Moderate planktivorous fish biomass stabilizes biomanipulation by suppressing large invertebrate predators of *Daphnia*

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With 4 figures and 2 tables

Abstract: In a long-term biomanipulation experiment started in 1979, all planktivorous fish were eliminated by strong piscivore stocking of an experimental lake (Piscivore Lake) in 1981. Immediately after this manipulation, daphnids reached and maintained high densities even though *Chaoborus flavicans* became abundant after 1985. Daphnids and *C. flavicans* coexisted until the larger *C. obscuripes* immigrated in 1992 and displaced both daphnids and *C. flavicans* by 1994. The present study began in 1995, when zooplankton biomass was even lower than in an adjacent reference lake (Planktivore Lake) that had very high abundances of small planktivorous fish (*Leucaspius delineatus*). Before the immigration of *C. obscuripes* into Piscivore Lake, Secchi depth was 4 to 5 m, but afterwards it decreased to about 2 m, similar to the average Secchi depth in Planktivore Lake. After introducing 20 kg ha\(^{-1}\) of juvenile rainbow trout (*Oncorhynchus mykiss*) into Piscivore Lake in April 1996, *C. obscuripes* disappeared and *Daphnia* spp. reached high densities. Secchi depth increased again to 4–5 m. The continuation of the experiment in Piscivore Lake in 1997 resulted in almost identical zooplankton biomass and species composition. On the other hand, zooplankton in Planktivore Lake was dominated by rotifers. We demonstrated that a moderate biomass of planktivorous fish of 20 kg ha\(^{-1}\) was apparently an “optimum” because it suppressed invertebrate predators but still allowed high *Daphnia* biomass. The result of our biomanipulation was higher and more stable water transparency, one of the main goals of water quality management.

Key words: biomanipulation, *Daphnia*, invertebrate predators, planktivorous fish, phosphorus, whole-lake experiment.

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