New research finds double damage in freshwater systems

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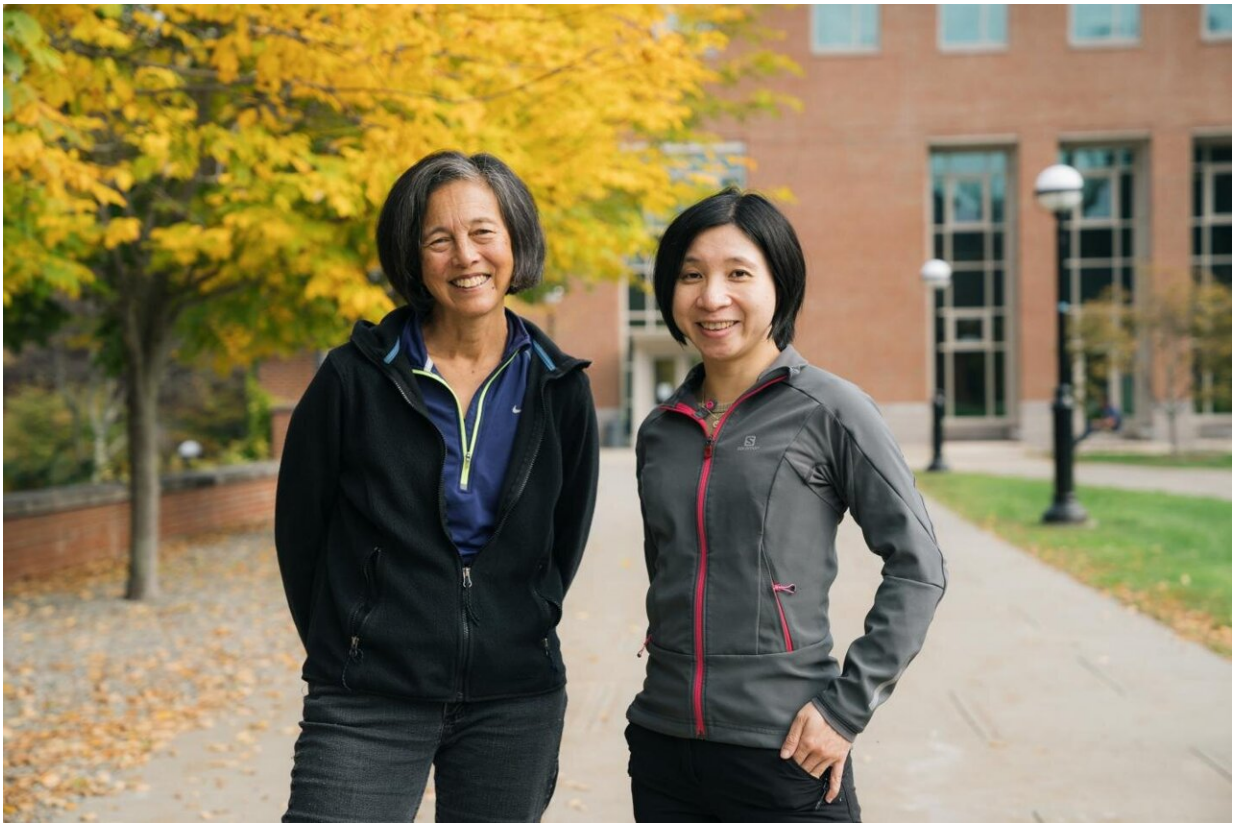

Celia Chen, left, research professor of biological sciences, and Pianpian Wu, postdoctoral researcher. Credit: Eli Burakian ’00

Organisms at the base of the aquatic food web may be hidden from sight, but they are just as sensitive to climate change as other plant and

animal life, according to a study published in *Scientific Reports*.

"Climate change causes food quality to deteriorate at the lowest level of the food web," says Pianpian Wu, a postdoctoral fellow at Dartmouth and lead author of the study. "That spells trouble for the entire food chain from phytoplankton to humans."

The study looked at two effects of climate change on water that researchers expect to increase in coming years: warming and "browning," the discoloration caused by high loads of dissolved organic matter.

According to the study, a combination of warmer, browner water results in greater transfer of toxic methylmercury from water to phytoplankton. The research also documented lower concentrations of essential polyunsaturated fatty acids in the organisms.

"The reduction of polyunsaturated acids is concerning," says Wu, who began the research as a Ph.D. candidate at the Swedish University of Agricultural Sciences.

Fatty acids such as omega-3 and omega-6 provide energy and regulate the immune systems in animal and plant life. Methylmercury is an easily absorbed form of mercury that acts a potent neurotoxin.

According to the study, fish and humans can be exposed to increased levels of methylmercury as organisms that are lower on the food chain consume more phytoplankton to gain fatty acid in their diets.

The team used mesocosms—controlled outdoor environments—at its research site outside Vienna, Austria. Credit: Pianpian Wu

"Humans eat fish," says Celia Chen, research professor of biological sciences and a co-author of the study. "Understanding how mercury and fatty acids in aquatic food webs respond to climate change will tell us about the embedded risks at the top of the food web."

While previous research on browning and warming has been conducted in natural environments, this is the first study to rely entirely on controlled outdoor environments known as mesocosms.

The researchers used 24 insulated cylinders to test the effects of various levels of warming and browning under four different scenarios at subalpine conditions.

"Mesocosms are really cool to work with," says Wu. "We can test for a variety of climate effects without needing to travel long distances to the field."

The study was conducted at the WasserCluster Lunz research facility outside of Vienna, Austria. Kevin Bishop, a professor at the Swedish University of Agricultural Sciences, served as the senior researcher.

Closer to home, Wu and Chen continue their research on aquatic food webs with a team that has also included undergraduate students. Past research has studied how freshwater organic matter may influence mercury uptake in blackfly larvae.

"Dartmouth students are engaged and hard working. Having undergraduates involved in our research gives them direct experience studying environmental challenges that will confront society for generations to come," says Chen.

More information: Pianpian Wu et al, Elevated temperature and browning increase dietary methylmercury, but decrease essential fatty acids at the base of lake food webs, *Scientific Reports* (2021). DOI: 10.1038/s41598-021-95742-9

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