



Effects of cyanobacterial toxicity and morphology on the population growth of freshwater zooplankton: Meta-analyses of laboratory experiments

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ABSTRACT: We synthesized data from 66 published laboratory studies, representing 597 experimental comparisons, examining the effects of cyanobacterial toxicity and morphology on the population growth rate and survivorship of 17 genera (34 species) of freshwater, herbivorous zooplankton. Two meta-analyses were conducted with these data. The primary analysis compared herbivore population growth rates for grazers fed treatment diets containing cyanobacteria versus control diets comprising phytoplankton that are generally considered to be nutritious for zooplankton (chlorophytes and/or flagellates). This analysis confirmed that cyanobacteria were poor foods relative to small chlorophytes and flagellates. More importantly, filamentous cyanobacteria were found to be significantly better foods for grazers than single-celled cyanobacteria over all studies. Surprisingly, the presence or absence of commonly-measured toxic compounds (microcystins in 70% of the cases) in the diet had no overall influence on grazer population growth relative to control diets. A secondary analysis compared survival rates for grazers fed cyanobacteria versus no food. In contrast to the primary analysis, grazer survival was more negatively affected by toxic cyanobacteria than non-toxic cyanobacteria, relative to starvation. However, this difference was attributable to the effects of a single *Microcystis* strain, PCC7820. Thus, though some cyanobacterial strains appear to be toxic to some strains of zooplankton, the overall role of commonly-assayed cyanobacterial toxins as a determinant of food quality may be less than widely assumed. We suggest that more attention be focused on nutritional deficiencies, morphology, and the toxicity of undescribed cyanobacterial compounds as mediators of the poor food quality of cyanobacteria for zooplankton.

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