Team suggests complex relationship between phosphorus levels and nitrogen removal in lakes

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Lake Superior. Credit: NASA

In the land of 10,000 lakes, one lake has been the starting place for research with implications for big lakes around the world. According to a study published online this week in *Science*, University of Minnesota researchers, building from studies of nitrogen levels in Lake Superior, uncovered a good news/bad news scenario for lake health that has long-term, global implications for pollution control efforts.

While many water-quality cleanup efforts focusing on the reduction of phosphorus have been highly effective, that success can also result in a decrease in microbial processes that remove nitrogen from water. Nitrogen accumulation in large lakes can lead to nitrogen pollution downstream, in rivers and coastal areas. The findings suggest that human-caused acceleration of global nitrogen and phosphorus cycles have boosted nitrogen removal processes in small to medium-size lakes. But in many of Earth's large lakes, these effects are reduced by successful control of phosphorus, resulting in nitrogen accumulation.

"Freshwater ecosystems, including lakes, streams and wetlands, are a large global sink for reactive nitrogen," says lead author Jacques Finlay, an associate professor in the College of Biological Sciences (CBS). "By reducing one aquatic pollutant – phosphorus – we are in some cases reducing the ability of lakes to remove nitrogen." Gaston Small, an assistant professor at the University of St. Thomas, and Robert Sterner, a fellow CBS ecology professor, co-authored the study.

To assess the influence of phosphorus on nitrogen removal, the researchers used a comparative approach – they examined the differences between how much nitrogen goes into lakes and how much comes out downstream – coupled with time-series analyses of nitrogen and phosphorus concentration in large lakes.

"The work was motivated by our thinking about the case of a single lake – Lake Superior. This lake is one that we would expect to efficiently remove nitrogen, but it doesn't, and it has extremely low phosphorus, so this work arose from efforts to generalize beyond a single system," Finlay says.

The excess nutrients can come from a variety of sources. City dwellers contribute nitrogen through sewage, lawn fertilizer, vehicle exhaust and pets. Farming represents the largest source in agricultural areas, and, in remote areas, air pollutants dispersing through the atmosphere can be a factor.

The study does not suggest we stop reducing phosphorus in lakes. "We need to pay attention to the way that nutrients interact in ecosystems and maintain our focus on reducing phosphorus and nitrogen pollution," says Finlay. "If we do that, we'll be taking steps toward improving water quality locally as well as downstream."

More information: "Human Influences on Nitrogen Removal in Lakes," by J.C. Finlay et al. *Science*, 2013.

Provided by University of Minnesota

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