which take two years to mature, and adult Eastern Newts.

"The first day I went out," says Edwin, I didn't have neoprene or long gloves. After lying on the ice for maybe ten minutes, I was actually stuck to it. And my arm was basically a block of wood. You get cold really fast."

This winter, as you venture out from the comfort of your cozy home and journey across the ice, take a moment to consider the life beneath the ice. The action may be different from summer, but despite the ice, it's still an active environment. ☼

FMI: Read LEA's 2022 Winter Monitoring Report: www.mainelakes.org/wp-content/uploads/2022/05/LEAWinterMonitoringReport2022.pdf

View Edwin Barkdoll's Pond Life: Under the Ice on YouTube: https://www.youtube.com/watch?v=G5r5wXq_4VM

Visit Willy C's Bait and Tackle Shop, 941 Pequawket Trail, Brownfield, or on Facebook