6-1-2003

LINKING LAKES WITH THE LANDSCAPE: THE FATE OF TERRESTRIAL ORGANIC MATTER IN PLANKTONIC FOOD WEBS

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Descriptors: lakes, dissolved organic matter, food webs, zooplankton, fish, carbon, nitrogen, phosphorus, stoichiometry

Problem and Research Objectives:

In this proposal, we evaluate how terrestrially-derived dissolved organic matter (DOM) influences the functioning of lake ecosystems. Terrestrially-derived DOM is commonly the largest pool of carbon in lakes (Wetzel 1992) . As such, terrestrial DOM represents a major source of potential energy for aquatic food webs that may subsidize higher trophic levels (including zooplankton and fish) and determine whether lake ecosystems act as sources or sinks of CO_2 (Cole *et al.*2000) . Terrestrial DOM can also influence how lake ecosystems respond to disturbance (Williamson *et al.* 1999) by attenuating light, reducing UV transmittance and pH, and diminishing the toxicity of pesticides and metals for aquatic biota (e.g., Jones 1992b) . Moreover, DOM can be a major concern for municipal water supplies because it forms carcinogenic trihalomethanes during water purification processes (cf. Williamson *et al.* 1999) .

Inputs of terrestrial DOM to aquatic ecosystems may be particularly important for managing New Hampshire (NH) watersheds. The median concentration of DOM for lakes in the New Hampshire region (7 mg/L) is substantially higher than the median concentration of DOM recorded for lakes in North America and Europe (4 mg/L; Nürnberg and Shaw 1998 ; Kalff 2001) . Therefore, NH lakes may be more tightly linked to their surrounding watersheds than lakes in other ecoregions. As such, NH lakes may be more vulnerable to changes in land cover, hydrology or climate - factors known to alter inputs of terrestrial DOM to lake ecosystems (Engstrom 1987 ; McDowell and Asbury 1994 ; Gergel *et al.* 1999 ; Neff and Asner 2001) . This raises some important questions: How might changing DOM inputs from land affect the structure and function of NH lake ecosystems? Does terrestrial DOM subsidize the diets of zooplankton and fish? Will changes in land use alter fish abundance or productivity? We propose to address these questions using laboratory experiments, simulation models, and field surveys of NH lakes.

The results from our study should advance our basic understanding of how terrestrially-derived material is used in lakes, and aid in decision making regarding land use activities such as agriculture, shoreline development, forestry, and wetland delineation. We will first conduct laboratory-based studies to assess how terrestrial DOM quantity and quality influence the production and growth efficiency of pelagic bacteria. These two processes ultimately dictate how much terrestrial DOM enters lake food webs. We will then incorporate the laboratory data into a simulation model that will help us predict the flow of terrestrial carbon in lakes with contrasting food webs and trophic states. In particular, we will use our model to identify the conditions under which terrestrial DOM is likely to be energetically important for higher trophic levels. Finally, we will evaluate model predictions by using stable isotopes (d 13 C) to quantify the incorporation of terrestrially-derived carbon into zooplankton and planktivorous fish in approximately 60 New Hampshire lakes. This survey will (1) reveal the extent to which lake organisms rely on terrestrially organic matter and (2) provide an important complement to data that has been collected in these lakes by other NH limnologists (including Jim Haney at the University of New Hampshire and Carol Folt and Rich Stemberger from Dartmouth

College). Results of all aspects of the project will be presented at national meetings and in peer-reviewed publications. For example, preliminary results from the simulation model will be presented in a special session on terrestrial-aquatic linkages that JTL has organized for the American Society of Limnology and Oceanography (ASLO) meeting in Vancouver, British Columbia, in June 2002.