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European Commission

Science for Environment Policy

Could freshwater crustaceans curb algal blooms?

Algal (cyanobacterial) blooms are a major threat to marine and freshwater ecosystems, as well as to human health. This study investigated a way to reduce numbers of harmful cyanobacteria using freshwater crustaceans. Data from a large Swedish lake show that this approach can be effective but is best used alongside other methods, such as nutrient reduction.

The pollution of water with nutrients (due to run-off from agriculture, for example) has led to the excessive growth of algae in marine and freshwater ecosystems across the globe. Algal blooms (known scientifically as cyanobacterial blooms, as they are caused by a type of phytoplankton called cyanobacteria) remove oxygen from the water, causing plants, fish and aquatic insects to die. Cyanobacterial blooms are also a human health concern, as some produce substances that are toxic to the liver and nervous system. There is, therefore, a pressing need to control cyanobacterial blooms.

One possible method is to use zooplankton: small organisms that provide a critical source of food to many large organisms but themselves eat the phytoplankton that cause blooms. Increasing the quantity of zooplankton in the water places top-down pressure on phytoplankton and reduces algal blooms.

In this study, EU funded[1] researchers from Sweden assessed this as a method of managing algal blooms, using large zooplankton called *Daphnia magna*. The experiments were performed in 2005 in a large eutrophic lake in Sweden where fish that eat plankton, such as bream (*Abramis brama*) and small perch (*Perch fluviatilis*), were removed to allow *Daphnia* to thrive.

Three studies were performed in June, July and August 2012. Plastic containers were filled with lake water to which *Daphnia* were added in increasing numbers (within a range that could be found naturally). The containers were sealed and placed in the lake, so they were exposed to the temperature and climate of the lake (but could not exchange with the surrounding environment). Unlike other studies, which have assessed the response of the entire community, this study assessed how each different type of cyanobacteria responded to *Daphnia* grazing.

The grazing experiments successfully reduced the overall amount of cyanobacteria in early and late summer. *Daphnia* successfully suppressed all but one type (*Dolichospermum crassum*) of bloom-forming bacteria. The researchers suggest this species might have reduced the efficiency of *Daphnia* by disrupting its feeding process.

Nineteen years of lake monitoring data (1996–2014) revealed that reducing fish predation in 2005 increased *Daphnia* numbers by 50% and body size by 20%. The dominance of *Daphnia* likely resulted in stronger top-down control on the cyanobacterial community. However, having fewer sediment-feeding fish in the lake also reduced the total number of nutrients in the water (from re-suspension), which likely also contributed to reducing the growth of cyanobacteria.

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Could freshwater crustaceans curb algal blooms? *(continued)*

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Importantly, the growth of *Microcystis botrys* was suppressed in all experiments — this is a species that accounted for a 300% increase in toxins in a previous experiment and is one of the most toxic forms of cyanobacteria found in European lakes.

This study shows that *Daphnia* (specifically large bodied, > 1 500 micrometres average body size) can graze on a wide range of cyanobacteria, and that this action can be enhanced by removing certain types of fish. However, the identification of a resistant species suggests that *Daphnia* cannot control all types of cyanobacteria and, therefore, that other methods of control (such as run-off reduction) are also important.

Overall, these results highlight the importance of large generalist feeders such as *Daphnia* as a way to control toxic cyanobacterial blooms and they have important implications for lake management and restoration.

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