



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: "Using a paleolimnological approach as a tool for protecting, restoring and understanding aquatic ecosystems"

Duration: September 1, 1996 - August 31, 1999

Federal Match: \$64,801

Non-Federal Match: \$131,332

Principal Investigator: Peter A. Siver, Botany Department, Connecticut College, New London, CT

Congressional District: 2

Statement of critical regional or State water problems:

Lake and resource managers are often faced with decisions that require knowledge of the past or historical conditions of the waterbodies they are charged to protect. Past conditions may reflect time periods ranging from tens of years, to hundreds of years. In either case if the data are not available the decision making process becomes hampered and often based on false or unfounded assumptions. Three scenarios will illustrate this point. First, two lakes are being considered for inclusion in a protection program aimed at identifying those resources that best reflect "natural" conditions. A primary element needed to make this decision is a knowledge of the past conditions of each waterbody. The central question, "which lake has undergone the least amount of anthropogenic related change since the beginning of European settlement?", needs to be answered in order to select the appropriate waterbody. In the second scenario, five waterbodies are under consideration for large scale restoration that will include expensive watershed management techniques. The appropriate question is "what are realistic background or target conditions for each of the five lakes?" Perhaps the target conditions set during the planning phase for several of the lakes are unrealistic simply because the waterbodies are naturally eutrophic, or naturally acidic. In this scenario the lack of appropriate historical knowledge may result in the expenditure of limited funds on restoring the less appropriate lake systems. The third example deals with sulfur dynamics, a fundamental and basic process in lake ecosystems. It is well known that the cycling of sulfur in lakes has been altered by acid deposition, and that this alteration of the sulfur cycle leaves a signal in the sedimentary record. More recent data suggests that eutrophication also alters the sulfur cycle and changes the sedimentary sulfur record. To understand the interaction between acid deposition and eutrophication on the sulfur cycle of lakes and on the chemical signals we measure in sediments, we need to examine biogenic markers in the sediment which respond uniquely to either eutrophication or acidification.

The three scenarios presented above each represents a different watershed/ecosystem management problem currently being addressed by agencies or research institutions in the northeastern US (see below). Each constituent agency clearly understands the need for attaining historical information on their lake systems in order to reach their goals, but lack the necessary tools to do so. The objective of the proposed project is to apply a set of paleolimnological inference models and methods recently developed in Connecticut to three different regional problems in order to provide the various constituencies with information and data that will aid in their research and/or management efforts. The results gleaned from the three applications will also be used to further identify uses of the paleolimnological tools, as well as to provide more robust and useful inference models. The models to be used in this project were developed, in part, through seed monies from the Institute of Water Resources, with the intent of utilizing them to address watershed related issues on a more regional scale. Since the development of inference models is time consuming and expensive, it makes economic sense to use the Connecticut models to address lake management issues in regions with similar types of waterbodies. Although the questions and management concerns being addressed in each scenario differ, the proposed project will provide a common thread between three otherwise disjunct programs.

Statement of Results or benefits:

This study will provide information on the past conditions of waterbodies in three geographic regions for a) use in resource protection (*Application #1*), b) the establishment of guidelines for lake remediation (*Application #2*) and, c) to assist in the understanding of the interactive role of eutrophication and acidic deposition on sulfur cycling (*Application #3*). The three *Applications* represent the needs of ongoing projects being directed in four states by state and federal agencies, and an internationally renown ecological research center. In each case there is a clear need to include a paleolimnological component in order to be able to reconstruct historical lake water conditions.

Application #1 will yield the methodology as to how a paleolimnological approach can be utilized to provide historical information on waterbodies for inclusion into a decision making process whereby "high priority" natural resources are selected and earmarked for protection. In addition to the development of a method, the pilot study will specifically yield information on four waterbodies that are situated within potentially "high priority" resource areas in Connecticut. *Application #1* is strongly supported by the EPA (see letter from R. Monahan), the New England Interstate Water Pollution Control Commission (see letter from J. Zimmerman), and the State of Connecticut Department of Environmental Protection (see letter from Charlie Fredette). In *Application #2* paleolimnological inference models will be utilized to determine the reference status of waterbodies (trophic status, specific conductivity and pH) earmarked for restoration programs in Vermont and New Hampshire. The project will provide the lake managers in these states with effective and meaningful conditions that can be targeted for remediation efforts. This portion of the proposed work is strongly supported by the State of Vermont Department of Environmental Conservation (VTDEC; see letter from N. Kamman) and the State of New

Hampshire Department of Environmental Services (NHDES; see letter from J. Connor). Both the VTDEC and the NHDES will provide field assistance, laboratory space and chemical analyses of their lakes. In *Application #3* a method will be developed to determine the degree to which waterbodies on Cape Cod have historically shifted along both trophic and acidic gradients. The method will be applied down core in specific lakes where long-term burial and storage of sulfur processes are being investigated. In order to understand the interaction of eutrophication and acidic deposition processes on sulfur dynamics in lake systems an understanding of the degree and timing of change in the trophic status and acidic nature of each waterbody is paramount; this information will be provided by the proposed research initiative. *Application #3* will be done in conjunction with scientists from The Ecosystems Center at the Marine Biological Laboratory, Woods Hole, MA (see letter from A. Giblin). The Ecosystems Center will provide office space and use of library and laboratory facilities during the PI's stay in Woods Hole.