Researchers study cyanobacteria infestations in waterways

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Cyanobacteria are among the oldest organisms on earth—they were the original oxygen-producing species and are thought to be responsible for the direction life has taken on earth. Nonetheless, they aren't the friendliest of species. Cyanobacteria produce neurotoxins, which can kill mammals in a matter of hours if ingested.

With today's changing environment, cyanobacteria are becoming more prolific in waterways as disparate as the Charles River in Boston and Lake Taihu in China, said Ferdinand Hellweger, professor of civil and environmental engineering.

Hellweger, along with three other principal investigators from the University of North Carolina, the University of Tennessee Knoxville and the University of Texas Austin, have collectively received $2 million in funding from the National Science Foundation to understand the factors behind cyanobacteria's increasing presence.

"We know there are links with temperature and nutrients," Hellweger said. "But exactly how those things work together to cause this trend is still a mystery."

Lake Taihu is the third largest lake in China, spanning more than 2,000 square kilometers. In recent years, cyanobacteria have plagued the waterway, which serves as the freshwater drinking supply for several million people. From both a health and an economic perspective, this pollution has the potential to cause significant damage to the society,

Hellweger said.

Hellweger's collaborators, Hans Paerl (UNC) and Steven Wilhelm (UT Knoxville), have been working on Taihu for a long time, collecting data on nitrogen and phosphorous levels, nutrient settling, and cyanobacterial growth rates, for example. "Now it is time develop a model to put all the data together," said Hellweger, whose expertise is in modeling complex water systems for prediction purposes.

"We want to be able to make predictions for nutrient reduction scenarios," he continued. For example, if new policy is geared toward spending millions of dollars to cut nitrogen levels in half, you'd want to know for sure that the approach would have a significant beneficial impact. "But it's very nonlinear," said Hellweger, explaining that even small changes in nitrogen or phosphorous levels could impact the species that call Taihu home, including cyanobacteria.

Much like the climate system, he said, there is so much going on that simple reasoning is not sufficient for determining outcomes. One needs to model many complex mechanisms and systems. But, "a model is always a simplification," he noted. "So we put in what we think is important."

The team will start work by developing a gene expression profile of all the organisms in the lake. "This will tell us who's there and what they're doing. It's up to us here at Northeastern to put it all together in a model, and to try to make sense of it," Hellweger said.

If successful, the model of Lake Taihu could set a precedent for understanding the cyanobacteria infestations of waterways across the globe, including the Charles River in the Boston area. Historically, sewage runoff has been the main pollutant in the Charles; today, cyanobacteria now shares equal blame in making the Charles River unswimmable,

according to research at Hellweger's lab. "If cyanobacteria are increasing in the Charles," he said, "it would not be surprising to find other local waterways next on the list."

Provided by Northeastern University