

Acid Deposition: Long-term Trends. Committee on Monitoring and Assessment of Trends in Acid Deposition, National Research Council, National Academy of Science, National Academy Press, Washington, D.C. 1986. 506pp.

This is the fifth published study undertaken by the National Academy of Science (NAS) concerning deposition of atmospheric chemical pollutants. The report's objective is to analyze present and historical data to see whether emissions, acid anion deposition, and ecological effects might be linked over the period of industrialization. Should they be linked this could reveal possible cause-effect relationships.

The report has nine chapters dealing with emissions of sulfur and nitrogen oxides; trends in sulfate and visibility (visibility is linked to sulfate levels); precipitation chemistry; and the effects of atmospheric contaminants on forests, lakes and streams. Sections of the text are not light reading. Knowledge of the topic is desirable to comprehend much of the text.

The NAS report provides a good, reasonably current review of the research, hypotheses, and attempts to link cause to effects. The topics addressed were selected based upon the availability of published or original region-wide spatial or temporal data.

Statistical analyses of these data reveal a strong relationship among emission densities of sulfur dioxide, sulfate aerosol concentrations, the range of visibility, wet precipitation sulfate concentrations, and sulfate fluxes in USGS Bench-Mark streams (Smith et. al. 1982, Smith and Alexander 1983). Since reliable precipitation data are generally absent prior to 1978, these relationships are especially important in estimating what historical deposition of acid precipitation and its associates might have been. These relationships are used to link emissions in the eastern portions of the US to probable deposition rates over time.

For example from limited historical visibility data and gradients of sulfate in lake sediments the study concludes that high levels of acid precursors have been emitted over Eastern North America from the turn of the century. Since 1920 these emissions have remained about the same. From about 1970 major differences in emissions have existed among regions of the eastern US especially north and south. Based upon historical visibility and especially stream

chemistry data (USGS Hydrologic Benchmark Stations and sites at the Hubbard Brook Experimental Forest) it appears that for the last 15 years the southeastern US has incurred the highest rates of increase in factors related to acid precipitation with the midwest region following.

Historical stream water chemistry for these regions indicate that sulfate flux effects change in stream alkalinity and base cation concentrations, particularly where soils are acid and streams have low alkalinity. However, historical lake water chemistry data for the midwest and northeast are not nearly as conclusive. Some suggest declines in alkalinity while others show increases. Also in many cases of alkalinity decline the rate is so rapid that factors other than acid precipitation are probably involved. An exception to this, of course, is the well documented case of chemical and biological change strongly linked to acid precipitation for 10 Adirondack lakes.

The report is scientifically valuable since it analyzes much data for the first time. However, it accomplishes little in carrying out its primary objective of establishing the cause-effect relationships between acid precipitation and aquatic or terrestrial effects. For example "there is no indication now that acidic deposition is an important factor in the red spruce decline." (p. 25). It is unable to even achieve this for regional lake effects, the arena of perhaps the most intense recent study within the National Acid Precipitation Assessment Program (NAPAP).

To its credit the study devotes appropriate attention to the complexity of this issue, in particular the constraints added by a lack of historical monitoring and research data, the inability to analyze much historical data because they were obtained using inconsistent or poorly documented procedures, and the basic lack of knowledge on the structure and function of ecosystems.

This NAS report, while addressing the issue of acid precipitation, contains many examples and statements of explicit value in the assessment of research and resource management strategy for a bureau such as the NPS. Some of the major ones follow.

First, acid precipitation has been an intensively studied issue in recent years. Despite this widespread but short-term effort, some of the most valuable data for assessing trends in past and present deposition and its probable effects have been long-term baseline data for which collection began long before acid precipitation was an issue. These data, mainly surface water chemistry, benthic lake cores and air visibility, were comprehensive, were routinely collected using consistent procedures with quality assurance, and the procedures were documented. These are minimal *a priori* requirements for data to be useful in future evaluations of environmental effects, especially in adversarial situations.

Second, a major factor in finding clear cause-effect relationships, as for example acid deposition and lake or soil acidification, is the need for *long-term* research and monitoring. In many instances what will be required is detection of statistically significant trends in concentrations of chemical compounds which also occur naturally with considerable year-to-year variation.

Third, much historical and even quite recent data have had to be discarded in such evaluations because they were not collected in a consistent manner using documented procedures which included quality assurance.

Fourth, the ecological effects of acid precipitation are inherently complex, much more so than most

initially thought. The effects are often subtle, affecting processes within ecosystems, ecosystems whose structure and function are still poorly understood. This will probably be found the case in many future anthropic threats.

It is evident that these are minimal components of a strategy the NPS must employ nationally if it is to carry out its mandate of park preservation.

Smith, R.A., and R.B. Alexander. 1983. Evidence for acid precipitation induced trends in stream chemistry at Hydrologic Bench-Mark Stations. Circ. 910 US Geological Survey. 12pp.

Smith, R.A., R.M. Hirsch, and J.R. Slack. 1982. A study of trends in total phosphorus measurements at NASQAN stations. US Geological Survey Water Supply Paper 2190.

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