Zooplankton biomass to chlorophyll ratios in relation to trophic status within and between ten South African reservoirs: Causal inferences, and implications for biomanipulation

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Abstract

Rising eutrophication in South African reservoirs is of major concern, leading to the consideration of top-down biomanipulation as a management option – reducing zooplankton-eating fish to sustain zooplankton grazing pressure and thus restrict autotrophic plankton that proliferate with nutrient increases. The biomass ratio of zooplankton to phytoplankton (ZB/PB) is used as an index of the likely value of biomanipulation to achieve this outcome, but values have not been explored for South African systems. Using chlorophyll (Chl) as a surrogate for PB, available ZB/Chl data are assembled for the first time for ten reservoirs of three types (minerally-turbid systems, oligo/mesotrophic clear water systems, and eutrophic/hypertrophic systems), and the results are discussed in relation to a generalised conceptual model proposed. With the exception of one minerally-turbid system, ZB/Chl values decline quasi-exponentially with rising chlorophyll within individual reservoirs. Conversely, between individual systems, median (or mean) values of ZB/Chl conversely increase rather than decline with rising trophic status – broadly contradicting observations reported elsewhere. Underlying causal reasons for the observed pattern and its implications for biomanipulation are considered. This assessment evaluates: the negative impacts of general declines in food quality that stem from rising eutrophication on zooplankton feeding ability and resulting seasonal changes in ZB and community structure; prospects of food sources other than living autochthonous autotrophs in sustaining ZB between systems; and inferences about fish predation pressure on zooplankton, derived from empirical data regarding the large body sizes of species and individuals of *Daphnia* that occur in the reservoirs. Observed increases in median ZB/Chl ratios with rising nutrient status are consistent with the inference that obligate visual zooplanktivorous fishes are scarce or absent, particularly in eutrophic reservoirs, suggesting that biomanipulative management is unlikely to assist in controlling the consequences of nutrient enrichment in local reservoirs.

Keywords: Biomanipulation, eutrophication, food webs, food quality, interactions, plankton communities