

What goes on under all the ice?

Record cold temperatures during the winter of 2013-14 has resulted in thick ice cover over most of Vermont's lakes and ponds. So what will happen when and if spring ever comes?

During the winter the temperature of the water just under the ice is at or just above the freezing point of water (0°C, or 32°F). Water below the first few feet will actually be warmer, relatively speaking, and may be near 4°C, or 39°F. That temperature was determined back in the fall when the lakes first froze over and the wind could no longer mix the water under the ice. Prior to ice formation most lakes will mix and cool until the water reaches its maximum density (heaviest per unit volume) at 4°C. Below that temperature the density of water decreases and will, "float", on the more dense water below. Under these conditions, continued cooling will result in ice formation. Cold air temperatures contribute to thicker and thicker ice being formed, while snow that accumulates on top of the ice forms an insulating layer that reflects solar radiation and keeps the ice from melting on sunny days.

As spring approaches and the sun gets higher in the sky the snow will melt exposing the ice to the sun's radiation. As the ice darkens more and more radiation is absorbed and the ice begins to melt and break up. Sometimes the ice gets blown to shore like a bulldozer moving rocks and docks in its path. Other times, honeycomb, icicle-like, forms are created that get blown to shore where they pile up in beautiful crystalline formations that sparkle in the sunlight.

When the surface water temperature reaches the temperature of maximum density it begins to sink and mix with the deeper waters of the lake. Once the water surface of the lake is exposed to the wind additional mixing can take place and the phenomenon of spring overturn commences. During this time deeper waters are brought to the surface carrying nutrients (N, P and Si) that were trapped at the bottom. The combination of increasing nutrient concentrations and more sunlight trigger a spring bloom of algae in the lakes that form the base of the food web that ultimately leads to fish and frying pans.

In shallow organically rich lakes the bottom waters may become depleted of oxygen under the ice resulting in winter fish kills. As mixing proceeds in the spring oxygen from the atmosphere is mixed downward to restore conditions where fish and other organisms can survive.

Continued warming of the surface waters results in conditions more familiar to summer swimmers and fisher persons, when warm water at the surface overlies colder more dense water below.

After such a long cold winter, let's hope this condition come soon in 2014!

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