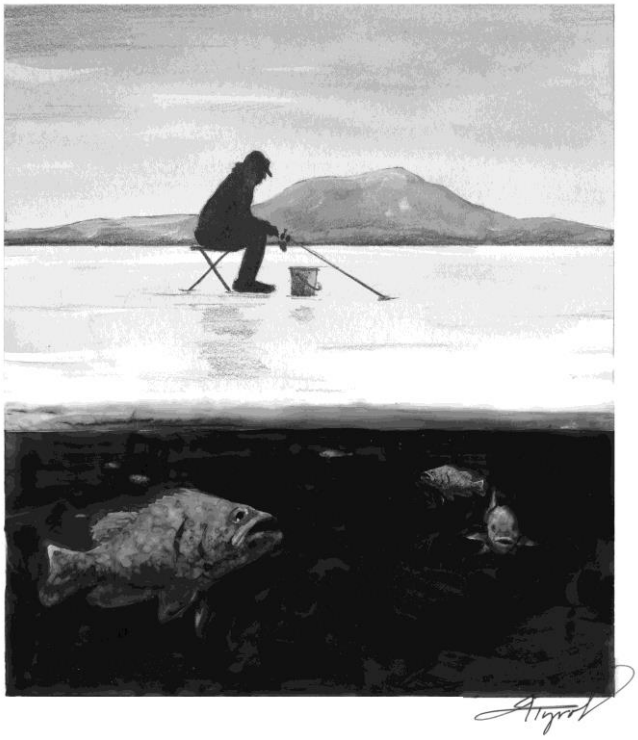
The Outside Story



Life at 39 Degrees

By: Declan McCabe

On a picture-perfect winter morning last year, 20 Saint Michael's College students and I visited Vermont Fish and Wildlife scientists for ice fishing at Knight's Point on Lake Champlain. We drilled holes, baited hooks, learned about ice safety, identified fish – and even caught a few.

The ice we tentatively walked on provides unshakably constant temperatures for those living in the water below. Burlington's February 2019 air temperature ranged from 72 degrees to negative 30, but water temperatures in Lake Champlain fluctuated a mere seven degrees, from 32 just beneath the ice to 39 degrees at depth.

This aspect of the under-ice environment never changes; 39-degree water remains a winter constant unless lakes freeze solid or stop freezing altogether.

Water is most dense at 39 degrees. When it cools below that temperature, it expands, which is why ice floats. In frozen lakes, the coldest water remains just beneath the ice, where on very cold days that water freezes, adding to the thickness of the ice. Meanwhile, the denser, 39-degree water sinks below this near-freezing layer and extends all the way to the lake floor. Fish, insects, amphibians, and a few brave mammals are exquisitely attuned to this winter reality.

The creatures who survive under the ice have evolved over eons, fine-tuning their physiology and behavior to thrive at that specific 39-degree mark, which remains a winter constant from year to year and lake to lake. Just as our enzymes work best at a body temperature of 98.6 degrees, fish enzymes work best at fish body temperatures, which change with the season. As lake water cools, fish stop making enzymes that worked in summer temperatures and start producing winter versions.

Different fish species take different measures to survive this chilly winter water. Some, like yellow perch and large-mouth bass, adjust by slowing their activities, metabolisms, and need for food. Others, like northern pike, remain more active. But even less lively fish can still be tempted by a tasty morsel; ice fishing in the North Country may yield yellow perch, salmon, trout, walleye, and rainbow smelt.

Smelt have an unusual ace up their fishy sleeves for survival at low temperatures: antifreeze. As temperatures cool, smelt produce increasing quantities of glycerol. Combined with antifreeze proteins, glycerol keeps smelt moving, even at temperatures below 32 degrees. This trait is

useful for smelt populations that migrate to sea, where the saltwater freezes at 28 degrees. It also explains why a baited hook dropped through a hole in lake ice can land smelt in even the coldest conditions. And for those lucky to catch enough smelt for a meal, the glycerol contributes to the sweet taste of this fish.

Many of New England's frogs also overwinter under ice. Contrary to popular belief, few frogs hibernate buried in mud. These amphibians absorb oxygen directly through their skin, an impossible feat in anoxic mud. Frogs are typically found on top of the lake or pond floor, and often near inflowing streams and seeps, where currents deliver oxygenated water. Although frogs in winter cease feeding and slow down to conserve energy, if stimulated they can still move and swim.

Springtime melt brings a gradual transition from ice to open water at a rate that allows organisms to adjust. Once water warms from near freezing to 39 degrees, density differences disappear, resulting in a fleeting uniformly warm water column. Gradually, the surface water will warm even more, but there'll still be plenty of cold places at depth. Life within the lake adjusts to the changes.

As the water warms, frogs stretch their legs once more, surface for air, and return to full activity. Fish stop making cold-optimized enzymes and switch to summer equivalents, and they increase their foraging.

Some fish, however, continue to seek cooler waters even in the heat of summer. Rainbow smelt eschew warm shallow water and migrate to deeper, cooler haunts. More than 90 percent of the 1,600 smelt University of Vermont researchers netted during a 2007-2008 study came from 60 feet below the surface or deeper, where the water temperature was 45 degrees and cooler, even in mid-summer.

And what of our winter ice fishing adventure? Twenty students fishing for two hours yielded three yellow perch, none of edible size and all dutifully returned from whence they came. It seems we are little threat to Lake Champlain fish stocks, and should be grateful for a well-stocked cafeteria.

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Northern Woodlands
PO Box 270, Lyme, New Hampshire 03768
Tele: 603.795.0660 eFax: 603.410.4675
www. northernwoodlands.org