Dead midges reveal living conditions of fish

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The mandibles of *Chaoborus* midges range in size from 0.1 to 0.4 millimeters. The mandibles found in lake-bottom sediments are species-specific and show which other *Chaoborus* midge species were present in the lake in different periods of time. Credit: Fredrik Palm

Microscopic remains of dead Phantom midge larvae (*Chaoborus* spp.) may explain a few hundred years of history of the living conditions of fish, acidification and fish death in Swedish lakes. Researchers at the University of Gothenburg, Sweden, have developed a method of using lake-bottom sediments to show when and how fish life disappeared from acidified lakes – invaluable knowledge for lake restorations in acidified regions.

"It is actually just like a journey through time. Fish hardly leave any

remains of their own when they die, but if we instead study the presence of organisms that are affected by fish, we can find clear traces. By studying mandibles (mouth parts) from *Chaoborus* larvae in lake sediments, we can recreate the history of the lake back to the early 19th century," says Fredrik Palm of the Department of Zoology at the University of Gothenburg.

Acidification of soil and water is one of the greatest environmental problems of modern times. A large proportion of Swedish lakes show clear signs of acidification, resulting in extensive fish death and severely reduced biodiversity.

Sediment samples are collected from an ice-covered lake. Credit: Fredrik Palm

Recent research has pointed to a clear correlation between fish death and the presence of *Chaoborus* larvae in lakes. Mandibles from *Chaoborus* larvae preserved in lake-bottom sediments can therefore be used to identify fish death and other fish changes in severely acidified lakes.

History in the rear-view mirror

The new method makes it possible to study the effects of acidification in lakes where no samples have previously been collected and where there are no historical data on fish community alterations. As it is also possible to determine the age of sediment samples, this method can additionaly reveal when different changes have occurred.

"By analysing *Chaoborus* mandibles that we recover in the bottom sediments we can tell how different fish communities have changed. Not only can we infer whether fish has disappeared, we can also see how different fish species have been affected. Roach, for example, are more sensitive to acidification than perch, and we have been able to show whether lakes historically have contained cyprinid fish or not. Remains of acid sensitive zooplankton can simultaneously be used to show trends of progressive acidification in lakes.

Providing a basis for restoration

As the method reveals how the fish community in a lake has changed over the last few centuries, it can also be used to turn the clock back as a way of deciding how biological restoration of an acidified lake should proceed. The historical perspective of the method also makes it possible to analyse natural variations in lake ecosystems.

Palm and his colleagues have therefore carried out their studies in the counties of Västra Götaland and Bohuslän, Sweden, focusing in primarily on the Lake Gårdssjön area in Ucklum, which has been a centre of Swedish acidification research for many decades.

Provided by University of Gothenburg

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