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Scientific Paper:

Microbial Ecology (2022) 83, 555-567

Fluctuation at High Temperature Combined with Nutrients Alters the Thermal Dependence of Phytoplankton

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Abstract:

The Metabolic Theory of Ecology (MTE) predicts that the temperature increases exert a common effect on organisms stimulating metabolic rates, this being stronger for a heterotrophic than for an autotrophic metabolism. However, no available studies within the MTE framework have focused on organisms' response under fluctuation at high temperature interacting with factors such as nutrient availability, or how this interaction could affect the coexistence between mixotrophic and strict autotrophic phytoplankton. Hence, we assess how the phytoplankton metabolism and species composition are affected under scenarios of high temperature and fluctuation at high temperature, and how nutrients alter the direction and magnitude of such impact. For that, we use a mixed culture composed of two phytoplankton species: a strict autotrophic species and a mixotrophic species. Our results indicate that, in agreement with the MTE, only fluctuation at high temperature treatment registered a greater activation energy (Ea) value for respiration than for primary production and stimulated mixotrophic over strict autotrophic species abundance compared to control treatment. Remarkably, fluctuation at high temperature had a strong negative impact on the total abundance of the mixed-culture. The interaction between nutrient enrichment and fluctuation at high temperature increased abundance of the strict autotrophic species and overall species abundance, and led to Ea values that were higher in primary production than in respiration. Changes in community composition, enhanced by nutrient enrichment, could be behind this response, which can have implications in ecosystem functioning in a changing world.

Keywords: interactive nutrient and temperature effects, metabolic theory of ecology, mixotrophy, nutrient enrichment, phytoplankton, temperature fluctuation