

Lake Wallenpaupack Community Science Newsletter

Scientists for Community, Community for Science

The Impacts of Nutrients on HABs

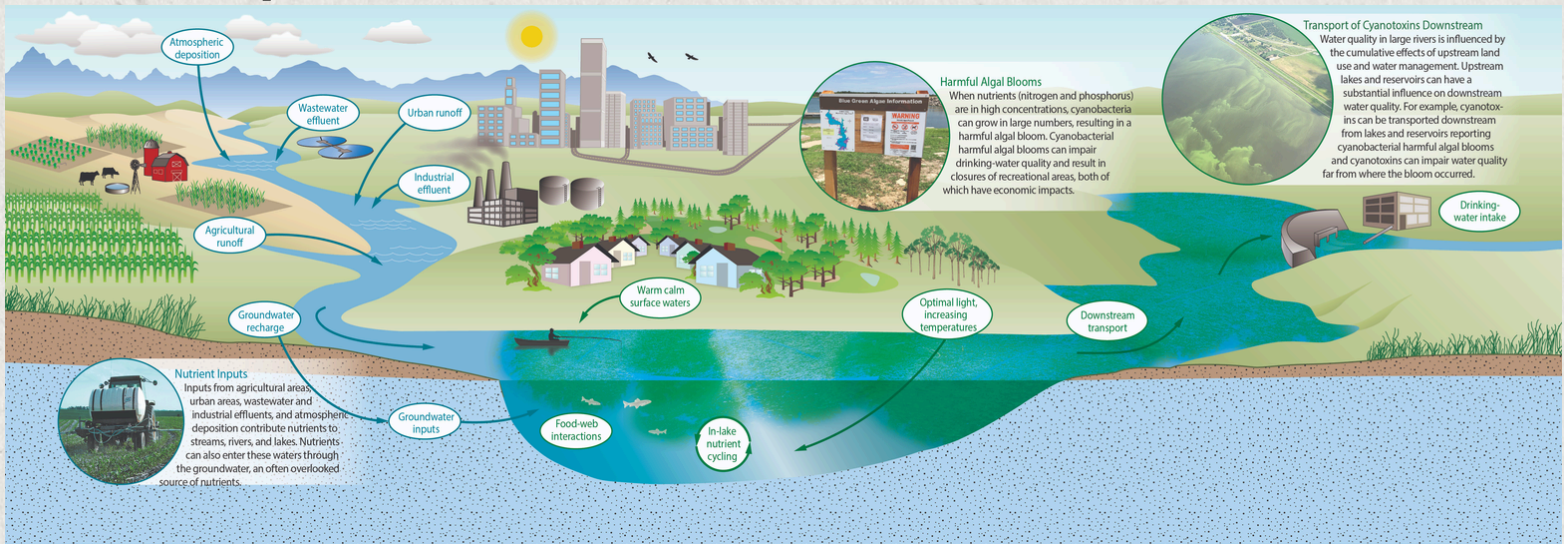


Figure 1. Key factors related HAB toxicity and the occurrence of blooms by Graham et al., 2016. The diagram above from a USGS open-file report depicts different forms of runoff feeding into a watershed and how this impacts freshwater systems and drinking water¹.

Under the right conditions, HABs can produce harmful toxins. As discussed in the past newsletter, toxin production is stimulated by an array of factors and is heavily influenced by nutrient availability, particularly nitrogen and phosphorus^{2,3}. For freshwater bodies, these nutrients come from an array of anthropogenic sources; primarily, nitrogen and phosphorus come from agricultural, stormwater, and wastewater runoff but are also fed by the use of fossil fuels and everyday living (utilization of fertilizers, soaps and detergents, landscaping, and pet/yard waste)².

Does Nitrogen or Phosphorus have greater influence on Toxin Production?

For many years, phosphorus was considered a primary if not sole nutrient for limiting cyanobacteria growth, though there was evidence of blooms being limited by nitrogen availability⁴. Nitrogen availability has been found to influence toxin production as well as the growth of some cyanobacteria⁵. In hypereutrophic systems where phosphorus concentrations are already high, temperature and nitrogen availability can contribute more to cyanobacteria dominated blooms as well as toxin production⁶. Particularly, nitrogen concentrations have been positively associated with the production of microcystin, a hepatotoxin.

Can Nutrient Inputs Happen Naturally?

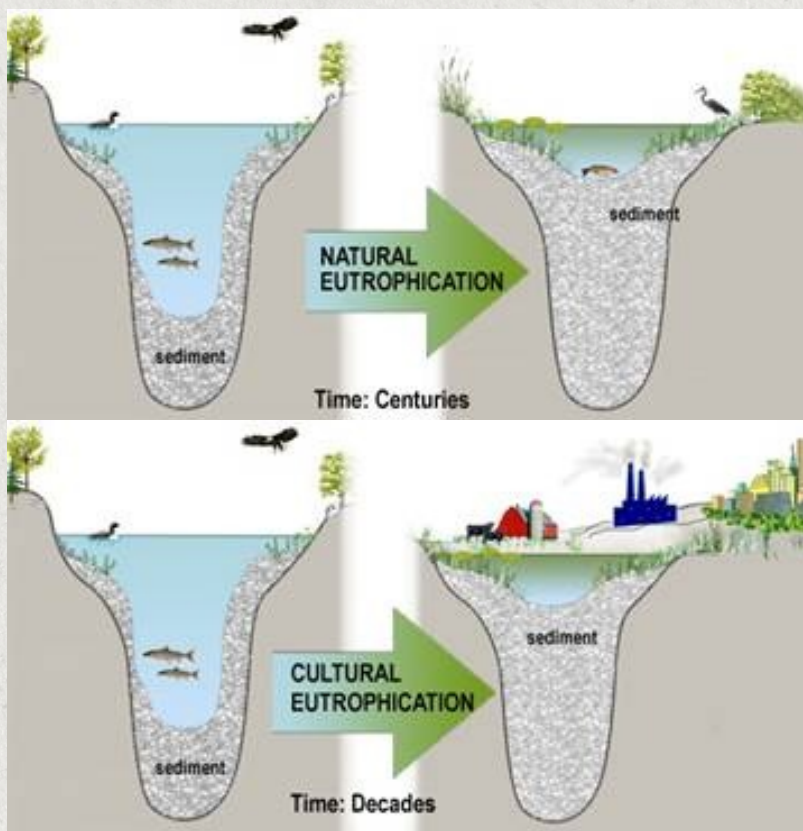


Figure 2. Diagrams of Natural Eutrophication (top) and Human-Induced “Cultural” Eutrophication (bottom). Published in an article written by Jeremy Mack, the figure displays water basins filling with sediment and increasing in productivity (more plants and algae present in the right of each diagram). However, the bottom is influenced by human impacts, resulting in eutrophication occurring at a faster rate⁷.

In short, yes! Accumulation of nutrients and sediments is a natural part of lake succession or “lake aging”⁸. Over time, a lake can be filled with sediments and nutrients deposited by tributary streams, the atmosphere, or within the lake itself (such as decaying organic matter⁹). All lakes age differently depending on when they formed and characteristics of their own watersheds; natural eutrophication typically takes centuries or even thousands of years as seen in the top image to the left⁷.

This same process can be rapidly accelerated by any human interactions resulting in nutrient input increases (this can be referred to as “cultural eutrophication”, see bottom image to the left), which can shorten lake aging to mere decades.

Sources Cited:

- (1) Graham, J.L., Dubrovsky, N.M., & Eberts, S.M. (2017). Cyanobacterial harmful algal blooms and U.S. Geological Survey science capabilities (ver 1.1, December 2017): U.S. Geological Survey Open-File Report 2016-1174, 12 p. <https://doi.org/10.3133/ofr20161174>.
- (2) United States Environmental Protection Agency. (2024). Nutrient Pollution: Sources and Solutions. <https://www.epa.gov/nutrientpollution/sources-and-solutions>.
- (3) United States Environmental Protection Agency. (2024). Nutrient Pollution: The Problem. <https://www.epa.gov/nutrientpollution/problem>.
- (4) Dolman, A. M., Rucker, J., Pick, F. R., Fastner, J., Rohrlack, T., Mischke, U., & Weidner, C. (2012). Cyanobacteria and Cyanotoxins: The Influence of Nitrogen versus Phosphorus. *PLoS One*, 7(6), e38757. <https://doi.org/10.1371/journal.pone.0038757>.
- (5) Kramer, B. J., Jankowiak, J. G., Nanjappa, D., Harke, M. J., & Gobler, C. J. (2022). Nitrogen and phosphorus significantly alter growth, nitrogen fixation, anatoxin-a content, and the transcriptome of the bloom-forming cyanobacterium, *Dolichospermum*. *Front Microbiol.* 13:955032. <https://doi.org/10.3389/fmicb.2022.955032>.
- (6) Tanvir, R. U., Hu, Z., Zhang, Y., Lu, J. (2021). Cyanobacterial community succession and associated cyanotoxin production in hypereutrophic and eutrophic freshwaters. *Environ Pollut.* 290:118056. <https://doi.org/10.1016/j.envpol.2021.118056>.
- (7) Mack, J. (2024). Eutrophication. Fondriest Environmental, Inc. <https://www.lakescientist.com/eutrophication/>.
- (8) New Hampshire Department of Environmental Services. (2019). Lake Eutrophication. <https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/bb-3.pdf>.
- (9) State of Rhode Island Department of Environmental Management. (2024). Nutrients in Lakes. <https://dem.ri.gov/environmental-protection-bureau/water-resources/waters-wetlands/lakes-ponds/nutrients-lakes>.

Questions or input on potential Lake Wallenpaupack Community Science newsletter topics?

Want to join the Wallenpaupack Community Led Water Quality Monitoring Program?

Email pleon@lacawac.org

Interested in Learning More About Lake Wallenpaupack and the Community Led Water Quality Program?



Five Years of PLEON's Lake Wallenpaupack Water Quality Monitoring Program

Alexandra Bros, Lacawac Sanctuary

Saturday, August 3rd, 2024

11am - Seminar | 12pm - Lunch by the Mustard Seed Cafe

Join us on Saturday, August 3rd for the third installment of Lacawac's Lunch and Learn Seminar Series.

This discussion will focus on the PLEON Lake Wallenpaupack Community Led Water Quality Program and its findings on factors impacting water quality and water clarity degradation after five years of data collection.

Following the presentation and discussion, a lunch will be catered by the Mustard Seed Cafe.

TICKETS AVAILABLE

RATE

Member Seminar Only	\$5.00
Member Seminar and Lunch	\$22.50
Non-Member Seminar	\$10.00
Non-Member Seminar and Lunch	\$25.00

Sign up for the Lunch and Learn at the link:

<https://secure.qgiv.com/for/pafe/event/901532/>