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High bacterial respiratory quotients in net heterotrophic lakes

Berggren, Martin; del Giorgio, Paul A.

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LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

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ABSTRACT

In most studies of bacterioplankton carbon metabolism, the need to assume a respiratory quotient (RQ; mole of CO2 produced per mole of O2 consumed) introduces a fundamental source of uncertainty. Many studies have assumed a fixed value, often close to 1, but this assumption has little empirical support, and ignores potential variability in RQ caused by physiological mechanisms and by varying oxygen contents of respired substrates. Here we present over 50 direct measurements of bacterioplankton RQ that we have carried out in epilimnetic samples of lakes distributed across the temperate and boreal regions of Québec, using O2 and CO2 sensitive mini sensors attached to the inside of closed incubation flasks. RQ was mostly in the range of 0.5-2, with the lowest values in net autrotrophic and the highest in net heterotrophic systems. A plausible explanation is that bacteria were utilizing oxygen-rich organic acids in the net heterotrophic lakes (e.g., formed by photo-chemical processes), and relatively oxygen-poor phytoplankton exudates in the net autotrophic lakes. The results suggest that respiration measured with the O2 consumption method assuming RQ=1 may underestimate the role of bacterial respiration as cause of lake net heterotrophy.