Geophysical Research Abstracts
Vol. 15, EGU2013-2268, 2013
EGU General Assembly 2013

Lake size and water-column stability affect the importance of methane for pelagic food webs of boreal lakes

Paula Kankaala (1), Jessica Lopez-Bellido (2), Anne Ojala (2), Tiina Tulonen (3), and Roger I. Jones (4)

(1) Department of Biology, University of Eastern Finland, Joensuu, Finland (Paula.Kankaala@uef.fi), (2) Department of Environmental Sciences, University of Helsinki, Lahti, Finland, (3) Lammi Biological Station, University of Helsinki, Lammi, Finland, (4) Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland

Physical forcing, related to lake size and morphometry, plays an important role in the landscape-scale biogeochemical processing and fluxes of terrestrial carbon in lakes. Boreal lakes are typically dimictic, with mixing of the water column in spring and autumn, but in small, sheltered, humic, forest lakes the spring mixing is often incomplete. This leads to a steep summer stratification and oxygen depletion in the hypolimnion of the lakes. As a result of anaerobic decomposition of organic matter, high concentrations of $CH_4$are typical in these lakes. At the oxic-anoxic interface zone methanotrophic microbes oxidize CH_4 to CO_2 and partly incorporate CH_4-C into microbial biomass, and thus potentially provide a diet source for pelagic consumers.

We studied production at the base of the pelagic food web by methane oxidising bacteria (MOB), heterotrophic bacteria (HB) and phytoplankton (PP) in five boreal lakes with a dissolved organic carbon (DOC) concentration varying between 7 and 25 mg C L^{-1} and an area ranging from 0.004 to 13.4 km^2. High MOB activity was detected in the water columns of the three smallest lakes having anoxia in the hypolimnion during summer. The highest MOB activities (ca. 2-12 μmol L^{-1} d^{-1}) were observed when the CH_4:O_2 ratio varied between ca. 0.5-12. Seasonally, the highest MOB activities were measured during late-summer mixed layer deepening and autumnal mixing of the whole water column. The proportion of MOB in the total basal production was highest in the two smallest lakes (24-56 and 13-36%), having the steepest summertime stratification. The proportion MOB in the basal production decreased with lake size being $<$1% in the largest lake having an oxic water column throughout the year. In the three largest lakes $>$70% of basal production was by PP. In all studied lakes HB contributed only 10-23% of the total basal production, suggesting that a transfer of allochthonous DOC via HB plays only a modest role for the nutrition of the higher trophic levels.