CSMI Cooperative Science and Monitoring Initiative

Phosphorus in Lake Erie Sediments Contributes Little to Harmful Algal Blooms

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Green scum floating near beaches. Drinking water warnings due to algal toxins. Harmful algal blooms have caused headaches for Lake Erie residents, tourists and government officials alike, and much of Ohio's focus is currently directed at the blooms and their impacts on public health and the economy. Research initiatives have formed to come up with new ways to fight the problem, but in the meantime, ongoing monitoring efforts like the Cooperative Science and Monitoring Initiative are in place to make sure new problems don't sneak up on scientists without warning.

To reduce the size and impact of harmful algal blooms, the Great Lakes Water Quality Agreement, a commitment between the United States and Canada to restore and protect the waters of the Great Lakes, has set a goal of reducing phosphorus entering Lake Erie from tributary rivers by 40%. Researchers, local and state governments and non-profit organizations are hoping to achieve that goal by focusing on the runoff from Lake Erie's watershed, which contains phosphorus and drives bloom development and growth.

The focus is on point sources like sewage treatment plants, where nutrients enter rivers and streams at specific locations, and on non-point sources like farm fields, where nutrients are carried by rainfall or snowmelt moving over and through the ground. Both types of sources add phosphorus to Lake Erie, and management practices like improved filtering and containment, cover crops and fertilizer application adjustments are common approaches to reducing that input.

But some people may be worried about how much phosphorus is already found in the lake, bound to sediments on the lake bottom. Is there already so much phosphorus in the lake that it's too late to fix the problem so blooms will continue regardless of efforts to reduce runoff from the land?

Turns out that's not likely. Results from a sampling study performed in 2014 show that under current conditions (a catch-all term for things like water temperature and oxygen content), lake sediments only contribute about three to seven percent of the phosphorus that drives harmful algal blooms. The majority of the bloom's fuel comes from the Maumee River, a major tributary in the western basin and the biggest single source of phosphorus to the lake.

Computer models can run scenarios to show the differences between reducing phosphorus from the different sources that contribute it to Lake Erie's harmful

algal blooms, such as the Maumee River, the Detroit River, sediment phosphorus, and all of the tributaries combined (excluding the Maumee). Using the 2014 algal bloom as an example, model results suggest that cutting off all phosphorus contributed by the Maumee River would effectively eliminate the yearly algal bloom, reducing the biomass of the harmful algae from 4,000 tons to less than 500 tons, an eight-fold reduction.

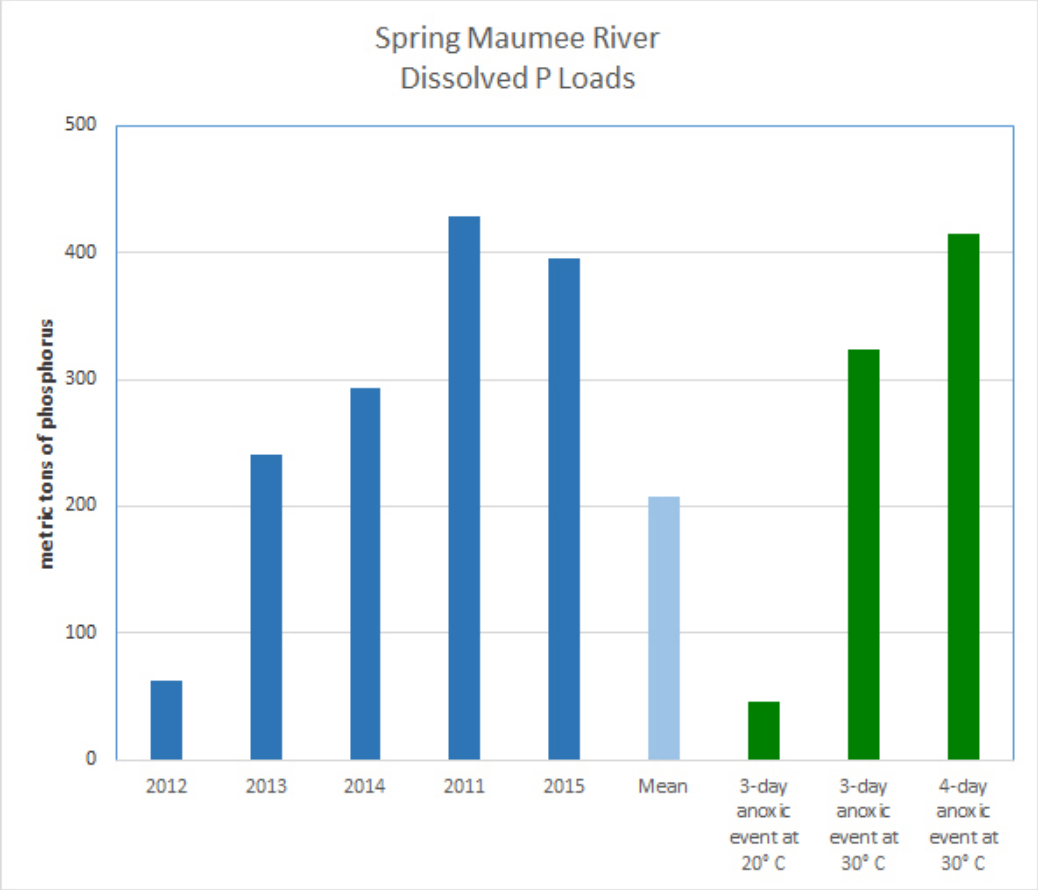

Figure 1

Even the current goal of reducing phosphorus contributions by 40% from priority tributary rivers entering Lake Erie would have a significant impact on algal blooms, with the model showing that this change would essentially cut the size of the 2014 bloom in half. So the researchers are confident that working towards this goal is a good investment for the future.

In addition, recent years have suggested that Lake Erie would recover quite quickly if phosphorus input is reduced or eliminated. The 2016 harmful algal bloom was smaller than predicted because models overestimated the effect of phosphorus stored in sediments and otherwise already present in the lake. Researchers thought that 2015's record high runoff would have a carryover effect the following year, but the expected lingering effect never materialized. The lack of phosphorus carryover and near-drought conditions in 2016 combined to produce one of the smallest blooms in recent years. This is a good sign, and researchers emphasize that Lake Erie would likely recover very quickly once appropriate changes on the watershed are implemented.

One concern some researchers have expressed is that current conditions may no longer be normal in the coming decades. It's likely that Lake Erie will become warmer as summers get hotter, and that anoxic conditions, when bottom waters of the lake run out of oxygen, will become more common due to that warming.

Both of these changes could dramatically increase the release of phosphorus from lake sediments, which means previously stored phosphorus could start to contribute a more significant portion of the nutrient load that drives harmful algal blooms. If summer lake temperature changes from 20C° to 30C°, an increase that isn't out of the question under some future climate predictions, the resulting sediment-derived phosphorus contribution over just three or four days could rival the amount of phosphorus currently coming from the Maumee River during the three spring months (Figure 1).

In addition, models predict an increase in heavy summer storms for the future, which leads to more runoff from the watershed into tributary rivers like the Maumee. So while the findings from the 2014 sampling study are reassuring in the short term, monitoring should continue to make sure sediment phosphorus continues to be only a small concern for Lake Erie and those who depend on it for drinking water.