EDITOR: ROB McCORMICK
745-4641 ext. 244
fax 743-4581
life@peterboroughexaminer.com

LIVING

Watching winter's ice

OUR CHANGING SEASONS
Drew Monkman

On an average year — if the word "average" makes sense any more in a time of climate change — the Kawartha Lakes are usually frozen over by mid-December. As a rule, they will be sealed off by a lid of ice until early April. How the ice forms and the ways in which life carries on in the darkness underneath are quite fascinating.

During the summer, the deeper Kawartha Lakes all function as two separate lakes, with a warm lake on top of a cold one. In much the same way as oil floating on water, summer lakes are very resistant to mixing. The difference in density means that there is almost no intermingling between the two. However, with the long, cool nights of fall, the surface waters eventually cool down to the same temperature (4 C) and density as the uniformly cold, deeper waters below. Currents, which are caused by wind action, can therefore thoroughly mix and oxygenate the entire lake. Water can actually absorb oxygen by direct contact with the air. This phenomenon is known as the fall turnover, and it continues until early December, when ice seals the lake off from terrestrial influences. At times, the mixing even brings dead weeds and other debris from the lake bottom to the surface. Anglers sometimes comment on the fact that the water looks dirty or even smells musty. This "breath of air" will have to last all winter, since ice will soon cut off the waters from further oxygenation.

Water is a truly remarkable substance. When it cools below 4 C, something remarkable occurs. Instead of becoming denser and sinking like other compounds, it actually begins to expand and becomes lighter. Being colder and lighter than the water below, it stays on the surface of the lake. As the water is cooled even more, the expansion continues until zero is reached. At this point, the water molecules lock into the pattern of a solid and form ice. In his marvellous book Winter, local author and naturalist Doug Sadler writes: "To the physicist as to the layperson, the suddenness of the metamorphosis is truly astonishing. It is as if tension builds up to an unbearable point where it has to be released in a sudden, orgasmic moment of creation." The expansion of water from 4 C up to the point of freezing means that the ice is 10 per cent lighter than the water below, and therefore floats on the surface. It also means that it takes up more room than the water it was made from. This property explains why ice forming in pipes can break them.

Ice forms first along shorelines and in bays. This is mainly because the water is usually moving much more slowly along the lake's edge as compared to the middle of the lake. Water at the lake's edge cools slightly faster, as well, since it is in contact with the colder shoreline, where the land is losing heat much faster than the water. The moving water in the middle of the lake is actually warming itself up very slightly from the friction of the water molecules banging into each other. A classic experiment by J.P. Joule demonstrated that by stirring water you can actually slightly raise its temperature. However, cold night air will eventually negate any warming effects, and the lake will freeze completely. Although it seems to be counter intuitive, ice will still form in the presence of waves. It would appear that the molecular bonding which results in freezing goes ahead regardless of wave action.

In some lakes, such as Jack Lake near Apsley, underwater springs are continually providing geothermically warmed water to the lake, which delays freezing. There is usually open water on Jack Lake for a week or so after the surrounding lakes have frozen.

You may also wonder why the ice does not extend right to the lake bottom. Obviously, if this was to happen, it would be devastating for any living creatures in the water. The explanation is fairly simple. Since ice forms on the top of the water, it puts an insulating layer between the water below and the colder air above. The blanket of snow that soon accumulates adds further insulation and greatly slows the formation of more ice. Even with these insulating layers, we can still get nearly a metre of ice.

Strange things can happen when freezing is sudden. Water usually contains dissolved air, but when it freezes, it gradually expels the air. However, if there is a rapid drop in temperature, some of the expelled air can get trapped before it has time to escape. This explains why you sometimes see bubbles frozen in the ice as they were rising to the surface. "At times this results in an impression of time being frozen," as Sadler puts it.

Life processes go on under the ice. Dissolved oxygen allows for gill-breathers such as fish, insects, crustaceans and other organisms to remain semi-active. Being cold-blooded, however, they tend to move more slowly in the frigid water. Because light levels are reduced as snow cover accumulates, the combination of low light and low temperatures brings photosynthesis by algae and certain bacteria almost to a complete halt. This means that very little new oxygen is being added to the underwater ecosystem. The only other source of oxygen during the winter in some of our lakes is from inflowing streams and springs.

Over the course of the winter, respiration by plants and animals is still taking place, so dissolved oxygen in the water continues to be used up. This can become a serious problem in shallow bodies of water with a lot of aquatic vegetation, sometimes leading to large die-offs of fish from asphyxiation. The lake will have to wait until the ice-cover melts in the spring for another full breath of air.

With no photosynthesis, there is no plant growth and therefore far less food available. The only way for organisms to cope with this is to slow their metabolisms. Some species of fish, for example, eat virtually nothing during the winter, while others continue to feed. Smallmouth bass almost starve themselves and that is one reason why so few bass are ever caught by anglers during the winter. Carp and bullheads will actually settle into the mud of the lake bottom and remain partially covered all winter. Walleye, perch, crappie, pike, whitefish and trout, on the other hand, remain relatively active and are pursued by anglers.

If you are out walking on a lake this winter, take a moment to reflect on the massive ice cube floating under your feet. Understanding the process of ice formation and how life is able to carry on in the black, cold abyss underneath adds another element to one's appreciation of nature in winter.

What to watch for this week

This is a good time to look for small numbers of ducks that linger until freeze-up. Some will even stay here all winter in areas of open water such as the Otonabee River and parts of Lake Katchewanooka. It is usually possible to find common goldeneye, common merganser, hooded merganser, mallard and American black duck. A small number of common loons, too, stay until the ice comes. These are usually young-of-the-year birds in juvenile plumage.

Drew Monkman is a Peterborough teacher and author of Nature's Year in the Kawarthas. He can be reached at dmonkman1@cogeco.ca. Terry Carpenter is an award-winning local nature photographer. Go to www3.sympatico.ca/terrycarpenter/ to see more of his photographs and to contact him.

Terry Carpenter, special to The Examiner

The Indian River, near the Warsaw Caves.