United States
Environmental Protection
Agency

Office of Modeling,
Monitoring Systems and
Quality Assurance
Washington DC 20460

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Research and Development

EPA AERP status

The Aquatic Effects Research Program (AERP) *status* provides information on AERP projects dealing with the effects of acidic deposition on U.S. surface waters. Our objectives are to:

- assist organizations involved in acidic deposition research to avoid duplication of efforts and to make maximum use of related research,
- promote communication among the Environmental Protection Agency, state agencies, and organizations involved in acidic deposition monitoring activities, and
- provide a mechanism to distribute available AERP information.

AQUATIC EFFECTS RESEARCH PROGRAM, AN OVERVIEW

In 1980, Congress passed the Acid Precipitation Act, thus establishing the Interagency Task Force on Acid Precipitation. Given a 10-year mandate, the Task Force implemented the National Acid Precipitation Assessment Program (NAPAP) to investigate the causes and effects of acidic deposition. NAPAP includes task groups formed to study emissions and controls, atmospheric chemistry, atmospheric transport, atmospheric deposition and air quality, terrestrial effects, effects on materials and cultural resources, and aquatic effects.

The AERP, formed in 1983 as part of the NAPAP Aquatic Effects Task Group, is responsible for assessing the effects of acidic deposition on aquatic ecosystems. Already, published AERP reports have described the chemical characteristics of lake and stream resources in regions of the United States potentially sensitive to acidic deposition. Complementing these findings, a report summarizing correlative relationships between watershed and surface water chemical characteristics in the Northeast and the Southern Blue Ridge Province will be published by the spring of 1989. This report will also provide time scales over which surface waters may become acidic at present levels of deposition. (For a complete listing of published AERP documents, see the mail order form attached to this status.) Current AERP field efforts focus primarily on watershed process studies and manipulations.

By 1990, the end of the 10-year mandate, Congress requires NAPAP to provide a full assessment of the acidic deposition phenomenon. An important aspect of current AERP efforts involves synthesizing results from past research and integrating them with new findings. A group of AERP scientists is planning this task, which will provide valuable aquatic information for the NAPAP report to Congress. A report on these activities can be found on page 12.

Status of AERP Activities-This section provides information about recently published AERP materials and projects in progress. Table 1 summarizes the present status of projects within the AERP.

Aquatic Effects Research Program

Project	Design	Implementation	Reporting
National Surface Water Survey			
National Lake Survey, Phase I (East and West)	Complete	Complete	Complete
National Lake Survey, Phase II (NE)	Complete	Complete	1989
National Stream Survey, Phase I	Complete	Complete	Complete
Direct/Delayed Response Project			
NE and SBRP Soil Survey	Complete	Complete	Summer 1989
Mid-Appalachian Soil Survey	Complete	Ongoing	Fall 1990
Watershed Processes and Manipulations			
Watershed Manipulation Project	Complete	Spring 1987 ongoing	Fall 1989
Watershed Recovery Project	In Review	Fall 1988	Spring 1990
Little Rock Lake Experimental Acidification Project	Ongoing	1983	Annually
Episodic Response Project			
Episodes	Complete	Fall 1988	Winter 1989-90
Regional Episodic and Acidic Manipulation Project	Complete	Spring 1987 ongoing	Summer 1990
Temporally Integrated Monitoring of Ecosystems	Ongoing	1991	Annually
Biologically Relevant Chemistry	Ongoing	Ongoing	Winter 1988-89
Indirect Human Health Effects	Ongoing	Ongoing	Fall 1990

Table 1. Present status and projected dates for stages of major AERP projects.

AERP FEATURE ARTICLE

An Overview of the Direct/Delayed Response Project

Much scientific interest and public debate surround the effects of acidic deposition on freshwater ecosystems. The U.S. Environmental Protection Agency (EPA) recently completed a comprehensive chemical survey (the National Surface Water Survey or NSWS) of the lakes and streams in the United States considered to be most vulnerable to acidic deposition, i.e., those with the lowest acid neutralizing capacity or ANC. Analysis of the survey data, along with data on atmospheric deposition, clearly indicates that long-term deposition of sulfur-containing compounds originating from the combustion of fossil fuels has acidified (decreased the ANC of) some surface waters in the northeastern United States. Transport within watershed soils of mobile anions (primarily sulfate) and closely associated cation leaching are the likely mechanisms for this acidification process.

That acidification of some surface waters has occurred leads to critical scientific and policy questions as to whether acidification is continuing in the regions noted, whether it is just beginning in other regions, how extensive the effects might become, and over what time scales effects might occur. The EPA is examining these questions through an effort called the Direct/Delayed Response Project (DDRP). The DDRP draws its name from the general question of whether future additional effects on surface water chemistry might be immediate (or immediately proportional to levels of deposition, i.e., direct), or whether there are lags in time (delays) related to important edaphic characteristics such as soil, vegetation, and bedrock geology.

The DDRP is a very large effort involving numerous participants. It was designed and implemented by the Agency's Environmental Research Laboratory at Corvallis, Oregon. It involves three other Agency laboratories (the Environmental Monitoring Systems Laboratory at Research Triangle Park, North Carolina; the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada; and the Atmospheric Sciences Research Laboratory at Research Triangle Park). The DDRP also is assisted by four other federal agencies (U.S. Department of Agriculture [including the National Office, two National Technical Centers and 12 state offices of the Soil Conservation Service], U.S. Geological Survey, U.S. Forest Service, and the National Oceanographic and Atmospheric Administration). Two national laboratories (Oak Ridge National Laboratory and Battelle-Pacific Northwest Laboratories), five state and private universities and four consulting firms also are involved in the project. In all, over 200 field, laboratory, data base management, scientific, and management personnel are part of the effort.

Objectives - The DDRP addresses four important technical objectives related to atmospheric, terrestrial, and aquatic interactions:

- characterize the regional variability of soil and watershed characteristics;
- determine which soil and watershed characteristics are most strongly related to surface water chemistry;
- estimate the relative importance of key watershed processes across the regions of concern; and
- classify a sample of watersheds with regard to their response characteristics and extrapolate the results from the sample of watersheds to the regions of concern.

Study Regions - The project is underway in three regions of the eastern United States where surface waters with low levels of ANC exist and where levels of acidic deposition are the greatest. These regions are the northeastern United States, upland areas of the Mid-Atlantic region (termed here the Mid-Appalachian region), and the mountainous section of the Southeast (called the Southern Blue Ridge Province) (Figure 1).

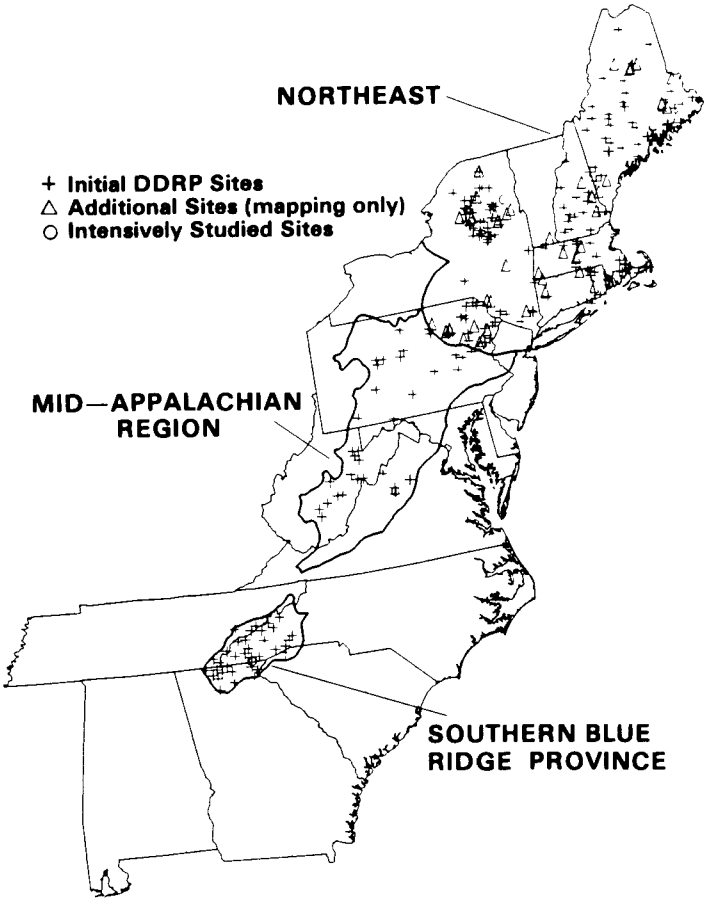

Figure 1. Location of study regions and watersheds for the Direct/Delayed Response Project.

Approach - For drainage lakes, reservoirs, and streams in the Northeast, Upper Midwest, and Southern Blue Ridge Province of the United States, a vast majority of surface water ANC originates as a result of biogeochemical processes within the surrounding watershed. Because of the importance of watershed characteristics (especially soils) in determining future aquatic effects, data on these factors are required. Existing soils data bases did not provide sufficient information on key characteristics; thus, a major soil survey was designed to provide a new regional soils data base. This effort was planned so that the specific soils (and specific soil types) could be intimately linked to the existing NSWS data bases on the chemistry of low-ANC lakes and streams. The project design had the following components:

- Watersheds selected as a high interest (low surface water ANC) probabilistic subset of those lakes and streams surveyed in the NSWS, thus allowing extrapolation back to a population of interest. Sufficient watersheds were selected to allow for (1) reasonably broad regional coverage (where warranted), (2) statistical examination of the interrelationships of deposition and watershed characteristics, and (3) appropriate regional extrapolation of predicted watershed responses.
- Maps prepared for soils, vegetation, land use, depth-to-bedrock, and bedrock geology for each watershed at a scale of 1:24,000 with a minimum map delineation of 2.5 to 4.2 hectares (6 to 10 acres).
- Sample class definitions based upon (1) expert knowledge about soils of the regions and (2) expectations of the potential responses of those soils to acidic deposition.
- Soil sampling sites selected randomly within the context of expert classification using a novel procedure developed for this purpose.
- Sample analyses performed by independent soil laboratories. Table 2 lists the types of analyses. A rigorous quality assurance and quality control program ensured comparability of the analyses.
- A variety of data analyses that include prediction of future effects and regional extrapolations based on these predictions.

Table 3 gives the schedule of the major field activities (mapping and sampling) of the DDRP. Field mapping and sampling were conducted by the U.S. Department of Agriculture Soil Conservation Service.

Data Analyses - Three levels of data analyses within the project are distinguished by the complexity and degree of reliance upon knowledge, or hypotheses, of actual process interaction within watersheds. For example, Level I analyses presuppose the least knowledge of the way watersheds operate, whereas Level III depends upon an existing knowledge base or model of system behavior.

Level I includes a variety of data analyses. One set of analyses focuses on the statistical evaluation of interrelationships of atmospheric deposition, soil and watershed characteristics, and current surface water chemistry. One goal of these analyses is to verify, as best possible, that the processes and relationships incorporated in the Level II and Level III analyses reasonably represent the systems under study. The Level I analyses are aided by the regional watershed and soils information gathered by the DDRP soil survey. The analyses are complicated, however, by uncertainties about levels of atmospheric deposition (especially dry deposition) and by the fact that the analyses focus on a relatively narrow range of surface water ANC (μeq/L).

A second set of Level I analyses focuses on determining the amount of retention within watersheds of atmospherically deposited sulfur, inasmuch as the leaching

Chemical Analyses

1. pH (distilled water; 0.01 M $CaCl_2$; 0.002 N $CaCl_2$)
2. Total carbon
3. Total nitrogen
4. Total sulfur
5. Cation exchange capacity
   a. 1 N NH_4OAc, pH 7.0
   b. 1 N NH_4CL, unbuffered
6. Exchangeable bases (Na, K, Mg, Ca)
   a. extraction by 1 N NH_4OAc, pH 7.0
   b. extraction by 1 N NH_4CL, unbuffered
7. Exchangeable acidity
   a. $BaCl_2$-TEA method, pH 8.2
   b. 1 N KCl - total acidity, exchangeable Al
8. Extractable iron and aluminum
   a. sodium pyrophosphate
   b. ammonium oxalate
   c. citrate-dithionate
9. Extractable sulfate
   a. water soluble
   b. phosphate extractable
10. Sulfate adsorption isotherms (six points)
11. Specific surface area

Physical Analyses

1. Particle size
2. Bulk density

Mineralogical Analyses

1. X-ray diffraction
2. Thin sections
3. Scanning electron microscopy/energy dispersive x-ray diffraction

Table 2. Laboratory Analyses of DDRP Soil Samples.

Activity	Date
Northeast Region	
Watershed Mapping	April-June 1985
145 routine	
4 special interest	
Soil Sampling	September-November 1985
306 routine pedons	
20 special interest pedons	
~2,000 samples	
Southern Blue Ridge Province	
Watershed Mapping	October 1985-March 1986
35 routine	
3 special interest	
Soil Sampling	April-June 1986
110 routine pedons	
15 special interest pedons	
~1,000 samples	
Additional Northeast Mapping (high interest watersheds apparently retaining some sulfur inputs)	
45 watersheds	October 1987-August 1988
Mid-Appalachian Region	
Watershed Mapping	October 1987-August 1988
37 watersheds	
Soil Sampling	September-December 1988
150 pedons	
~1,000 samples	

Table 3. DDRP Soil Survey

of the mobile anion sulfate is considered to be a key process in long-term acidification. In the sulfur retention analyses, scientists are examining annual watershed input-output budgets for sulfur (estimates of the amount of sulfur deposited and released) based upon detailed studies at a few sites (intensive approach) and relatively sparse data from a large number of sites (extensive approach). The characterization of regional responses of sulfate mobility, as it relates to hypotheses of the acidification process, is an important part of this work.

The Level II analyses entail the use of relatively restricted models of the key processes that regulate the dynamics of base cation supply and retention of atmospherically deposited sulfur within watersheds. Project participants are using the models to project how these processes might control or affect conditions in the DDRP watersheds and the surface waters that drain them under continuing or altered future levels of atmospheric sulfur deposition. The models are run independently of one another and of other watershed factors (e.g., forest accretion) that might affect watershed response.

Level III analyses use integrated watershed models to project future effects of atmospheric sulfur deposition on surface water chemistry. Projections of changes in annual surface water chemistry for up to 100 years will consider two scenarios of atmospheric sulfur deposition for each region: (1) current rates (for both regions) and (2) a decrease in the NE and an increase in the SBRP. Uncertainty and error propagation analyses are an important part of all levels of analyses.

Geographic Information System (GIS) - Scientists are using a GIS as an integral part of the DDRP. Initial GIS activities in the project were data entry, display, and spatial analysis of the watershed mapping data from the soil survey. This role has been greatly expanded, however, to include aggregation, analysis, and display of data and results at a variety of scales and projections. The GIS should be particularly useful in helping to communicate project results to a variety of interested audiences, e.g., scientists, Agency managers, and policymakers.

Preliminary Products and Results - One of the information needs for the DDRP was standardized estimates of average annual surface water runoff (as runoff depth) across the eastern United States. In order to fill this data gap, the U.S. Geological Survey produced annual runoff maps, for not only the 1-year periods just prior to the NSWS sampling of the surface waters under study, but also the period from 1951 to 1980 to represent an average annual runoff.

At this time most data analyses for DDRP are still in progress. Some early Level I analyses on watershed sulfur input-output budgets, however, indicate that significant differences in watershed sulfur retention exist between the Northeast region and Southern Blue Ridge Province. Whereas watersheds in the Northeast appear to be at a steady state (sulfur outputs equal inputs), watersheds in the Southeast are retaining much of the atmospherically deposited sulfur (Figure 2). This result indicates that the full effect of acidic deposition has not yet been realized in the Southern Blue Ridge Province and that streams in this region could suffer decreases in ANC in the future at current (or even reduced) levels of deposition. The timing of these potential changes is being evaluated in the ongoing DDRP Level II and Level III analyses.

All levels of DDRP analyses continue at present. DDRP findings will be available to the public in late 1989 for the Northeast and Southern Blue Ridge Province and in late 1990 for the Mid-Appalachian region. Data collected during the course of the surveys will be available slightly later.

Address inquiries concerning the DDRP to:

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COMPLETED AERP ACTIVITIES

This section lists projects for which recently published materials are available. These materials may be ordered by filling in the order form at the end of this *status*. As indicated on the form, it should be returned to the address given for the Center for Environmental Research Information (CERI).

Western Lake Survey - Phase I

The complete set of reports related to the Western Lake Survey are available through the mail order form attached to this *status*. During this survey, which was conducted in 1985, samples were collected from 752 lakes in the Cascade Mountains of the Pacific Northwest; the northern, central, and southern Rocky Mountains; and in the Sierra Nevada Mountains in California. Survey data provide baseline information about the current chemical status of western lakes. Western Lake Survey reports available for the first time in this *status* are described below.

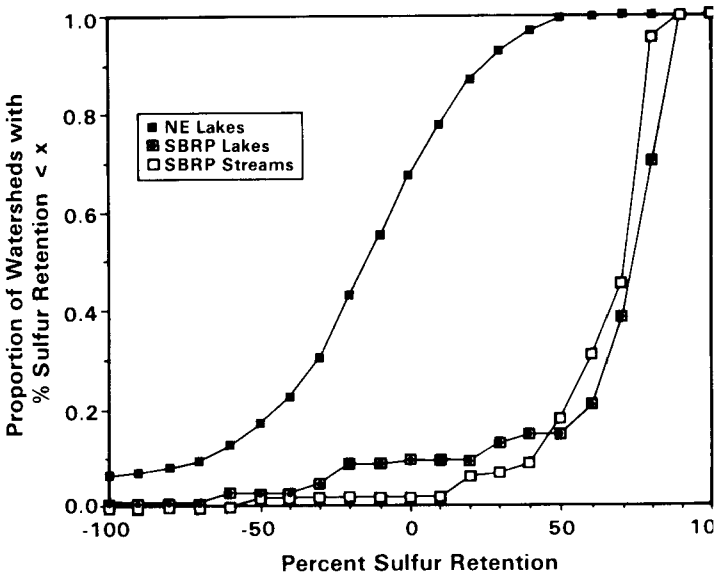

Figure 2. Cumulative distribution functions of curren annual percent sulfur retention (based on "long term average" deposition and runoff) fo watersheds of the target population of drainage lakes and reservoirs in the Northeast (NE) Region N=6,288), target population of drainage lakes an reservoirs in the Southern Blue Ridge Province (SBRP) (Region 3A, N=250), and target popula tion of stream reaches in the NSWS Pilot Surve (Region 2As, N=2,031).

The *Western Lake Survey - Phase I Analytical Methods Manual* describes new and modified sample processing procedures developed specifically for the Western Lake Survey. This manual is a supplement to the analytical methods manual for the Eastern Lake Survey - Phase I. This supplement provides a general description of analytical methods that were used by the field and analytical laboratories; a detailed description of the analytical methods appears in the analytical methods manual for the Eastern Lake Survey - Phase I. The supplement also describes new and modified sample processing procedures that were developed specifically for the West.

The *Western Lake Survey - Phase I Field Operations Report* describes the planning and execution of the field sampling and field laboratory operations for this survey.

The *Western Lake Survey - Phase I Quality Assurance Plan* describes in detail the quality assurance requirements and procedures for field operations that are unique to this survey. Quality assurance requirements and procedures that were adopted from Phase I of the Eastern Lake Survey are referenced in this plan and discussed in detail in the quality assurance plan prepared for that survey.

The *Western Lake Survey - Phase I Quality Assurance Report* describes the results of the survey quality assurance program. It provides data users with an evaluation of the survey data base in terms of the survey objectives. For future surveys the report recommends refinement of data quality objectives and of the sampling design and suggests refinements of procedures for lake sampling, field and analytical laboratories, data management, and data analyses.

The Western Lake Survey - Phase I Data Base includes descriptions of the survey design and implementation as well as findings from the 752 lakes sampled. To order the data base, complete the order form in this *status* and return it to CERI. CERI will send you a Data Base Request Form that lists data base format options. Fill out this form and return it to the address given (a contractor at the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada) along with two blank disks or tapes as specified on the Data Base Request Form.

National Stream Survey - Phase I

Several reports describing aspects of Phase I of the National Stream Survey (see the October 1988 *status*) are available for the first time through the mail order form attached to this *status*. Field activities for the stream survey took place in the spring of 1986; a pilot survey was conducted in the spring of 1985. Conducted in four Mid-Atlantic and five southeast subregions, this survey was designed to (1) determine the percentage, extent, location, and chemical characteristics of streams that are presently acidic or that might become acidic due to acidic deposition and (2) identify representative streams in each region for more intensive study.

The two-volume set entitled *Characteristics of Streams in the Mid-Atlantic and Southeastern United States* describes the design and results of National Stream Survey field activities in the Mid-Atlantic and Southeast during the spring of 1986 and summarizes the current interpretation of these results. Data obtained during the 1985 National Stream Survey pilot survey in the Southern Blue Ridge Mountains are discussed in a separate interpretive report entitled *National Surface Water Survey: National Stream Survey, Phase I - Pilot Survey.*

The *National Stream Survey, Phase I - Pilot Survey: Field Operations Report* describes the activities required to plan and conduct the field operations of the pilot survey conducted in 1985.

The *National Stream Survey - Phase I Field Operations Report* describes activities during the primary Phase I survey in the Mid-Atlantic and Southeast, as well as during a pilot survey of episodes. This report describes survey planning, protocol development, personnel requirements, field operations, and logistics aspects. It also evaluates the sampling activities conducted during episodic events and provides recommendations for future consideration.

The *Eastern Lake Survey - Phase II and National Stream Survey - Phase I Processing Laboratory Operations Report* describes the centralized processing laboratory operations associated with these two 1986 surveys. The main function of the laboratory was to prepare and preserve water samples received from the field and to ship prepared aliquots to contracted analytical laboratories for subsequent analyses.

The *National Stream Survey - Phase I Quality Assurance Plan* describes the quality assurance plan for the Pilot Survey, the Phase I survey, and the Episodes Pilot Survey. This plan specifies the quality assurance requirements and procedures that were designed to assure the data quality objectives of the project were met.

The *National Stream Survey - Phase I Quality Assurance Report* describes the major design and operational aspects of the survey quality assurance program and provides an evaluation of the survey data base in terms of the survey objectives. It also describes sampling and analytical problems that occurred during the survey and the corrective actions that were implemented.

CURRENT AERP ACTIVITIES

Current AERP activities include acidic deposition research projects either in progress or scheduled to begin by Spring 1989.

Watershed Processes and Manipulations

Watershed studies within the AERP are using three approaches to further understand the effects of acidic deposition on surface waters. Process oriented research on natural systems aims to improve our understanding of the nature and function of specific watershed mechanisms that contribute to surface water acidification. Watershed manipulations focus on understanding the integrated response of the biogeochemical processes that operate within a watershed and contribute to surface water quality. Developing and testing surface water acidification models combines current understanding of surface water acidification with the results of the other two areas of research to help quantify the uncertainties associated with forecasting future surface water chemistries with models.

The Watershed Manipulation Project, Watershed Recovery Project, and Little Rock Lake Acidification Project are watershed studies currently in progress.

Watershed Manipulation Project (WMP) - At the Bear Brook watersheds, located on Lead Mountain in southeastern Maine (Figure 3), WMP scientists are assessing the quantitative and qualitative responses of watershed soils and surface waters to altered levels of acidic deposition. Hypothesis testing at the southeastern Maine research site is being conducted through an interdisciplinary approach that involves the cooperative effort of a site team, six scientific task teams, a modeling team, and an EPA management team.

Installation of instruments at the site is nearing completion as the ninth (and final) catchment reference plot has been established in East Bear Brook. Installation of the throughfall collectors on all external (adjacent to Bear Brook watersheds) and catchment reference plots has also been completed, with sampling of throughfall and lysimeter solutions now occurring biweekly. Stemflow plots have been established adjacent to the southwest corner of all reference plots, and trees have been fitted with stemflow collars. Litterfall traps have been installed in all internal plots (four per plot).

The U.S. Geological Survey has completed restoration of areas adjacent to the weir that were disturbed during construction. Deposition inputs to Bear Brook are now being measured more intensively at two wet deposition stations recently installed by EPA contractors from Research Triangle Park. The dry deposition station located at the mid-elevation level has been completed and weekly sampling of filter packs is progressing. A third wet deposition station established at the weir site at the bottom of the catchment on East Bear Brook is now operational.

Various levels and combinations of deposition are being simulated by sprinkler-applied acid treatments to a series of eighteen experimental plots that represent the major soil and vegetation types within the experimental catchments. These plots are located outside the experimental catchments. Successful field testing of the procedures for sprinkler treatments in July yielded targeted coefficients of uniformity ranging from 60 to 80 percent (60 to 80 percent of the area receives the mean application). Irrigations occurred weekly through October. The irrigation system has been refined to include a flushing tank to apply a small

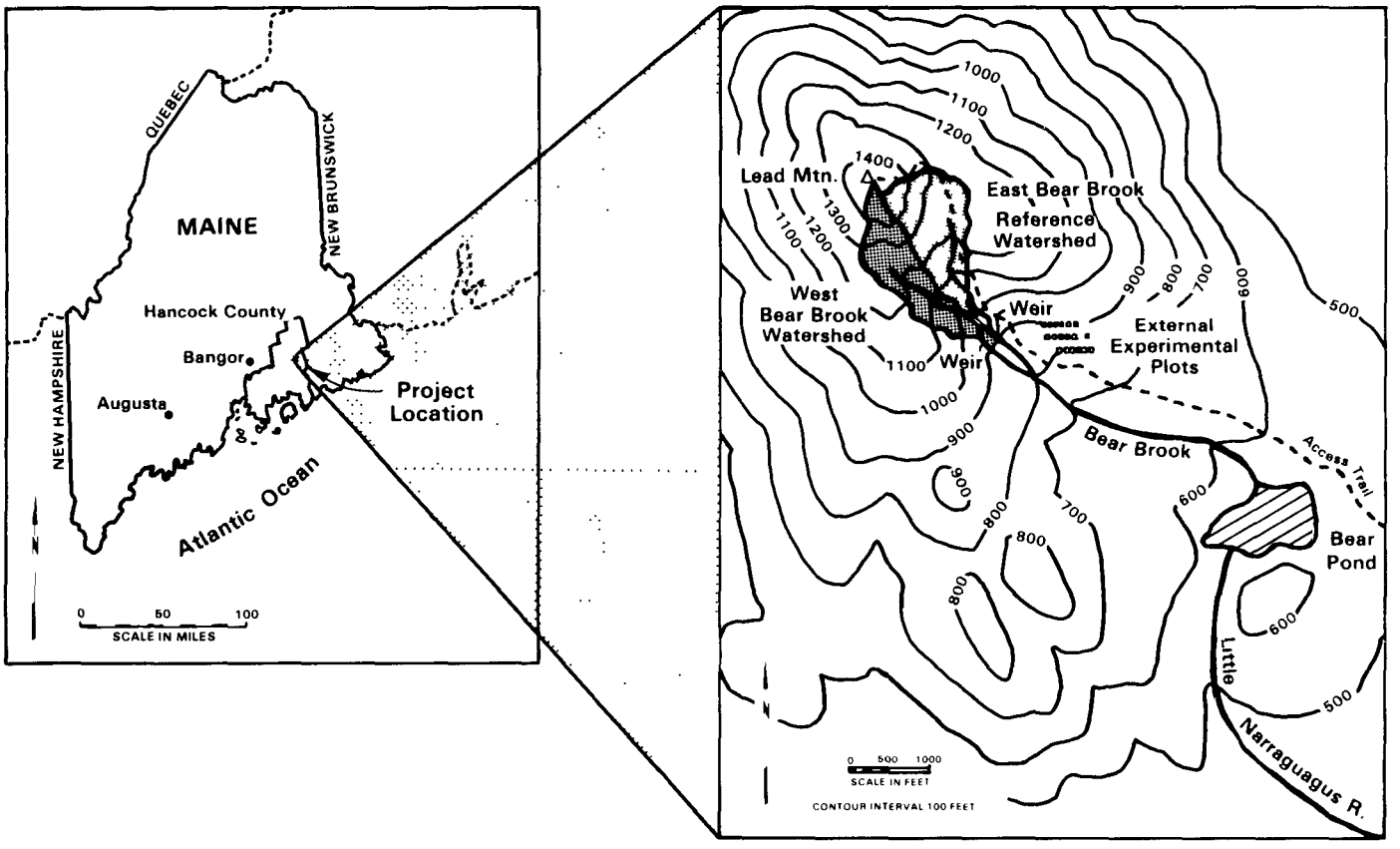

Figure 3. Watershed Manipulation Project at Bear Brook watersheds located on Lead Mountain in southeastern Maine.

amount of water to the plots prior to the treatments, thus wetting plot vegetation. This in turn, flushes the treatment acid from the pipes. In addition, a safety system designed to drain the mixing tanks and pipes into a calcium carbonate neutralization bed has been installed. Acidic irrigations of an additional six mineral weathering plots began in June and continued through October 1988. Treatments were applied weekly, and soil solutions were sampled monthly.

Recent seismic refraction investigations of the catchments have been completed by the team from the State University of New York at Plattsburgh. Soil depths-to-bedrock were determined at 47 points selected by personnel from the EPA Environmental Research Laboratory in Corvallis and the Maine site team. Results indicate that soils are relatively shallow, ranging from 1.3 to 5.2 meters.

Address inquiries concerning the WMP to:

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Watershed Recovery Project (WRP) - The WRP is focusing on the question of how air drying affects the measured sulfate adsorption and desorption isotherms of soils. A regression equation(s) will be developed to allow estimation of isotherms of moist soils from the isotherms and other measured properties of air dried soils. The results will be directly applicable to the Direct/Delayed Response Project (DDRP) soils data base for the Northeast (NE) and Southern Blue Ridge Province (SBRP). Thus, the results will be useful in quantifying and reducing the uncertainties in forecasts of watershed response times to acidic deposition. The desorption isotherms will be especially useful in predicting the possible rates of recovery of acidified Northeast lakes and streams in response to decreased acidic deposition.

Scientists from the EPA Environmental Research Laboratory in Corvallis and Oregon State University (OSU) conducted a pilot test the results of which show that the sulfate isotherms do not need to be determined immediately after sampling, but can be determined from samples that have been shipped in refrigerated containers to OSU. Subsequently, samples were taken at 10 sites in the NE and are being analyzed at OSU. Sampling at 20 sites in the SBRP is planned to begin in March. Three soil horizons are sampled at each site, for a total of ninety samples.

Address inquiries concerning WRP to:

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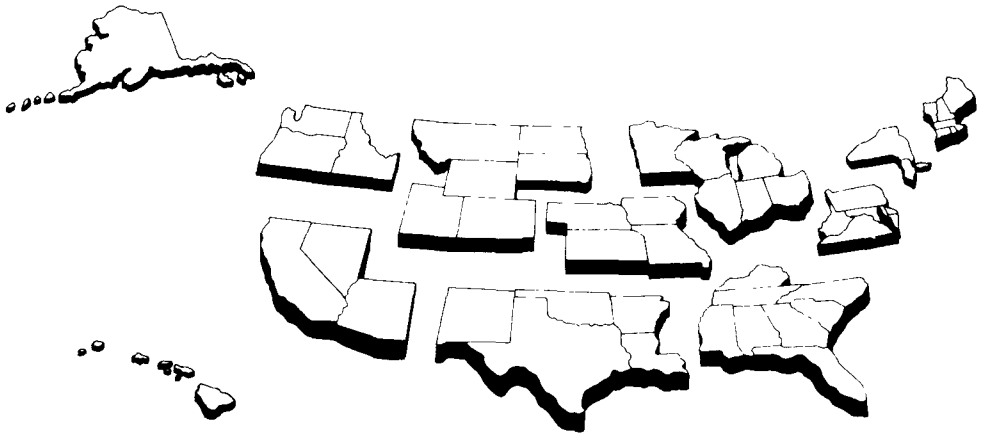
Little Rock Lake Experimental Acidification Project - The artificial acidification of Little Rock Lake (April 1988 *status*) in northern Wisconsin offers researchers the chance to study the responses of whole ecosystems to the effects of acidification. In 1984 the two basins of the lake were separated by a plastic and dacron fiber curtain to allow gradual acidification of one basin. To guard against a loss of acid-treated and untreated basin integrity in the final stages of acidification and during recovery, a new sea curtain was installed between the two basins in August 1988. A second year of sulfuric acid addition to obtain a pH of 5.1 was completed in November and two more years at a pH level of 4.5 remain in the project. Approximately 200 L of acid were required to maintain a pH level of 5.1 in 1988, or about half the amount required during the previous year. Weather that was warmer and drier than normal for the second consecutive year caused further declines in lake water level and volume. All ground-water inputs to this seepage lake have stopped during this period; only precipitation remains.

Like the weather, a number of biological parameters have demonstrated unexpected variability or anomalous behavior during the past summer. For example, largemouth bass young of the year grew faster than normal, which could result in better survival rates in the acidified basin this winter than during the previous three years. A laboratory investigation is in progress to examine the relationship between the condition of young bass, acid stress, and overwinter survival. Another surprise compared to the previous year was a substantially reduced, although still obvious, *Mougeotia* algal mat at the same pH level of 5.1 both years. There were also less consistent differences between the basins in epilimnetic chlorophyll concentrations, water color, and transparency than in the year before.

STATE INFORMATION



The AERP status provides a forum for states to exchange information and updates about acidic deposition monitoring activities. Highlighted state activities are presented below.

Arkansas

The Arkansas Department of Pollution Control and Ecology has been involved in acidic deposition studies since 1981. Currently, the Department has monitoring sites at Little Rock, North Little Rock, Oden, El Dorado, Forrest City, and Buffalo Point.

During the past year, 185 samples were collected at the various sites. The pH and conductivity were measured, and the sample was then analyzed for selected anions and cations. The average pH value was 4.58.

California

The Air Resources Board of the State of California released a 30-page assessment of the impacts of acidic deposition in the State. This report discusses in nontechnical terms what is known about the extent of acidic deposition in California and the potential for damage to human health, materials, crops, and natural ecosystems. This assessment contains a discussion of what has been discovered regarding the sensitivity of high elevation lakes and streams to acidification. This report, *The Health and Welfare Effects of Acid Deposition in California: An Assessment*, is available from the Research Division.

In September 1988, the California State Legislature passed Assembly Bill 2930, the Atmospheric Acidity Protection Act. The Governor signed the bill into law at the close of the legislative session. This bill authorizes an extension of the acidic deposition research and monitoring program that has been in place since 1983. This new program began on January 1, 1989, and will continue for five years at a funding level not to exceed $3 million per year. One of the priorities for funding under this new program will be the long-term monitoring of high-elevation watersheds in the Sierra Nevada and the development of dose-response relationships for aquatic vertebrate and invertebrate populations in areas having dilute surface waters.

Florida

The Florida Department of Environmental Regulation is conducting studies of Florida's sensitive lakes in order to characterize their chemistry and biology and to evaluate the factors contributing to their acid neutralizing capacity (ANC). The Florida Soft Water Lakes Study project is evaluating the water chemistry and status of fish populations in twelve acidic soft water lakes. The Florida Seepage Lake Study is evaluating the factors that regulate ANC, including ground-water contributions. This project is being conducted by a cooperative effort among the Florida Department of Environmental Regulation, the U.S. Geological Survey, the U.S. Environmental Protection Agency, the Florida Electric Power Coordinating Group, and the Electric Power Research Institute.

Maine

Two lake surveys were conducted in Maine during 1986-87 to characterize the chemistry of (1) all lakes at an elevation greater than 600 meters (91 lakes) and (2) lakes hydrologically associated with sand and gravel aquifers, generally seepage lakes. These data sets were compared to the statistical population estimates for Maine from the U.S. Environmental Protection Agency 1984 Eastern Lake Survey - Phase I (ELS-I). The lake population size distributions differed due to selection criteria: ELS-I lakes were restricted to those which are larger than 4 hectares; the Maine case study lakes were selected from those which are larger than 0.4 hectare.

High elevation lakes are chemically similar to ELS-I lakes, but distributions of pH (Figure A) and acid neutralizing capacity (ANC) are shifted towards lower values. While about 1 percent of the ELS-I population is acidic (defined as ANC less than zero), 12 percent of the high-elevation lakes are acidic.

Seepage lakes have lower pH (Figure A) and ANC than either ELS-I or high elevation lakes. Median sulfate concentrations are only 60 percent of the median ELS-I value. One third of the seepage lakes have ANC less than zero (i.e., they are acidic). Dissolved organic carbon and organic acid concentrations are high in seepage lakes,

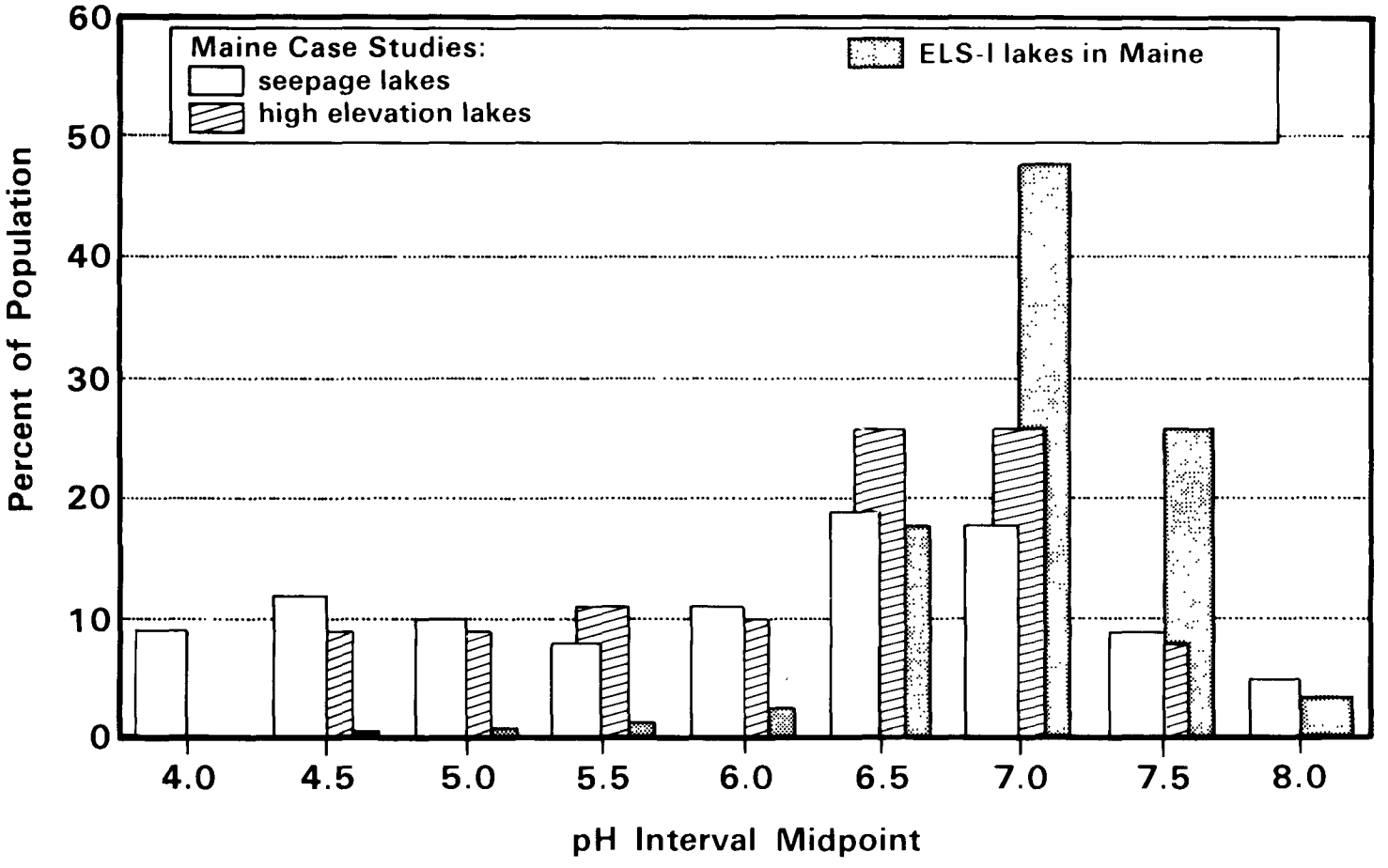


Figure A. Data from 1984 Eastern Lake Study-Phase I (ELS-I) and 1986-87 Maine Case Studies.

possibly due to lack of mineral soil contact. Seepage lakes also have the lowest median and mean aluminum concentrations of any of the three groups. Typically, the lowest aluminum concentrations are found in the seepage lakes with the lowest pH. This relationship is the reverse of that found between pH and aluminum in either the ELS-I or the high-elevation lakes.

The results indicate that both acidic deposition and organic acidity are important acidification agents in these subpopulations of Maine lakes. The seepage lakes are more influenced by organic acids, whereas acidic deposition is a more important factor in the acid-base chemistry of the high elevation lakes. However, these subpopulations represent less than 5 percent of all lakes in Maine. The 60 known acidic lakes in the state of Maine represent less than 0.5 percent of the total lake surface area in Maine.

Minnesota

Activities in 1988 centered on the continuation of a long-term lake monitoring program and the initiation of a study to assess the impact of snowmelt on stream chemistry and discharge characteristics.

Long-Term Monitoring (LTM) Lakes - Twelve lakes were selected and sampled from May 9-11, August 15-17, and October 10-12, 1988. LTM lakes are characterized as low alkalinity ($< 100 \mu eq/L$) seepage or drained bedrock systems and were selected to provide regional distribution throughout the established sensitive areas. The Acid Precipitation Program has been monitoring water chemistry on 35 lakes since 1981. The 12 LTM lakes represent a partial subset of the original 35 lakes.

Stream Study - Seven streams located in northeast Minnesota were selected for inclusion in a snowmelt/episodic acidification study. All streams are identified and managed as brook trout fisheries and range from first through third order systems at the point of sampling and discharge measurement. Instruments were installed at two streams to provide a continuous record of stream stage and allow for point-in-time discharge measurement through snowmelt. Water sampling was initiated at all sites on March 14, 1988, and continued on a semiweekly schedule through April 30. Weekly samples were collected in May, semimonthly samples in June, and monthly samples through the end of 1988. Preliminary plans for spring 1989 involve continued sampling at four of the original seven sites with one stream equipped for continuous discharge gauging and flow proportional sampling.

New Mexico

The New Mexico Air Quality Bureau currently sponsors the operation of two National Atmospheric Deposition Program (NADP) acidic deposition monitoring stations by providing funding for sample analysis and supplies. The actual sites are operated by U.S. Forest Service and U.S. National Park Service employee volunteers. Wet deposition samples are collected weekly. If sample volume is sufficient, field measurements for conductivity and pH are made before the samples are shipped to the NADP contractor for analysis. All sample analyses and data reporting are carried out by the NADP contractor. Results are reported to the NADP coordinator in Fort Collins, Colorado.

Pennsylvania

Limestone ($CaCO_3$) has been applied to three lakes in northeastern Pennsylvania to increase their acid neutralizing capacity (ANC). One hundred tons of limestone were applied on the ice to White Deer Lake (20 hectares) in February 1985 following the collection for one year of biological and chemical data. A smaller dose (15 tons) of limestone slurry was added by barge in October 1987 because the lake was starting to reacidify. An intensive sampling program (eight times a year) indicates significant increases ($p < 0.01$) in acid sensitive organisms such as mayflies. A nearby reference lake, which was similiar biologically and chemically to the treated lake, became acidic during the 4-year study.

Two additional lakes ($ANC \leq 0.00$) were treated with limestone slurry in November 1988, following the collection of background data. This research is being conducted at Lehigh University and is funded by the Pennsylvania Power and Light Co. in Allentown, Pennsylvania and Living Lakes, Inc., Washington, D.C.

Texas

Texas has an ongoing acidic precipitation program which includes monitoring, effects research, and emissions control programs. Currently, Texas has three rainfall monitoring networks operating at nineteen sites throughout the State and effects research in East Texas (Figure B). Monitoring results indicate that acidic precipitation occurs throughout Texas on a routine basis but occurs more frequently and with greater acidity in East Texas. Even in West Texas with its alkaline dust, a major proportion of rains are acidic.

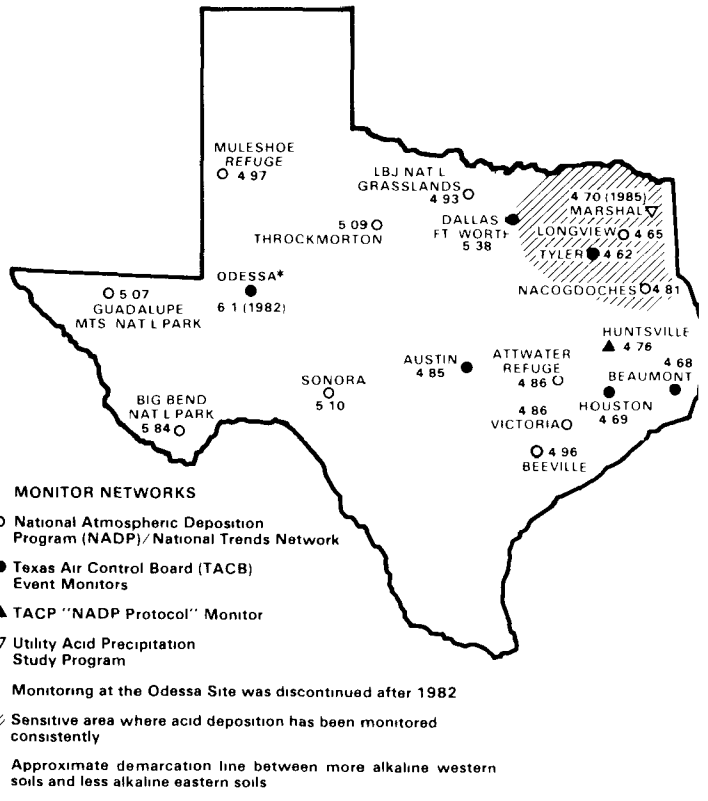


Figure B. Monitoring sites for acidic precipitation in Texa and 1987 average pH values (the pH of norma rain = 5.6). (From J.A. Levy, ed., Plan to Evaluat Acid Deposition Issues in Texas, Volume I *Austin, Texas; Texas Energy and Natura Resources Advisory Council, January, 1982.)*

Acidic precipitation is not a problem of immediate concern throughout most of Texas because of the strongly alkaline soils characteristic of most of the State and the absence of a snowpack melt common in more northern states. The melt concentrates the acid in the first water from the melting snowpack. However, in East Texas, where the most acidic precipitation has been monitored, there are areas that may potentially be susceptible to acidic deposition effects because of sensitive vegetation and the lack of buffering capacity of the soils.

Studies by the Texas Parks and Wildlife Department and the Texas Water Development Board indicate that Texas does not currently have any identified environmental effects linked to acidic precipitation. A study by the Texas A&M Agricultural Experiment Station near Nacogdoches to evaluate the effects of acidic precipitation and ozone on seedling pine trees is currently underway.

Texas has major programs to limit sulfur dioxide and nitrogen oxide emissions. Most of the new and existing source control measures in Texas have been in effect since the early 1970's.

Wisconsin

Since its inception in 1986, the Wisconsin Acid Deposition Research Council (Council) has supported 13 acidic deposition research and monitoring projects. Most of the field work has been completed, but final analysis has not yet been published.

The Council has issued three major reports: The *Wisconsin Acid Deposition Research Council Progress Report* (July 1987), the *Wisconsin Acid Deposition Research Council Addendum Report* (October 1987), and the *Wisconsin Acid Deposition Research Council Biennial Report* (July 1988). The latter report summarizes the status and significant findings, where available, of the following acidic deposition studies: mercury bioaccumulation/relationship to acidic deposition, modeling mercury levels in walleyes, intensive acidic lake studies, paleolimnological analyses, tree ring study, white pine assessment, sugarbush survey, permanent forestry plot network, Cooperative Maple Decline survey, National Acid Precipitation Assessment Program (NAPAP) North American Maple Decline Project, atmospheric deposition monitoring, stream survey, and lake monitoring.

In addition to these research and monitoring studies, the Biennial Report gives the status of the nitrogen oxide emission reduction cost study. Some significant findings described in this report follow:

Mean mercury levels for each of three different length classes of walleyes studied increased as lake pH, alkalinity, calcium, conductivity, or chlorophyll α decreased. Low values for these parameters are characteristic of most lakes in northern Wisconsin. Mercury concentrations exceeded the Wisconsin health standard of 0.5 μg/g wet weight in all sizes of walleyes from study lakes with pH less than 6.0; in walleyes greater than 15 inches from lakes with pH of 6.0 to 6.9; and in walleyes greater than 20 inches from all lake pH categories. The best model developed and tested to predict mercury concentrations in a 17-inch walleye used alkalinity and calcium as independent variables. The mechanisms and sources involved in mercury bioaccumulation are still not well understood; thus major research on this phenomenon continues.

The historical pH of five sensitive Wisconsin lakes was reconstructed through analysis of diatom remains in lake sediment cores. Two lakes, McGrath and Bastile, appear to have undergone cultural acidification in the last ten to fifteen years. The other three lakes do not appear to show cultural acidification.

As the result of the Regional Integrated Lake Watershed Acidification Studies, a new criterion was proposed for the sensitivity of seepage lakes to acidification in the Upper Midwest. The established criteria of lake sensitivity in the past [ANC (acid neutralizing capacity) $<$ 200 microequivalents per liter (μeq/L)] was based upon drainage lakes in the Northeast U.S. and northern Europe. For seepage lakes in the Upper Midwest, the proposed sensitivity criterion is ANC of less than 40 μeq/L. The important factors that control ANC in seepage lakes are: (1) amount of ground-water contribution and (2) because of the longer water residence time, sulfate reduction by bacteria in the lake sediments.

Acidic precipitation continues to fall in Wisconsin. Sulfur dioxide emissions have decreased by 33 percent from 1980 baseline levels. As emissions have been reduced in Wisconsin, a decline in acidity of rainfall has also been noted. The annual average pH gradient of wet precipitation now measures from 4.5 along the eastern edge to 4.9 along the western border of Wisconsin. Before 1985, the pH gradient measured from 4.4 to 4.8 across the state.

Using EPA sensitivity criteria (ANC $<$ 200 μeq/L), it appears some Wisconsin streams may be sensitive to acidic deposition. However, only a small number of Wisconsin streams could be classified as extremely sensitive. Monitoring of rainfall events indicates rainfall does have an effect on stream water chemistry.

The Council will continue to review all relevant research and monitoring activities related to acidic deposition in the area of aquatics, forestry and baseline monitoring, soils, materials, human health, and visibility in the state of Wisconsin.

Address inquiries regarding state information to:

J. Y. Aoyama
AERP State Information Coordinator
1050 E. Flamingo, Suite 209
Las Vegas, Nevada 89119
(702) 734-3288

Interesting shifts in species diversity and abundance continue to emerge as acidification progresses. Some zooplankton have been greatly reduced during the first year of each incremental pH change, while others do not respond until the second year. Cladocerans (daphnids) as a group continue to prosper under acidic conditions although *Holopedium gibberum*, a supposedly acid-tolerant species, was greatly reduced at the pH 5.1 level. The total abundance of rotifers has remained about equal in the two basins of the lake, but species diversity is reduced under acidic conditions.

A study sponsored by the National Science Foundation will conduct an extensive food web analysis of fish and invertebrate organisms in the lake. Many technical manuscripts describing the projects at Little Rock Lake are in preparation and presentations continue at national professional meetings. An updated list of Little Rock Lake project-related publications is available upon request from the Technical Director at the address listed below.

Address inquiries concerning the Little Rock Lake Experimental Acidification Project to:

John Eaton
Little Rock Lake Project Technical Director
EPA/Environmental Research Laboratory-Duluth
6201 Congdon Blvd.
Duluth, Minnesota 55804
(218) 720-5557
FTS: 780-5557

Episodic Response Project

Several approaches to understanding acidic episodes in surface waters have had only partial success for several reasons. Both intensive studies and survey approaches have been generally data-limited, primarily as a result of the unpredictable nature of snowmelt and rainstorm events. Most of these studies have employed manual sampling as the principal field sampling approach, and thus episodes that begin on weekends or at night are typically missed. Survey approaches have had limited success because of logistical difficulties associated with sampling unfamiliar systems. Therefore, a more intensive approach is being employed at 10-15 streams in Pennsylvania and New York. Biological and chemical characterization will be conducted during snowmelt and rainstorm events through means of automated and manual sampling techniques. In addition, a watershed manipulation experiment is being conducted in West Virginia to examine the influence of altered acidic deposition on chronic and episodic water acidification.

Eastern Episodes - Scientists within the Episodic Response Project are working to quantify episodic acidification and associated biological effects in streams of the Appalachian Plateau of Pennsylvania and the Adirondacks and Catskills of New York. A major effort of the ERP during the last several months has been to complete the installation of sophisticated continuous monitoring and automatic sampling equipment at each of the study sites. Initial fish population and benthic invertebrate surveys have been completed. Also, wild fish captured in the study streams have been marked and returned to the streams. Fish movements in response to acidic episodes were monitored during the fall rainy season by the use of fish traps and repeated electroshocking surveys. In addition, wild fish were placed in cages within the streams to determine the toxicity of acidic episodes. Some streams now have fish with implanted radio tags in order to study their behavioral avoidance of episodes. Data collection for Phase I of the ERP will continue, year-round, for the next two years.

Topics on the agenda for a meeting of ERP cooperating scientists conducted in January at Pennsylvania State University included a review of project accomplishments and planning of new experiments for the upcoming seasons.

Address inquiries concerning the ERP to:

Parker J. Wigington, Jr.
ERP Technical Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext. 354
FTS: 420-4666, ext. 354

Regional Episodic and Acidic Manipulation Project (REAM) - REAM is designed to provide data on the effects of increased acidic input on surface water quality following whole-catchment manipulation. The response of surface waters to acidification is being monitored on both chronic and episodic time scales at the Fernow Experimental Forest near Parsons, West Virginia (Figure 4).

REAM project personnel completed installation of zero-tension lysimeters in August. Project participants also collected benchmark soil samples from each of two watersheds, and a complete soil chemical characterization is underway. Oregon State University cooperators

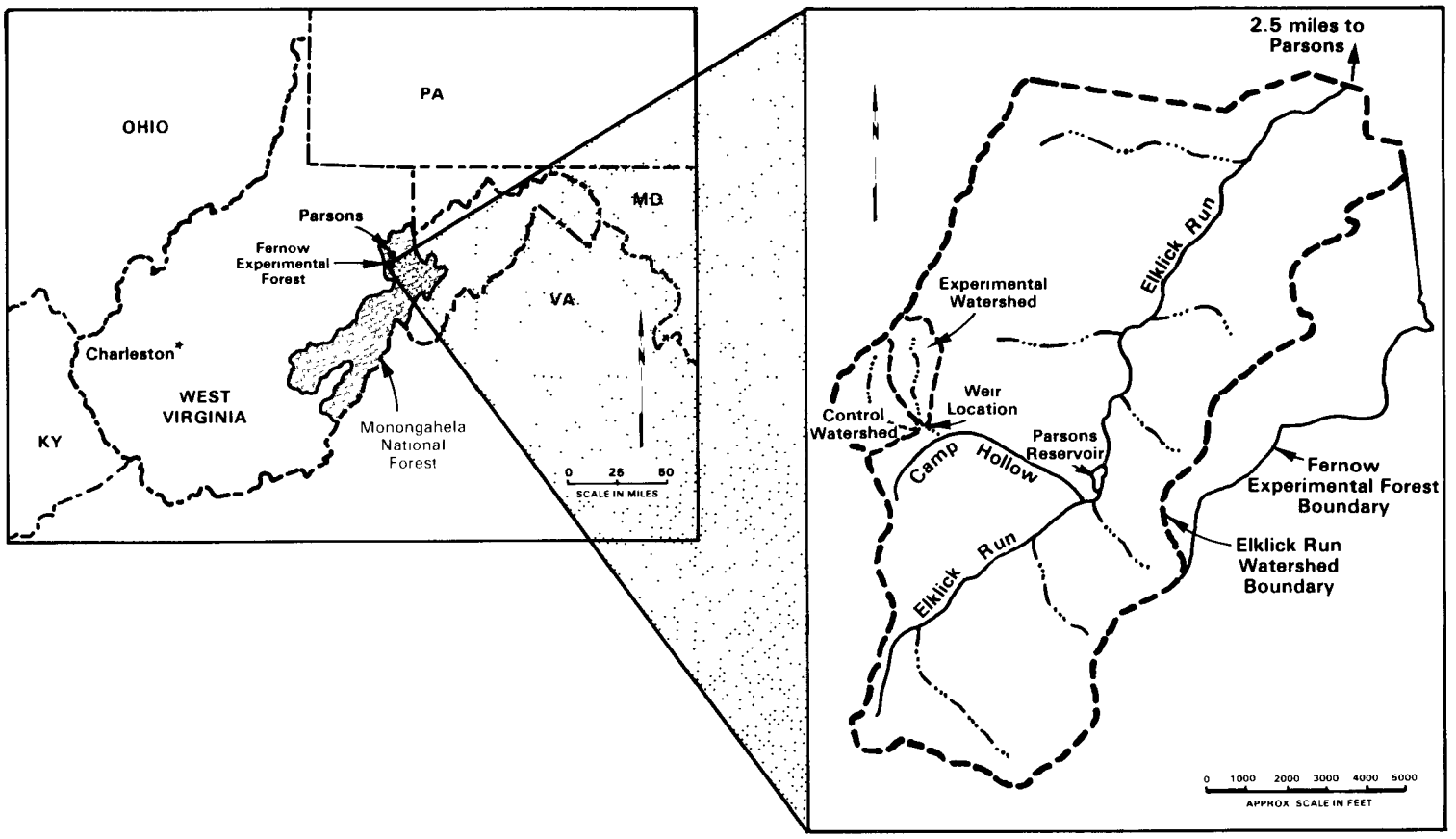


Figure 4. Location of the control and experimental watersheds for the Regional Episodic and Acidic Manipulation Project taking place at the Fernow Experimental Forest near Parsons, West Virginia.

completed installation of equipment for 15 N-labelled ammonium chloride field tracer experiments. The field experiments will remain in place for 12 months and will be used to estimate rates of nitrification, biological ammonium uptake, and nitrogen retention within watershed soils. Plans call for the acidic manipulation of the watershed to begin in early 1989.

Address inquiries concerning REAM to:

Timothy C. Strickland
REAM Technical Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, OR 97333
(503) 757-4666, ext. 353
FTS: 420-4666, ext. 353

Temporally Integrated Monitoring of Ecosystems Project (TIME)

The conceptual plan for the TIME project, *The Concept of Time*, was first distributed in the fall of 1987. Since that time, the focus of the project has shifted from one that emphasizes the regionally extensive probability sample in a tiered, hierarchical design to one that emphasizes intensive sampling at a smaller number of sites per region. *The Supplement to the Concept of TIME*, which describes these modifications to the TIME project, is now available for distribution from the address given below. The supplement also provides an update on additional research efforts and workshops related to the development of the TIME Research Plan. Implementation of the TIME project is currently scheduled for spring 1991.

A major TIME objective is to identify trends in surface water chemistry that may be related to acidic deposition. TIME scientists have completed an internal report, "Detecting Trends in TIME Data Series," that presents results from a comparison of several statistical techniques for trend detection tests using long-term water quality data. The Seasonal Kendall Test, a nonparametric statistical

technique, was found to provide the best balance between significance and power when applied to detection of seasonal patterns in the data.

The shift in focus and a delay in implementing the TIME project have allowed increased attention to be directed to the EPA Long-term Monitoring (LTM) Project. The LTM project has independent cooperators in six areas: lake sites located in Maine, the Adirondacks, Vermont, the Upper Midwest, and Colorado and stream sites in the Catskills. Data management for the LTM Project was moved this year to the Environmental Research Laboratory in Corvallis. The data base is currently being validated for use in assessment activities for the National Acid Precipitation Assessment Program.

Address inquiries concerning the TIME project to:

Jesse Ford
Technical Director
TIME/Long-term Monitoring
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext. 442
FTS: 420-4666, ext. 442

Distribution of Mercury in Fish in the Upper Peninsula of Michigan

In the Upper Peninsula of Michigan and the extreme northwestern portion of Wisconsin the EPA has been conducting an investigation of the relationships between fish and the chemical and physical attributes of lakes. The study is a cooperative effort of EPA, Michigan State University, and the Electric Power Research Institute. A principal aspect of the study is the effort to determine the relationship between fish mercury content and lake acidity.

A subset of 49 of the Eastern Lake Survey Phase I lakes was resampled in the Upper Peninsula (Figure 5) to characterize the fish species present and to determine the concentration of mercury in their tissues. This sample is directly related to a target population of 642 lakes in this region. The data resulting from this project will be used to relate mercury concentrations in fish to lake chemistry and possibly to the acidity of deposition which forms an increasing gradient across this area from west to east.

The mercury data will be analyzed to determine:

- the estimated number of lakes containing fish with high levels (exceeding 0.5 ppm) of mercury in their tissue and
- if an association exists between fish mercury levels and water chemistry.

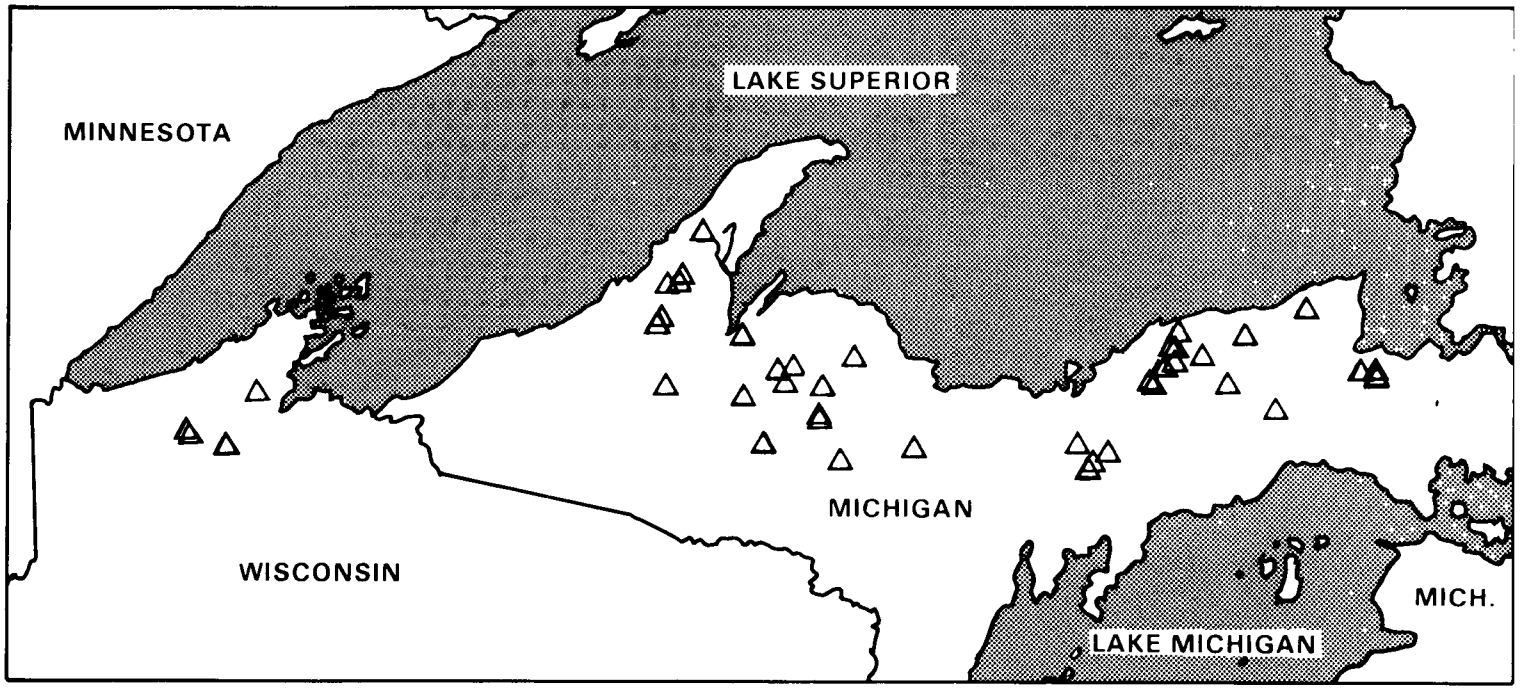


Figure 5. Locations of the 50 lakes sampled for fish and fish tissue mercury concentrations in the upper Midwest during Phase II of the National Lake Survey.

Currently, the data base for mercury content in fish is complete and initial analyses have been performed by subcontractors for this task. An oral presentation on the results of this work was given at the Society of Environmental Toxicology and Chemistry meeting in November.

In an associated effort, water samples and sediment samples were collected and analyzed by Battelle-Pacific Northwest Laboratories to permit comparisons of mercury content in fish with mercury concentrations in water and sediments. These analyses are complete and the data base is now being constructed.

The final report summarizing the key analyses made during this project and presenting statistical estimates for lakes in the entire Upper Peninsula of Michigan is expected to be complete by June of 1989. Agency release of the report and the data bases will follow.

Address inquiries concerning this project to:

D. H. Landers
Technical Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext 423
FTS: 420-4666, ext. 423

SYNTHESIS AND INTEGRATION ACTIVITIES

1990 Report Activities - The National Acid Precipitation Assessment Program (NAPAP) was created by Congress in 1980 as a 10-year program to provide scientific, technological, and economic information on the causes and effects of acidic deposition. NAPAP is required to report its findings periodically to Congress and the President. NAPAP concludes its program in 1990 with the publication of a two-part comprehensive assessment. Part I is the State of Science/Technology (SOS/T), 27 individual reports containing comprehensive analyses and discussions related to acidic deposition. Part II is the Integrated Assessment (IA), a structured compilation of the SOS/T results presented in a form that allows policymakers and the public to evaluate the principal questions on the causes and effects of, and strategies for controlling, acidic deposition.

As the lead Agency for the NAPAP Aquatic Effects Task Group, EPA is actively involved in producing both the SOS/T Reports and the IA. Aquatics information will be presented in a series of seven reports (numbers 9-15) that will present the current state of knowledge regarding the chronic and episodic effects of acidic deposition on aquatic resources. Historical status and methods for forecasting future change in status also will be addressed.

Report 9 will summarize the current chemical status of surface waters in five regions of the United States, evaluate the spatial distribution of their chemical characteristics, and examine the associations of surface water chemistry with watershed characteristics and wet deposition chemistry. Results for the United States will be compared with those for Canada, Norway, and other nations having temperate climates.

Report 10 will focus on what is known about natural watershed processes, both aquatic and terrestrial, that affect chronic acid-base chemistry in lakes and streams. Processes related to hydrology and biogeochemistry in watersheds and in lakes and streams, and those associated with changes in land use will be examined. How acidic deposition interacts with these natural processes, and the implications for surface water and soil acidification or recovery, will be presented. Results from case studies of soil and water acidification, conducted internationally and in the United States, will be compared for natural systems with and without acidic deposition and for a number of experimentally acidified systems.

Report 11 will be an overview of the state of knowledge regarding natural and anthropogenic factors that influence the acid-base chemistry of surface waters and how these factors might influence the occurrence and detection of historical change. Methods for investigating historical change (historical water chemistry measurements, paleolimnological reconstructions, comparisons between high and low deposition areas, and models) and their associated uncertainties will be discussed. Results from several distinct lines of investigation will be integrated to provide historical estimates of change for lakes in the Adirondacks, and possibly for drainage lakes in the Northeast and Upper Midwest and seepage lakes in Florida.

The current understanding of episodic acidification of surface waters will be summarized in Report 12. The relationships of episodes to chronic acidification and the hydrologic cycle, their chemical characteristics and biological significance, and the processes that control them will be discussed. The extent and severity of episodic acidification will be presented, with data limitations clearly identified, for the United States, and compared when appropriate with European and Canadian information. This

report concludes with a discussion of modeling approaches for regional estimates of the magnitude, duration, frequency, and extent of episodes (and associated uncertainties).

Report 13 will identify the chemical parameters that influence the effects of changes in acid-base chemistry on biological communities and processes. Methods for quantitatively evaluating the relationship between changes in acid-base chemistry and regional effects on fish populations will be presented, along with associated uncertainties. Qualitative discussions will include the effects of surface water acidification on aquatic organisms other than fish, e.g., benthic invertebrates, amphibians, waterfowl, and mammals.

Methods for forecasting changes in acid-base chemistry of surface waters and their associated uncertainties will be presented in Report 14. Three general types of models -- steady-state, empirical time varying, and dynamic system models -- will be evaluated. Prior model applications in the United States, other North American regions, and Europe will be summarized. Each model will be discussed with regard to its structure, assumptions and limitations, sensitivity and behavioral analyses, and verification/validation studies. Error analyses, linkages to deposition estimates and inputs to biological models, and procedures for extrapolation to obtain regional estimates will be discussed.

The last report on aquatic effects (Report 15) will be an evaluation of the mitigative (surface water acid neutralization) approaches to restore and protect surface waters from acidification. This report will include a description of previously applied mitigative strategies and the effects of these mitigation techniques on ecosystem structure and function.

Outlines for the SOS/T and IA were distributed for review in October as part of the NAPAP Assessment Plan and Schedule. This Plan and Schedule was the subject of a public review meeting at which some 30 individuals (representing the electric utility industry, various environmental groups, and several state, federal, and international government groups) presented comments. The revised Plan is scheduled for release in January 1990 and will be available directly from the National Acid Precipitation Assessment Program, 722 Jackson Place NW, Washington, DC 20503. In December, AERP personnel attended an authors' workshop sponsored by NAPAP. First drafts of the reports will be submitted to NAPAP this spring.

Technical Information Project - The Technical Information Project disseminates information on AERP activities to state agencies, organizations, and technical audiences. Distributed information includes the following items:

- Major Report with Companion Documents - These document sets consist of a compilation of the manuals and reports used during or prepared as a result of a particular AERP project. Companion documents to each major data report include field operations and quality assurance reports, quality assurance plans, and analytical methods manuals. Document sets for the Eastern Lake Survey - Phase I, Western Lake Survey, and the National Stream Survey are available through the mail order form in this *status*.
- Data Bases - Each data base consists of two components: a computer diskette or tape containing the validated data base for a particular AERP project and a user's guide with instructions on how to use the disk or tape and information about how the quality of the data was assessed. Data bases for the Eastern Lake Survey - Phase I and the Western Lake Survey are available through the mail order form in this *status*. The National Stream Survey data base will be available through the order form in a future issue of the *status*.
- Handbooks - The handbooks are guidance documents that contain procedures for field operations, laboratory operations, and quality assurance for surface water and soil chemistry sampling. They are beneficial to those organizations involved in designing and implementing monitoring activities related to acidic deposition. One handbook, *Laboratory Analyses for Surface Water Chemistry*, is available through the mail order form in this issue of the *status*. A second handbook, *Field Operations for Surface Water Chemistry*, will be available through the mail order form in the next issue of the *status*.
- Project Descriptors - This document is a compilation of AERP project descriptions for activities to be performed in a given fiscal year.
- Biennial Publications and Presentations - This document is a compilation of abstracts describing presentations and publications authored or co-authored by AERP-EPA and contractor support personnel. The first issue, with abstracts for 1985 and 1986, is available through the mail order form in this *status*.

Address inquiries concerning the AERP Technical Information Project to:

Daniel T. Heggem
Technical Director
AERP Technical Information Project
EPA/Environmental Monitoring Systems Laboratory - Las Vegas
P.O. Box 93478
Las Vegas, Nevada 89103-3478
(702) 798-2358
(FTS): 545-2358

AERP ANNOUNCEMENTS

Acidic Deposition Impacts on Aquatic Systems

A one day session during the 32nd Annual Conference of the International Association for Great Lakes Research (May 30 - June 2, Madison, Wisconsin) will deal with Acidic Deposition Impacts on Aquatic Systems. The session will be co-hosted by John Cooley as Canadian representative and John Eaton as U.S. representative. The program currently consists of 20 invited papers dealing with effects on various ecosystem components, and deposition and mercury relationships, and ecosystem recovery. Posters and a few oral presentations will be added as a consequence of the general call for papers. For more information contact:

John G. Eaton
Environmental Protection Agency
Environmental Research Laboratory-Duluth
6201 Congdon Boulevard
Duluth, Minnesota 55804
(218) 720-5557
FTS: 780-5557

Site Selection for TIME (Temporally Integrated Monitoring of Ecosystems)

Scientists at the EPA Corvallis, Oregon, laboratory are entering the final phase of selecting sites that will be sampled quarterly or monthly by the TIME project (see Current AERP Activities, page 6). They are seeking to finalize the list of candidate sites and are particularly interested in low-ANC streams and lakes with existing data bases and those that are unlikely to have experienced anthropogenic disturbances other than atmospheric deposition. If you know of sites that you believe are not yet in the pool of candidate sites, please contact Jesse Ford or Bob Hughes at the EPA Corvallis laboratory (503-757-4666, FTS-420-4666) as soon as possible. We will mail you the necessary forms to ensure that your candidate sites are considered.

If you would like to receive any of the following AERP products, please check the appropriate box(es) and fill in your name and address below.

MAJOR REPORT/COMPANION DOCUMENTS

Eastern Lake Survey - Phase I

Major Report - Characteristics of Lakes in the Eastern United States

- Volumes I-III ..... 4007 ____
- Volume I ..... 4007a ____
- Volume II ..... 4007b ____
- Volume III ..... 4007c ____

Quality Assurance Plan ..... 4008 ____

Analytical Methods Manual ..... 4009 ____

Field Operations Report ..... 4010 ____

Quality Assurance Report ..... 4011 ____

Western Lake Survey - Phase I

Major Report - Characteristics of Lakes in the Western United States

- Volumes I-II ..... 3054 ____
- Volume I ..... 3054a ____
- Volume II ..... 3054b ____

Quality Assurance Plan ..... 8026 ____

Analytical Methods Manual ..... 8038 ____

Field Operations Report ..... 8018 ____

Quality Assurance Report ..... 4037 ____

* Publications listed for the first time.

National Stream Survey - Phase I

Major Report - Characteristics of Streams in the Mid-Atlantic and Southeastern United States

- Volumes I-II ..... 3021 ____
- Volume I ..... 3021a ____
- Volume II ..... 3021b ____

Pilot Survey Major Report ..... 4026 ____

* Pilot Survey Field Operations Report ..... 8019 ____

Quality Assurance Plan ..... 4044 ____

Field Operations Report ..... 4023 ____

* Processing Laboratory Report ..... 4025 ____

* Quality Assurance Report ..... 4018 ____

DATA BASES

Western Lake Survey - Phase I Data Base

(Special order form will be sent) ..... 4027 ____

Eastern Lake Survey - Phase I Data Base

(Special order form will be sent) ..... 4028 ____

HANDBOOKS

Handbook of Methods for Acid Deposition Studies, Laboratory Analyses for Surface Water Chemistry ..... 3026 ____

PROJECT DESCRIPTORS

Research Activity Descriptors, FY 1988, October 1987--September 1988 ..... 9006 ____

ABSTRACTS

Biennial Publications and Presentations Journal, 1985-86 ..... 9007 ____

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U.S. Environmental Protection Agency

26 W. Martin Luther King Drive

Cincinnati, Ohio 45268