Stirred, not shaken, lake mixing experiment shows promise

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To see if changing the temperature profile of Vilas County's Crystal Lake would drive out rainbow smelt, a small invasive fish, a novel system using trampoline-sized GELIs (Gradual Entrainment Lake Inverters) to thoroughly mix the lake was deployed this past summer by UW–Madison scientists.

(Phys.org)—The question is simple: can a lake be cleansed of a pernicious invader by simply raising the water temperature?

The answer so far: maybe, maybe not.

In an experiment playing out on a small lake in northern Wisconsin, scientists from UW-Madison are deploying a novel lake-mixing technology to alter the lake's temperature profile and see if warmer water will drive out the cold water-loving rainbow smelt, an invasive sardine-sized fish. The smelt were accidentally introduced into the Great Lakes in the 1920s. They are now found in about 25 inland lakes in Wisconsin.

"We're certainly making life harder for the smelt," avers Jake Vander Zanden, a limnologist and one of the researchers directing the study of Crystal Lake, a small lake in Vilas County that is one of a suite of lakes intensively studied for nearly 30 years as part of UW-Madison's National Science Foundation-funded Long Term Ecological Research project.

Rainbow smelt prefer cold water habitat, and in Crystal and other small lakes the fish are found in the cooler waters at the bottom of the lake.

The idea behind the Crystal Lake experiment, explains Vander Zanden, is to eliminate the lake's temperature gradient and deprive the smelt of their cold-water refuge. Typically, lakes stratify with warmer surface water overlying colder deeper water.

This summer, the Wisconsin team mixed the lake with an experimental system of six trampoline-sized devices called GELIs (Gradual Entrainment Lake Inverter). "It looks like a jellyfish," says Vander Zanden of the technology invented by former UW-Madison civil and environmental engineering doctoral student Jordan Read. "This is actually a much more efficient lake mixing technology than current methods."

Using compressed air pumped into a bladder, the 24-foot diameter GELIs were continuously raised and lowered throughout the summer to effectively mix the 60-foot deep, 83-acre lake. Doing so effectively

eliminated the lake's temperature gradient and made its water temperature uniform top to bottom.

"Normally, you have two distinct habitats, one at 40-45 degrees Fahrenheit at the bottom of the lake and another that is warmer at the top," according to Vander Zanden. "We were able to bring the entire lake to about 70 degrees Fahrenheit."

Smelt are the only species of fish in Crystal Lake that depend on cold water habitat. Other fish in the lake include yellow perch, largemouth bass and suckers. Finding an efficient and environmentally safe way to eliminate the invasive smelt is important because spring floods can potentially move them to nearby lakes, compounding an already serious management problem, says the Wisconsin limnologist.

Eliminating the cold temperature habitat in Crystal Lake, however, did not do in the smelt. "What we did not see was a major fish kill," notes Vander Zanden.

The fish dispersed throughout the water column and were more vulnerable to predators like gulls, which were observed in Crystal Lake feeding frenzies on several occasions. The elevated temperatures, Vander Zanden adds, may induce stress that affects the long-term survival and reproductive capacity of the smelt.

"The take home is that the smelt are still there, but we may still see effects into the coming year. Stress accumulates over time and that could reduce their ability to put energy into reproduction for next spring."

The ongoing experiment also promises a window into how a warming world will affect one of Wisconsin's most critical resources. "We also aim to learn how the lake ecosystem as a whole responds to warming and homogenizing, both likely features of our future world," says Vander

Zanden.

Provided by University of Wisconsin-Madison