Ohio Environmental Protection Agency

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The Impact of Nitrogen and Phosphorus on Water Quality

Phosphorus and nitrogen are key elements to life on Earth. Phosphorus is the second most abundant element in our bodies, found mostly in our bones and teeth. Phosphorus also is found in foods such as soft drinks and baking soda, fertilizers and cleaning products. Nitrogen makes up about 78 percent of the air we breathe and is a major component of foods and fertilizers.

Small amounts of phosphorus and nitrogen, commonly referred to as nutrients, are naturally present in soil and water. Both elements are essential to healthy plant growth.

Most nutrients in our environment come from human activities, primarily through the addition of fertilizers to crops, lawns and gardens, from municipal and home sewage systems and animal manure runoff from feedlots and fields.

However, in excess they are the main causes of nutrient enrichment in Ohio's lakes and streams. Nitrogen, in the form of nitrate, can leach into ground water where it can contaminate drinking water wells.

History

Water quality problems created by nutrient enrichment are not a new issue. Gradual declines in water quality across the United States led Congress to pass the Clean Water Act in 1972 to address a host of contamination issues, including nutrient pollution. Early focus was put on reducing pollution from point sources – the pipes releasing municipal and industrial wastewater into the nation's waterways.

Construction of new wastewater treatment plants led to a significant decline in phosphorus loading. Around the same period, adoption of no-till agriculture and the elimination of phosphorus from laundry detergents further reduced phosphorus in the Great Lakes and Ohio River basins. Annual harmful algal blooms in Lake Erie were almost nonexistent in the 1980s and early 1990s.

Impacts of Algal Blooms

Since the mid-1990s, increasing levels of nutrients, particularly dissolved reactive phosphorus, have been measured in Ohio waterways. Dissolved reactive phosphorus is a form of phosphorus that is soluble in liquids. Dissolved reactive phosphorus is more readily available for plant growth than particulate phosphorus. Both manure and commercial fertilizers have relatively high concentrations of soluble phosphorus.

Grand Lake St. Marys in western Ohio has been particularly hard hit by a phosphorus-enriched environment. A severe algal bloom in 2010 virtually shut down the lake. Algal blooms have returned to western Lake Erie at densities not seen since the 1970s. Record phosphorus levels recorded in recent years by Heidelberg University researchers in the Maumee and Sandusky rivers, the largest Lake Erie tributaries, indicate a very close relationship between phosphorus loads from these watersheds and the severity of harmful algal blooms.

Harmful algal blooms (HABs) consist of blue-green algae. Blue-green algae really are not algae at all; they are bacteria scientifically known as cyanobacteria. HABs can be unsightly, smell and when they die they can reduce oxygen levels in the water, causing fish and shellfish to suffocate. Algal blooms also reduce sunlight to lakebeds, reducing or eliminating the growth of beneficial aquatic plants. This leads to declining fisheries and favors pollution-tolerant fish such as carp over less tolerant fish such as darters and bass.

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As lakes and streams drain into other bodies of water, the combined effects of nutrient loads from multiple streams can cause oxygen-depleted “dead zones” downstream. Two well-known “dead zones” exist in Lake Erie’s central basin and in the Gulf of Mexico.

Algal blooms can clog drinking water filters and sometimes produce toxins that are harmful to both human and animal health.

The presence of algal toxins at high levels has led to beach advisories in Ohio in recent years. While necessary to protect public health, the water quality advisories have combined with aesthetic appearances to cause significant economic hardships to businesses that rely on recreation and tourism. In addition, algal blooms lead to higher drinking water treatment costs to address odor and taste issues. Fortunately, the typical water treatment processes remove most algal toxins from drinking water.

Other Nutrient Problems

Nutrient enrichment from nitrogen compounds (nitrates, nitrites and ammonia) can create problems even when algal blooms are not involved. Nitrogen, in the form of nitrate, can infiltrate ground water and drain or run off into surface water. Drinking water advisories are issued when nitrate levels are detected at concentrations greater than 10 mg/L.

At these concentrations, nitrates can cause a potentially fatal blood disorder known as blue baby syndrome in infants six months old and younger. This occurs when the human body converts nitrate to nitrite. The risk is higher for infants; however, it also can be harmful to pregnant women and individuals with certain gastric issues.

The maximum contaminant limit for nitrite in drinking water is 1 mg/L. High nitrite levels are not common in drinking water. Most of our exposure to nitrites is from food and nitrates in drinking water. Ammonia concentrations generally do not pose a human health risk. Ammonia is toxic to aquatic life and a common cause of fish kills following large agricultural runoff events, industrial and agricultural spills.

Ohio EPA has been working to address nutrient loading issues through the most recent years of nutrient build up, and has a monitoring and response plan in place. However the results have not been effective enough as nutrient enrichment continues to rise in our waterways.

Ohio’s Plan

Ohio EPA is partnering with other state agencies to develop a state nutrient reduction strategy that will set goals to achieve clean waterways. There will be a renewed emphasis on removing nutrients from point sources such as municipal wastewater treatment plants. It also will include a focus on strategies to accelerate progress in reducing nutrients from nonpoint sources such as erosion and agricultural runoff.

The strategies will be developed with input from citizens, industry, stakeholders and affected communities. The goal will be to reduce nutrient loads significantly within five to 10 years. Grants and educational efforts will be offered to assist programs.

For More Information

Read the companion fact sheet *Ohio’s Nutrient Reduction Strategy.*

Visit the Division of Surface Water website
www.epa.ohio.gov/dsw

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