ABSTRACT

DISSOLVED ORGANIC CARBON IN LAKES: EFFECTS ON THERMAL STRUCTURE, PRIMARY PRODUCTION, AND HYPOLIMNETIC METABOLISM.

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Watershed characteristics determine the inputs of dissolved organic carbon (DOC) and nutrients into lakes. In-lake processes modify these inputs to determine lake characteristics. I examined the role of allochthonous DOC as a master variable that affects the thermal structure of lakes during summer stratification, primary production, ecosystem respiration, and dynamics of the biota. I combined comparative studies, theoretical modeling, and ecosystem experiments to address the following questions: 1) Is light important in the interactions of algal biomass and DOC concentrations? 2) How does the input of allochthonous nutrients (which affects chlorophyll concentrations) and DOC (which determines water color) affect lake thermal structure? 3) What effect does DOC have on hypolimnetic metabolism? 4) Do short-term fluctuations in food-web structure have long term effects on lake nutrient dynamics and primary production?

The response of algal biomass to increased nutrient inputs was lower in a high DOC lake than a low DOC lake. Modeling results indicate that light absorption by colored DOC is a reasonable mechanism behind this pattern. Colored lakes have epilimnia that are more shallow, darker, and colder than clear lakes. Colored lakes also experience more pronounced diel temperature cycles and higher resistance to mixing across the thermocline. Lakes with higher DOC inputs have higher rates of hypolimnetic metabolism as indicated by the rates of accumulation of dissolved inorganic carbon (DIC) and methane (CH_4). Furthermore, in most lakes DOC concentrations declined during the stratified season and the accumulations of DIC+CH_4 in lake hypolimnia were positively correlated with, and of comparable magnitude to, this DOC decline.

In a related study, I evaluated long-term effects of temporary food web manipulations as biological controls of nutrient cycling and primary production in lakes. Though the upper level of Tuesday Lake's food web had recovered from a food web manipulations conducted in 1985-1986, zooplankton and *Chaoborus* remained below their premanipulation abundance; chlorophyll *a* remained low, and the dominant premanipulation phytoplankton had not reappeared. Thus, inputs of nutrients and DOC from the landscape affect the primary production, respiration and thermal structure of lakes, and these effects can be modified by in-lake interactions and biological processes.