Quagga mussel found to be primary regulator of phosphorus cycling in lower four Great Lakes

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Invasive quagga mussels extend their siphons from the sediment of Lake Michigan to feed and breathe. Credit: Sergei Katsev

A team of researchers from the University of Minnesota and the Hong Kong University of Science and Technology reports that quagga mussels are now the primary regulator of the phosphorus cycle in the lower four Great Lakes. In their paper published in *Proceedings of the National Academy of Sciences*, the group describes creating a model to represent the impact of invasive mussels on the Great Lakes.

Back in the 1980s, Russian trade ships began moving cargo up and down the Saint Lawrence seaway. Shortly thereafter, it was discovered that zebra mussels carried in the ships' ballast water were making their way into the water. Over time, the mussels spread to all four of the lower Great Lakes. Their presence became known as locals reported choked waterpipes and dead mussels on shorelines. Over the following decade, another kind of mussel, the quagga, appeared in the Great Lakes. They, too, came from Russian trade ships and unfortunately, proved to be even better suited to the waters of the Great Lakes—they very quickly became the dominant species. Today, divers venturing to the bottom of any of the four lower Great Lakes will find it covered with quagga mussels. In this new effort, the researchers wondered what impact such large numbers of mussels might be having on the Great Lakes ecosystem. To find out, they created a model that took into account the impact that individual mussels have in their environment, and then multiplied it by the numbers believed to exist in the Great Lakes.

Something else was also happening in the 1980s—farmers surrounding the Great Lakes were pouring massive amounts of fertilizer into their soil. One of the ingredients in the fertilizer was phosphorous, which was making its way into the Great Lakes via rivers and streams. The addition

of the phosphorous into the water led to algae blooms, which, besides being unsightly, led to fish die-offs. Once the problem was recognized, governments began restricting the use of fertilizers containing phosphorous—but the algae blooms did not recede. The researchers with this new effort found that the reason the algae was not diminishing was because the phosphorous that had already been dumped into the lakes was still present. They found the quagga mussels have been recirculating it, preventing it from being buried in lake bed sediment. Their model also showed that due to their huge numbers, quagga mussels have become the dominant regulator of phosphorus cycling in the lower four Great Lakes.

Quagga mussels colonize the bottom of Lake Michigan (80 m depth) at a density of nearly 10,100 per m^2. Credit: John A. Zalusky

More information: Jiying Li et al. Benthic invaders control the phosphorus cycle in the world's largest freshwater ecosystem, *Proceedings of the National Academy of Sciences* (2021). DOI: 10.1073/pnas.2008223118