Limnol. Oceanogr., 59(6), 2014, 2112–2120

doi:10.4319/lo.2014.59.6.2112

Dissolved organic carbon concentration controls benthic primary production: Results from in situ chambers in north-temperate lakes

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Abstract

We evaluated several potential drivers of primary production by benthic algae (periphyton) in north-temperate lakes. We used continuous dissolved oxygen measurements from in situ benthic chambers to quantify primary production by periphyton at multiple depths across 11 lakes encompassing a broad range of dissolved organic carbon (DOC) and total phosphorous (TP) concentrations. Light-use efficiency (primary production per unit incident light) was inversely related to average light availability (% of surface light) in 7 of the 11 study lakes, indicating that benthic algal assemblages exhibit photoadaptation, likely through physiological or compositional changes. DOC alone explained 86% of the variability in log-transformed whole-lake benthic production rates. TP was not an important driver of benthic production via its effects on nutrient and light availability. This result is contrary to studies in other systems, but may be common in relatively pristine north-temperate lakes. Our simple empirical model may allow for the prediction of whole-lake benthic primary production from easily obtained measurements of DOC concentration.