



NUTRIENT AVAILABILITY MODULATES NATURAL PHYTOPLANKTON COMMUNITY RESPONSES TO SIMULATED WARMING, THERMAL VARIABILITY, AND HEATWAVES

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Artificial ponds are embedded in agricultural landscapes and therefore exposed to external nutrient inputs that increase eutrophication. These small systems are simultaneously exposed to changes in temperature regimes and extreme events associated with climate change. Controlled experimental studies addressing the effects of these drivers have largely relied on simplified assessments, typically examining single factors under constant conditions in laboratory populations, whereas studies incorporating closer to natural conditions remain scarce. We conducted a medium-term laboratory experiment exposing four natural phytoplankton communities from artificial ponds with contrasting eutrophication levels (two low, two high) to six thermal regimes, combining three mean temperatures (ambient, +3°C, +6°C) with two levels of thermal variability (constant and daily fluctuations). Additionally, treatments were subjected to a 5-day heatwave with (+5°C), followed by one week of recovery. Warming generally increased community growth rates, while the effect of thermal variability depended on the mean temperature and the pond identity, indicating that thermal performance and adjustments in response to thermal regimes differed among communities. During the heatwave, biomass was promoted by elevated temperatures, particularly in treatments with higher nutrient availability, with similar effect sizes across the thermal regimes. Interestingly, after the heatwave, communities from eutrophic systems showed a sharper decline than those from low-nutrient systems, and this effect was amplified by warming and thermal variability. Overall, our results emphasize that evaluating the effects of global change requires a multi-stressor perspective and demonstrate that nutrient context and community properties critically determine phytoplankton sensitivity to thermal variation.

Palavras-chave: *primary producers; temperature fluctuations; nutrient concentrations; thermal performance*