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Variability and regulation of the planktonic respiratory quotient in a eutrophic lake (Lake Vombsjön) in summer 2016

Bacterial respiration and biomass growth are important processes for carbon cycling in freshwater ecosystems and bacterial respiration is often quantified from measured O₂ concentrations by using a respiratory quotient (RQ=O₂ consumed to produce CO₂, in moles) of 1. Recent studies have shown, however, that RQs can vary a lot in different aquatic ecosystems (0.5-5), which may lead to an under- or overestimation of respiration. In this study, we conducted in-situ measurements of O₂ and CO₂ fluxes in a eutrophic lake (Lake Vombsjön) to assess the magnitude and variability of the RQ and bacterial growth efficiency (BGE) during summer 2016. The RQ was mostly <1 and increased with increasing water depth while the BGE was high (0.2-0.5) and decreased with increasing water depth. In both cases, this could be attributed to the preferential use of autochthonous organic matter by bacterioplankton. Still, no coupling between the RQ and BGE was observed. All in all, our observed RQs were much lower than any reported values (between 0.5 and 0.2). No single explaining factor could be found; instead, a combination of high primary productivity, increasing nitrification and denitrification rates over the summer and possibly the occurrence of methane oxidation may be responsible. This indicates that using a theoretical RQ of 1 may lead to an overestimation of bacterial respiration in eutrophic ecosystems and that other metabolic processes (nitrification, denitrification, methane oxidation) should be considered when studying respiration processes in those ecosystems.

Keywords: Physical geography and ecosystem analysis, biogeochemistry, bacterioplankton respiration, eutrophic lake, carbon cycling

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