Toxic blue-green algae adapt to rising CO2

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Credit: Universiteit van Amsterdam (UVA)

A common type of blue-green algae is finding it easy to adapt to Earth's rising CO2 levels, meaning blue-green algae – of which there are many toxin-producing varieties – are even more adept at handling changing

climatic conditions than scientists previously supposed. A team of microbiologists at the University of Amsterdam (UvA) are reporting this finding in the journal *PNAS* this week, and point here at implications for clean drinking water, swimming safety and freshwater ecosystems.

The research team, led by Professor of Aquatic Microbiology Jef Huisman, trained their microscopes on Microcystis, a type of blue-green algae that proliferate in lakes and reservoirs in summer. The team analysed the genetic composition of cyanobacteria (blue-green algae's scientific name), observing Microcystis in both the lab and the Kennemer lake, under CO2-rich and poor conditions. "Before this, the adaptive potential of these harmful cyanobacteria in response to increasing CO2 concentrations had never been studied systematically, even though this can help us predict how algal blooms will develop in future", explains Xing Ji, a PhD researcher on the team.

In both the lab and the lake, cyanobacteria's genetic makeup changed in response to increasing CO2 concentrations. "It's a textbook example of natural selection", says lead author Giovanni Sandrini. "Cyanobacteria absorb CO2 during photosynthesis to produce their biomass, and we observed that the strain best equipped to absorb dissolved CO2 eventually gains the upper hand."

Some Microcystis strains have a slow but efficient carbon uptake system that enables them to squeeze out the last bit of CO2 from the water even at very low concentrations. Those strains become dominant in low CO2 conditions. By contrast, other strains have a fast uptake system that allows them to take up dissolved CO2 at very high rates when in high concentrations. "We discovered that these high-speed strains enjoy a major selective advantage in CO2-rich water", Sandrini continues. "Given the rising atmospheric CO2 values, these strains are poised to thrive."

Bathing and drinking water

Cyanobacteria's adaptation to rising CO2 is cause for concern. That's because Microcystis can produce microcystin, a toxin that causes liver damage in birds and mammals. In high concentrations, cyanobacteria also disrupt freshwater ecosystems, killing fish and aquatic plants. In the Netherlands, blue-green algal blooms regularly put swimming areas off limits.

Ji personally experienced just how harmful these bacteria have already proved to be in 2007, when he was living in eastern China, where cyanobacteria covered the entire surface of Lake Taihu, a 2000-km2 lake, and led to a drinking water crisis affecting five million people. "I watched my mother arguing with other supermarket shoppers who all had their sights set on the last bottles of drinking water. It's precisely because I'm aware of how poor water quality can impact society that I am happy to be doing research that can yield relevant insights."

More information: Giovanni Sandrini et al. Rapid adaptation of harmful cyanobacteria to rising CO, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1602435113

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