Vlad Matveev, CSIRO Land and Water

Main picture: The toxic cyanobacterium, *Microcystis flos aquae*, blankets Lake Maroon.

Below: Lake Maroon at the start of the experiment in1997.

Stocking experiment
tests the limits of the lake

Australia's lakes and rivers are often stocked with fish to ensure plenty of action for recreational anglers. But new research has found that overstocking can trigger blooms of toxic blue-green algae. The research also questions a long-held scientific theory that large numbers of predatory fish can control blue-green algae, or cyanobacteria, through their effect on the food web.

According to CSIRO Land and Water ecologist Dr Vlad Matveev, the 'trophic cascade theory' proposes that big predatory fish eat smaller fish, removing the pressure on tiny grazing crustaceans that are normally eaten by the smaller fish. As the number and size of these micro-grazers increases, their constant grazing brings cyanobacteria under control.

This theory was developed for North American lakes, but Matveev wanted to test the theory under Australian conditions.

'Our geological history, climate and fauna are all different, and I've seen many cases where assumptions have been turned upside down,' he says.

To test the theory, Matveev, with the Queensland Department of Natural Resources, the Queensland Department of Primary Industries – Fisheries, and the Maroon-Moogerah Fish Stocking Association, set up a five-year whole lake experiment in two south-east Queensland lakes.

In the reference lake (Lake Moogerah), fish stocking continued as usual and major ecosystem variables – algae, cyanobacteria, micro-grazers, small fish, chemistry and hydrology – were monitored.

The same was done in the experimental lake (Lake Maroon), which, 18 months into the experiment, was stocked with 100 000 Australian bass fingerlings: three times the usual amount of fish.

The ecosystem response to this 'pulse' stocking was then monitored for the next three years and compared with the ecosystem processes in the reference lake.

'If the trophic cascade theory applies, we would expect to see the small fish biomass decrease, the micro-grazer biomass increase, the algal biomass decrease, and water quality improve,' Matveev says.

'In the second year after stocking, that's exactly what we saw.'

But then the unexpected happened.

'We were about to celebrate our success when the population of effective micro-grazers crashed to pre-stocking levels,' Matveev recalls. 'Then, as stocking continued, there was a complete reversal of the situation, and a toxic soup of cyanobacteria exploded across the lake.'

Matveev began searching for answers in the catchment. Could there have been a flush of nutrients into the lake from feeding creeks, for example? But his search produced no plausible explanations.

'The only explanation lies within the lake itself,' he says. 'There has been some kind of change in the internal food web structure caused by stocking Australian bass.'

Matveev says the results indicate that moderate stocking has a positive effect on the health of a lake. But there is a stocking threshold, which, once exceeded, will trigger a rapid decline in water quality.

'We don't know what that threshold is, but it may be different for every lake,' he says. 'It will be a function of the type of predatory fish and the existing food-web structure.'

An application to extend this research and determine a 'threshold stocking density' for Lake Maroon is under consideration.

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