# Cyanobacteria problems will worsen if carbon concentrations continue to rise

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Fisherman in Lake Taihu in China. Credit: Jason Xing Ji

Scientists from the University of Amsterdam are warning that problems with toxic cyanobacteria are likely to increase in the future. In an article in the journal *Science Advances*, they show that a common cyanobacterium adapts exceptionally easily to rising $CO_2$ concentrations. This toxic cyanobacterium can increase its $CO_2$ uptake rate by a factor of five at high $CO_2$ concentrations, the strongest response recorded thus far in any alga.

Each summer, the water quality of lakes and ponds is threatened by the growth of cyanobacteria, also known as blue-green algae. Cyanobacteria can produce a variety of toxins that are harmful to humans, other mammals and birds. In humans, these toxins may cause nausea, dizziness and liver damage. Intense cyanobacterial growth increases the amount of toxins in the water, which can negatively affect the use of lakes for recreation, drinking water or fisheries. Cyanobacterial growth already affects water quality across the globe, for example in Lake Erie (U.S.), Lake Taihu (China), Lake Victoria (Africa) and many European lakes.

## Fertilising the water worldwide with $CO_2$

$CO_2$ (carbon dioxide) is an essential nutrient for algal growth. Just like plants, algae acquire $CO_2$ through photosynthesis. The rising $CO_2$ concentration in the atmosphere also increases $CO_2$ concentrations in surface waters. Ecologist Jolanda Verspagen: "We are fertilizing waters with $CO_2$ on a global scale. This is beneficial for many algae, including toxic species."

The new study, led by scientists from the University of Amsterdam, shows that one of the most common toxic cyanobacteria, Microcystis, can adapt exceptionally well to high $CO_2$ concentrations. The cyanobacterium was cultured at low and high $CO_2$ concentrations. The $CO_2$ uptake rate of Microcystis was subsequently measured with an advanced laboratory instrument, known as a Membrane Inlet Mass Spectrometer (MIMS), which can detect very small changes in $CO_2$ in response to algal photosynthesis. "This specific cyanobacterium is able to growth faster, because it can increase its $CO_2$ uptake rate by a factor 5 at high $CO_2$ concentrations," explains Ph.D. student Jason Ji. "To our knowledge, this is the strongest $CO_2$ response ever recorded! Other non-toxic algae, like green algae and diatoms, can adapt less well, and some of them even grow slower at high $CO_2$ concentrations."

The ability of toxic cyanobacteria to grow faster at high $CO_2$ concentrations has far-reaching consequences for water quality. Model predictions by the research team show that the exceptional ability to adapt will further increase cyanobacterial growth at elevated $CO_2$ concentrations, particularly in nutrient-rich waters. The researchers therefore warn that, if atmospheric $CO_2$ concentrations continue to rise, problems with cyanobacteria will continue to worsen in the future.

**More information:** Xing Ji et al. Phenotypic plasticity of carbon fixation stimulates cyanobacterial blooms at elevated CO2, *Science Advances* (2020). DOI: 10.1126/sciadv.aax2926

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