Overview

There is considerable circumstantial evidence that implicates acid deposition effects on aquatic biological systems. However, investigations have not substantiated the existence of a single cause-effect relationship. Not all the suspected effects have been observed in apparently similar susceptible environments that have been studied, and significant differences between the results of apparently similar investigations of the same suspected effects have not been resolved. Great uncertainties are associated with the historical aquatic biological data base relevant to acid deposition effects. However, these uncertainties and the need for continuing research do not negate the present significance of acid deposition as one factor that appears in varying degrees to effect aquatic biological communities. This weakness in the historical data base has led to the present controversy about the contribution of acidification to depletion of biological diversity, especially with regard to fishery resources in ultraoligotrophic waters (water with low concentrations of dissolved ions). Lack of suitable biological (toxicological) and chemical methodologies appropriate to ultraoligotrophic waters have been factors contributing to the lack of hard data.

This volume brings together a diverse group of papers that have been used to link sources of acidification to aquatic biological effects. Air, water, soil (sediment), toxicology, and biological papers contribute to our understanding of lake/stream acidification processes and aquatic biological effects such as toxicity, productivity, and diversity. The volume opens with a paper by Malanchuk et al., who present the U.S. National Acid Precipitation Assessment Program (NAPAP) plan for 1985 and ongoing for ascertaining aquatic effects of acid deposition. Sections that describe the scope and organization of the assessment and a list of policy-related questions presented in the context of an Adirondack Mountain and New York regional case study are of particular interest. Fish are the principal biotic resource considered in the case study. Especially discussed are the uncertainties of: (1) the inferential process of relating acid deposition to loss of fish populations; (2) the application of laboratory-derived, dose-response functions to field situations; and (3) the correlating of chemistry to fish field surveys, some of which do not take factors into account such as fishing pressure, historical stocking practices, habitat changes, etc. that are necessary to identify the contribution of acid-deposition effects. The conceptual basis for an environmental model of reduced fishing benefits related to acidification is addressed also.

Crisman et al. and Parent et al. address the role of aquatic biological communities in acidified waters. Crisman et al. noted that while littoral and benthic communities are usually major contributors to autotrophic production in small lakes, they become much more important in acidified lakes where plankton are severely limited by lack of nutrients. Many studies have ignored this response in the past but should be included in future studies so that littoral-pelagic linkages can be quantified.

Parent et al. studied the effect of acidification on different trophic levels in freshwater microcosms. Perhaps surprisingly, at least to some, they found a contradiction to the hypothesis coupling acidification with the process of "oligotrophization" in that they found increased periphytic production following acidification.

Lam et al. investigated the underlying causes of acidification on the primary productivity of phytoplankton with the hypothesis that large regional differences in soil/sediment buffering capacity and watershed hydrology provide for large differences in growth rates even if acid deposition and nutrient conditions are the same. In their Turkey Lakes case study, they found that the pH, alkalinity, and dissolved inorganic carbon increased progressively downstream and were more important determinants of primary productivity than nutrients, sunlight, and temperature in these oligotrophic waters. The implication of their findings to the use and development of models relating acidification to eutrophication is also discussed.

The paper by Allan and Burton was more focused and reported size-dependent sensitivity of caddisflies, isopods, and snails to the effects of acidity in laboratory streams. Their recommendations were that biological programs designed to detect sensitivity to environmental stress should include testing of several life stages.

The paper by Perry et al. related the buffering capacity of soft-water lake sediments to artificial acidification in the laboratory and found in general that chemical- and biological-mediated processes in the sediments tend to counter impacts of acidity to the water column, which shows the importance of conducting highly integrated, interdisciplinary studies as suggested by Malanchuk.

Morgan et al. discussed linking automated biomonitoring (live organism responses) in acidified streams to remote computer platforms with satellite data retrieval. The advantage of this system is its capability to relate real-time organism responses to water quality during normal and unusual events such as spates or snowmelts. Another advantage is that it can be left at remote monitoring sites where real-time data is virtually impossible to obtain without automated sensing. The system described is significantly advanced over systems that have been used for a single waste stream or used in the laboratory.

Young's paper discusses identifying potential problems with the use of aluminum salts in laboratory toxicity tests of acidification effects, especially anion effects such as may be experienced with the use of aluminum chloride stock solutions, for example. There are many such chemical speciation problems in trying to separate acidification effects from other chemical/biological effects in poorly buffered waters. These problems include measuring pH, for example. It was soon found when acid deposition studies really got under way that conventional pH electrodes, which are designed to function in high conductivity solutions, simply did not work very well in very soft waters that scientists had to deal with. The paper by Boyle et al. addresses this problem and reported that increasing conductivity without changing the pH solved the measurement problem in combination with the use of the Ross pH electrode. Boyle et al. are sufficiently confident in their methods and in the electrode system to introduce them into the ASTM standards process for collaborative testing.

The collective papers in this volume will be of great help to those evaluating the impacts of acid deposition on aquatic biological systems and for evaluating mitigative benefits to such systems.

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