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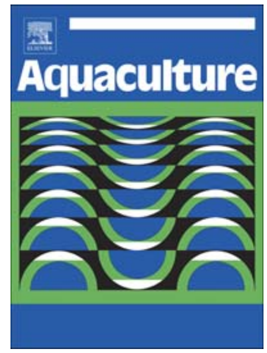

Contrasting response of a plankton community to two filter-feeding fish and their feces: An *in situ* enclosure experiment

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Contrasting response of a plankton community to two filter-feeding fish and their feces: an *in situ* enclosure experiment

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ABSTRACT

The responses of plankton communities and nutrient loads to different biomass levels of silver carp and tilapia (0, 25, 70, 130 g/m^3) were evaluated *in situ*, using enclosures in Lake Taihu, and the effects of fish feces on algal biomass were assessed using *in situ* dialysis culture. Both silver carp and tilapia significantly suppressed zooplankton biomass, after which zooplankton grazing was too low to suppress algal populations. Both fish also played an important role in accelerating nutrient circulation, and their feces directly contributed to algal growth. In fact, after passing through the digestive tract of silver carp, the cyanobacteria *Microcystis* remained viable, and their photosynthetic activity was even stimulated; however, no viable algae were detected in the tilapia feces. Overall, algal biomass increased with increasing biomass levels of the tilapia, whereas the medium biomass level of silver carp (70 g/m^3) was most effective in controlling cyanobacteria. Our results indicate that stocking with silver carp, rather than with tilapia, is an appropriate strategy for reducing summer cyanobacteria blooms in eutrophic lakes that lack large crustaceous zooplankton, such as Lake Taihu. In addition, stocking with 70 g/m^3 of silver carp was most effective for suppressing cyanobacteria blooms and improving water quality, which suggests that this moderate biomass level can be used to achieve a beneficial balance between the positive effects of filter feeding and negative effects of feces-derived nutrients on the growth of algae.

Keywords: Filter-feeding fish; Plankton; Feces; Biomanipulation; Stocking density; *Hypophthalmichthys molitrix*

1. Introduction

The frequency of harmful cyanobacteria blooms is increasing worldwide, as a result of anthropogenic nutrient runoff and climate change (Neil et al., 2012), and such blooms cause a variety of environmental problems, including reductions in fish yields (Carstensen et al., 2014), deterioration of water quality (Svirčev et al., 2014), loss of submerged macrophytes (He et al., 2014), and an overall declines in biological diversity (Chen et al., 2006). In order to prevent further deterioration, researchers from all over the world have been investigating means to control cyanobacteria blooms, and as a result, biomanipulation has emerged as a promising tool for the restoration of lakes (Shapiro et al., 1975).

Previous studies have shown that non-classical biomanipulation, mainly the stocking of silver carp (*Hypophthalmichthys molitrix*) or tilapia (*Oreochromis niloticus*), is an effective and environmentally sound strategy for controlling cyanobacteria blooms in tropical and subtropical lakes (Lu et al., 2006; Radke and Kahl, 2002), and the method has also been used to prevent cyanobacteria blooms in

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