

Scientific Paper:

Nature Communications (2022) 13:43

The role of methanotrophy in the microbial carbon metabolism of temperate lakes

Paula C. Reis¹, Shoji D. Thottathil², Yves T. Prairie¹

¹Département des Sciences Biologiques, Groupe de Recherche Interuniversitaire en Limnologie, Université du Québec à Montréal, Montréal, Canada

²Department of Environmental Science, SRM University AP, Andhra Pradesh, India

Abstract:

Previous stable isotope and biomarker evidence has indicated that methanotrophy is an important pathway in the microbial loop of freshwater ecosystems, despite the low cell abundance of methane-oxidizing bacteria (MOB) and the low methane concentrations relative to the more abundant dissolved organic carbon (DOC). However, quantitative estimations of the relative contribution of methanotrophy to the microbial carbon metabolism of lakes are scarce, and the mechanism allowing methanotrophy to be of comparable importance to DOC-consuming heterotrophy remained elusive. Using incubation experiments, microscopy, and multiple water column profiles in six temperate lakes, we show that MOB play a much larger role than their abundances alone suggest because of their larger cell size and higher specific activity. MOB activity is tightly constrained by the local methane:oxygène ratio, with DOC-rich lakes with large hypolimnetic volume fraction showing a higher carbon consumption through methanotrophy than heterotrophy at the whole water column level. Our findings suggest that methanotrophy could be a critical microbial carbon consumption pathway in many temperate lakes, challenging the prevailing view of a DOC-centric microbial metabolism in these ecosystems.

Keywords: methane-oxidizing bacteria MOB, dissolved organic carbon, freshwater ecosystems, methanotrophy, carbon consumption pathway