Research links aquatic ecosystem changes in the Chinese Loess Plateau to anthropogenic climate change

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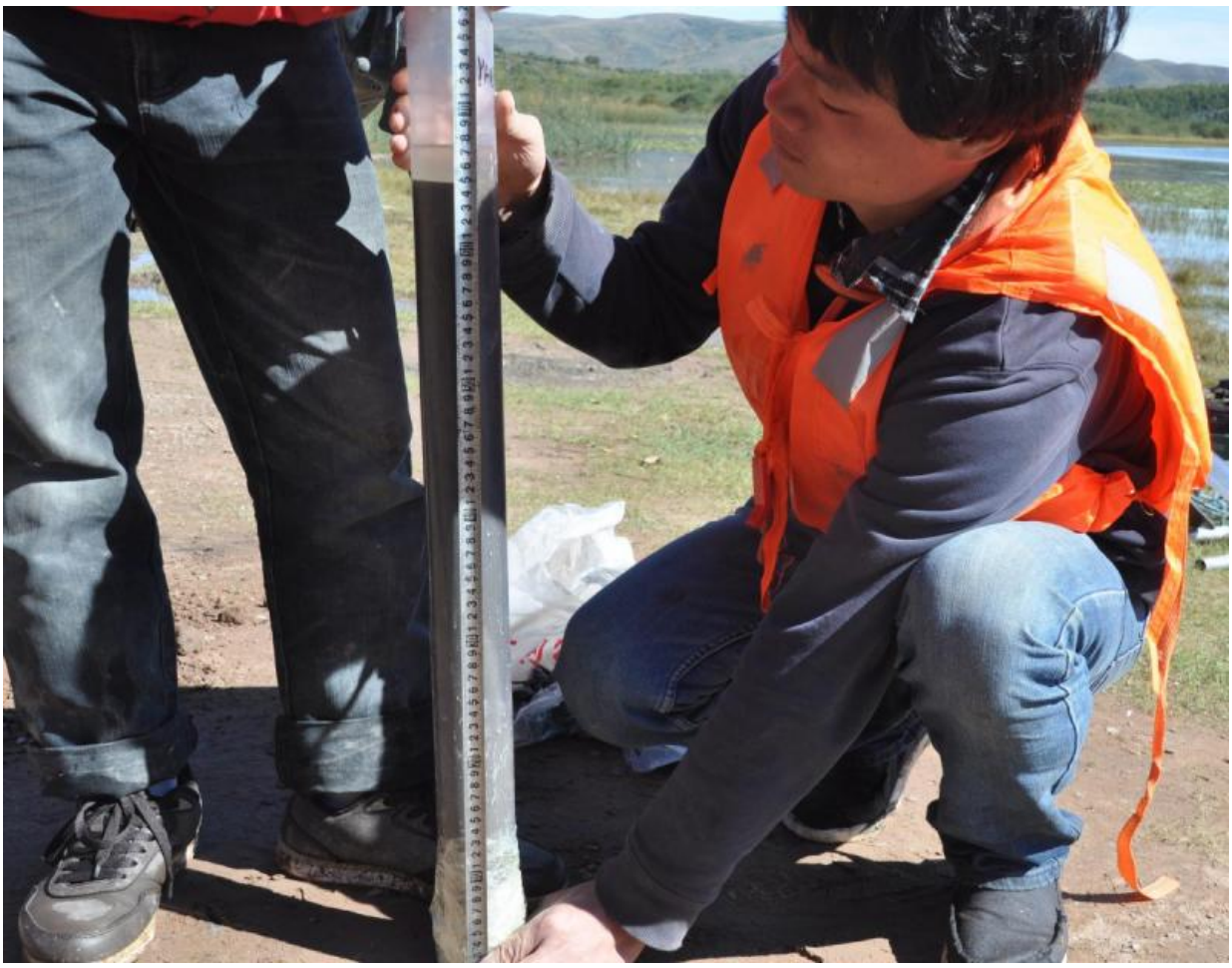

Researchers are seen measuring a sediment core retrieved from Lake Gonghai, Chinese Loess Plateau. The core samples provided evidence that aerosol-weakened summer monsoons have triggered changes the lakes' ecosystems.

Credit: Can Zhang

New research, published in the journal *Nature Climate Change*, has determined that aerosol-weakened summer monsoons have triggered changes in aquatic ecosystems of the Chinese Loess Plateau region.

The team, led by researchers at Queen's University and Lanzhou University in China, says their research highlights how the current Anthropocene period represents an important departure from prior natural warm periods in Earth's history. The findings provide further evidence of the complexity of climate change when assessed within the context of multiple environmental stressors.

"One of our main findings was that anthropogenic warming over the past 50 years resulted in very different but equally pronounced responses in these lake ecosystems compared to past warm periods," says John Smol, a professor in the Queen's Department of Biology and a co-author on the paper.

The researchers analyzed the fossil diatoms (microscopic algae) preserved in dated lake sediment profiles from Gonghai Lake. The Loess Plateau is a high elevation region in north-central China that takes its name from extensive deposits of powdery mineral-rich, wind-blown material known as loess. This monsoon-dominated region is known for its incredibly fertile and highly erodible land. The millions of people who live there face serious erosion issues and severe eutrophication (nutrient enrichment, algal blooms) as a result of the delivery of massive amounts of soil nutrients into freshwater systems. Located at the monsoon boundary zone, the region is particularly sensitive to global climate change.

The researchers were able to determine that reduced lake fertilization and fundamental changes in lake ecosystems during anthropogenic warming of the past 50 years were linked to a marked weakening of the summer monsoons stemming from a rise in anthropogenic aerosols (microscopic particles from combustion).

"We found that the pulse of nutrients entering the lake during previous warm episodes had dramatically altered the composition of fossil diatom assemblages from species associated with nutrient-poor conditions to those that thrive in nutrient-rich conditions," says Jianbao Liu, Assistant Professor at Lanzhou University. Dr. Liu was the study's lead author and a visiting PhD student at Queen's University when the study was undertaken.

Previous natural warm periods over the past 2,000 years were accompanied by increased monsoon rain and wind intensity leading to severe erosion of nutrient-laden soil and lake fertilization. In contrast to past warm periods, the most recent fossil assemblages are dominated by diatom species that thrive in waters with lower nutrient concentrations and weaker water column mixing – consistent with decreased monsoon intensity.

"This is an important shift in the aquatic regime that indicates a fundamentally different climate mechanism and biological response from previous well-documented warm periods" says Kathleen Rühland, co-author and a research scientist in the Department of Biology at Queen's University.

Ironically, continued environmental efforts to reduce anthropogenic aerosols in Asia, whilst global warming continues, will likely result in the return of severe nutrient enrichment that will further impair the already stressed freshwater supply in this region.

"In many respects, we are entering uncharted territory," warns Dr. Smol.

More information: Aerosol-weakened summer monsoons decrease lake fertilization on the Chinese Loess Plateau. *Nature Climate Change*. DOI: 10.1038/nclimate3220

Provided by Queen's University