United States
Environmental Protection
Agency

Office of Acid Deposition,
Environmental Monitoring 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 NAPAP's 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.

Status of AERP Activities—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 Surveys	Complete	Complete	Spring 1989
Mid-Appalachian Soil Survey	Ongoing	Ongoing	Fall 1990
Watershed Processes and Manipulations			
Watershed Manipulation Project	Complete	Spring 1987	Annually
Episodic Response Project	Fall 1987	Spring 1988	Winter 1989-90
Regional Episodic and Acidic Manipulation Project	Complete	Spring 1987	Summer 1990
Watershed Recovery Project	In Review	Fall 1988	Spring 1990
Little Rock Lake Experimental Acidification Project	Ongoing	1983	Annually
Temporally Integrated Monitoring of Ecosystems	Ongoing	1990	Biennially
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

Ar[illegible]view of the National Stream Survey—Field a[illegible]s of the National Stream Survey - Phase I (NSS-I) took place in the spring of 1986. Conducted in four Mid-Atlantic and five Southeast subregions (Figure 1), NSS-I 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 atmospheric acidic deposition inputs and (2) identify representative streams in each region for more intensive study

On the basis of geology, deposition rates, and previous water quality data, the selected subregions were expected to contain a significant number of streams that have low acid neutralizing capacity (ANC) or that are acidic (ANC ≤ 0). These areas are characterized by relatively high acidic deposition rates and few lakes Furthermore, the National Lake Survey (NLS) data base does not provide synoptic information on surface water chemistry in most of these areas.

To date, NSS-I field activities have not included areas of the Northeast, Upper Midwest, and West. Though these regions are expected to contain streams potentially sensitive to acidic deposition, they also contain numerous lakes that were sampled as part of NLS Parts of the South Atlantic and Gulf Coastal Plains expected to contain predominantly low ANC surface waters have also been excluded from NSS-I efforts. Field activities in the Florida subregion tested the utility of NSS-I logistical and design protocols in these lowland stream networks of the Southeast Coastal Plain.

Within the NSS-I subregions, the stream resource of interest was identified as those streams that have drainage areas less than 155 square kilometers (60 square miles), but that are large enough to be represented as blue lines on 1:250,000-scale U.S. Geological Survey (USGS) topographic maps. This size range includes streams large enough to be important for fish habitat, yet still small enough to be susceptible to the impacts of acidic deposition

Unlike lakes, which can be counted and sampled as discrete entities, streams form a hierarchical network in which small streams are tributaries to large streams. To meet the objectives of NSS-I, stream reaches, defined as segments of the stream network as represented by blue lines on the 1:250,000-scale maps, were chosen as sampling units. Mapped blue-line segments between two tributary confluences identified these segments. Sampling points on each reach were located just above the downstream point of confluence (lower node) and just below the upstream point of confluence (upper node). The upper node of each headwater reach was defined as the farthest upstream extent of the mapped, blue-line representation.

Because not all stream reaches in the Mid-Atlantic and southeastern regions could be sampled, a statistical procedure was developed for selecting a subset of streams as a probability sample from which the characteristics of the total reach population could be extrapolated. A two-stage sampling procedure was used to obtain a randomized, systematic sample of approximately 500 reaches with good spatial distribution over each of the nine NSS-I subregions (50 to 80 reaches per subregion). Reaches were excluded if they were too large (drainage area >155 km^2), were located within metropolitan areas or tidal zones, or were affected by oil field brine, acid mine drainage, or point-source pollution.

The NSS-I used index values to describe the chemical status of each stream sampled. Occurring during baseflow of the spring season between snowmelt and leafout (approximately March 15 to May 15), the spring index sampling period minimized within-season and episodic chemical variability and maximized the probability of sampling chemical conditions potentially limiting for the growth and reproduction of aquatic organisms.

As a result of pilot survey experience *(status*, September 1987), two spring seasonal samples were judged sufficient to index chemical characteristics of streams in the Mid-Atlantic subregions. In the southeast, where acidic deposition effects were expected to be less probable, one spring sample was taken at each site. To quantify and incorporate the variability between upstream and downstream ends of reaches, chemical and physical variables were measured at both ends.

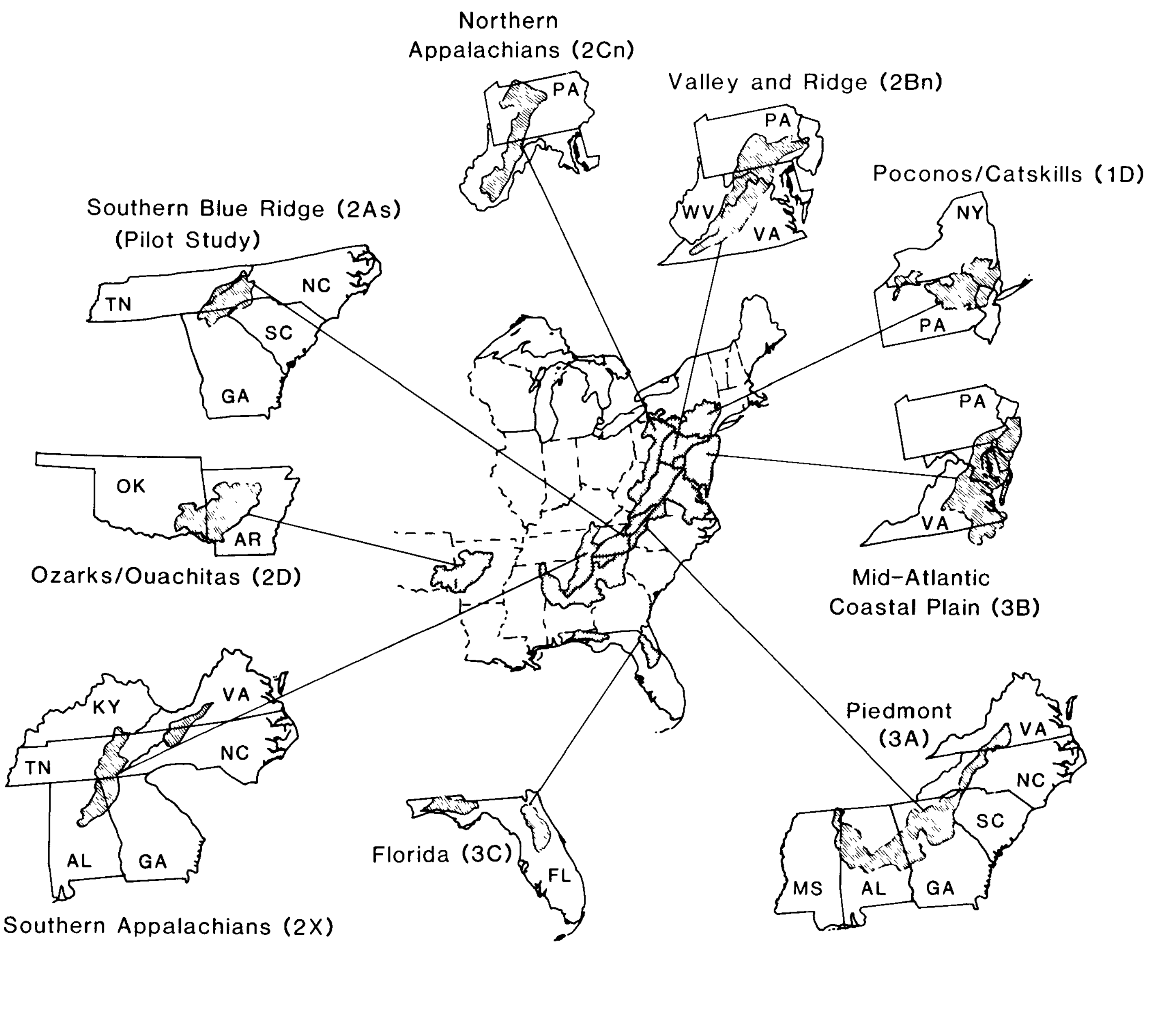

Figure 1. Subregions studied during NSS-'

Chemical variables measured at each sampling site included those related to biological effects (pH, extractable aluminum, and competing ligands such as fluoride and dissolved organic carbon), other variables related to potential sensitivity and related geochemistry (ANC, base cations, acid anions, and silica), and others indicative of anthropogenic disturbances or nutrient status (phosphorus, iron, ammonium, and turbidity). Processing laboratory personnel stabilized samples within 24 hours of collection; at all times standardized quality control and quality assurance protocols were followed. Population frequency distributions (with 95 percent confidence bounds) were calculated for selected chemical and physical variables.

Physical and chemical characteristics of an estimated 57,000 stream reaches with combined length of approximately 200,000 km (124,000 mi) were extrapolated from a probability sample of approximately 450 stream reaches in the stream population of interest within the nine NSS-I subregions. The population of streams targeted by the NSS-I consists of small to mid-sized streams in the low end of the size range typically managed by state fishery agencies. Stream reaches are typically about 3 km long. The majority of the streams have widths between 1 and 6 m and depths between 0.1 and 0.5 m.

The basic results of the NSS-I provide detailed population descriptions of the location, number, length and percentage of streams within referenced ranges of chemical concentration. The most important descriptions concern ANC and pH. Acidic reaches (ANC ≤0) comprised 4.4%, or 4,851 km, of the length of the target stream resource in the Mid-Atlantic Region. In the Southeast Region, on the other hand, only 0.6%, or 578 km, of the length of the target stream resource were acidic. Table 2 provides regional population estimates of target stream reaches with specific ANC values.

Population distribution estimates for pH mirrored those for ANC. As observed for ANC below a reference value of 0 µeq/L, reaches with spring baseflow index pH less than 5.5 were concentrated largely in the Mid-Atlantic and Florida. Reaches with pH 5.5 or less made up an estimated 13% (14,277 km) of the target stream length in the Mid-Atlantic Region, as opposed to 2.7% (2,431 km) in the Southeast Region. Table 3 provides regional population estimates of target stream reaches with specific pH values.

Results of the survey are too numerous to list here completely. However, the two-volume NSS-I Major Report, entitled "Characteristics of Streams in the Mid-Atlantic and Southeastern United States," contains detailed descriptions of all survey findings. The report, which is available through the mail order form in this *status*, includes an examination of regional patterns in the relationships among the chemical constituents within stream waters in an effort to infer the possible geochemical factors and anthropogenic impacts controlling stream chemistry. Also, a high-interest segment of the stream population with lowest ANC has been examined and classified according to probable sources of acidity.

Subregion	ANC ≤0 Length	%	ANC ≤50 Length	%	ANC ≤200 Length	%	Total Length (km)
Poconos/Catskills	543	3.6	1,606	10.6	5,489	36.2	15,144
	(270)	(1.8)	(500)	(3.3)	(1,100)	(7.3)	(1,912)
N. Appalachians	1,524	7.0	3,713	17.1	12,935	59.5	21,738
	(750)	(3.5)	(920)	(4.2)	(2,200)	(10)	(2,746)
Valley & Ridge	257	0.8	2,111	6.5	12,811	39.2	32,687
	(210)	(0.6)	(990)	(3.0)	(3,400)	(10)	(4,492)
MA Coastal Plain	2,527	6.3	9,636	23.9	21,091	52.3	40,296
	(1,200)	(2.9)	(2,700)	(6.6)	(4,400)	(11)	(5,799)
S. Blue Ridge	*	*	706	7.8	7,084	78.4	9,036
	-	-	(250)	(2.8)	(940)	(10)	(960)
Piedmont	*	*	2,390	7.1	13,554	40.4	33,531
	-	-	(1,300)	(3.9)	(2,900)	(8.5)	(4,402)
S. Appalachians	117	0.5	763	3.5	6,130	28.0	21,892
	(120)	(0.5)	(440)	(2.0)	(1,700)	(8.0)	(2,807)
Ozarks/Ouachitas	*	*	205	0.9	15,092	67.1	22,480
	-	-	(150)	(0.6)	(2,500)	(11)	(2,507)
Florida	461	12.0	2,356	61.2	2,939	76.4	3,848
	(160)	(4.1)	(530)	(14)	(590)	(15)	(678)
Mid-Atlantic (MA)	4,851	4.4	17,067	15.5	52,327	47.6	109,865
	(1,600)	(1.4)	(3,100)	(2.8)	(6,200)	(5.6)	(8,063)
Southeast (SE)	578	0.6	6,420	7.1	44,799	49.3	90,787
	(210)	(0.2)	(1,500)	(1.7)	(4,400)	(4.8)	(5,910)
Total NSS-I	5,429	2.7	23,487	11.7	97,125	48.4	200,652
	(1,500)	(0.8)	(3,400)	(1.7)	(7,700)	(3.8)	(9,996)

Calculated using linear interpolation of $[H^+]$ between upper and lower reach nodes. Standard errors were approximated by an ad hoc procedure using the variances of separate length estimates based on the upstream and downstream nodes.

* No samples observed below this reference value, estimated percentage is less than 1%.

NOTE: To calculate upper and lower one-sided 95% confidence bounds, multiply the standard error by 1.645 and add or subtract that value from the length estimate. To calculate the two-sided 95% confidence bounds, multiply the standard error by 1.96.

Table 2. Population estimates of the combined length (km) and percentage of NSS-I target stream reaches with spring baseflow ANC less than reference values (standard errors in parentheses).

COMPLETED AERP ACTIVITIES

This section lists projects for which recently published materials are available for dissemination.

Eastern Lake Survey-Phase I Data Base—Phase I of the Eastern Lake Survey was conducted in the northeastern, midwestern, and southeastern United States in 1984. The data base includes descriptions of the survey design and implementation, as well as findings from the 1,798 lakes sampled. The Data Base Request Form, which is available through the mail order form in this *status*, lists data base format options. To receive the data base, fill out this form and return it along with two blank disks or tapes.

Subregion	pH ≤5.0 Length	%	pH ≤5.5 Length	%	pH ≤6.0 Length	%	Total Length (km)
Poconos/Catskills	550	3.6	906	6.0	1,354	8.9	15,144
	(290)	(1.9)	(420)	(2.8)	(520)	(3.4)	(1,912)
N. Appalachians	1,424	6.6	1,870	8.6	3,044	14.0	21,738
	(700)	(3.2)	(710)	(3.2)	(900)	(4.2)	(2,746)
Valley & Ridge	257	0.79	1,937	5.9	4,116	12.6	32,687
	(260)	(0.8)	(1,300)	(4.0)	(1,900)	(5.9)	(4,492)
MA Coastal Plain	3,147	7.8	9,565	23.7	18,707	46.4	40,296
	(1,300)	(3.3)	(3,000)	(7.5)	(4,300)	(11)	(5,799)
S. Blue Ridge	*	*	*	*	*	*	9,036
	-	-	-	-	-	-	(960)
Piedmont	*	*	*	*	2,390	7.1	33,531
	-	-	-	-	(1,200)	(3.7)	(4,402)
S. Appalachians	*	*	313	1.4	920	4.2	21,892
	-	-	(310)	(1.4)	(540)	(2.5)	(2,807)
Ozarks/Ouachitas	*	*	410	1.8	2,437	10.8	22,480
	-	-	(290)	(1.3)	(990)	(4.4)	(2,507)
Florida	522	13.6	1,708	44.4	2,828	73.5	3,848
	(250)	(6.5)	(440)	(12)	(620)	(16)	(678)
Mid-Atlantic (MA)	5,378	4.9	14,277	13.0	27,221	24.8	109,865
	(1,500)	(1.4)	(3,400)	(3.1)	(4,800)	(4.4)	(8,063)
Southeast (SE)	522	0.57	2,431	2.7	8,576	9.5	90,787
	(250)	(0.3)	(800)	(0.9)	(1,900)	(2.1)	(5,910)
Total NSS-I	5,900	2.9	16,708	8.3	35,797	17.8	200,652
	(1,600)	(0.8)	(3,400)	(1.7)	(5,200)	(2.6)	(9,996)

Calculated using linear interpolation of $[H^+]$ between upper and lower reach nodes. Standard errors were approximated by an ad hoc procedure using the variances of separate length estimates based on the upstream and downstream nodes.

* No samples observed below this reference value, estimated percentage is less than 1%.

NOTE: To calculate upper and lower one-sided 95% confidence bounds, multiply the standard error by 1.645 and add or subtract that value from the length estimate. To calculate the two-sided 95% confidence bounds, multiply the standard error by 1.96.

Table 3. Population estimates of the combined length (km) and percentage of NSS-I target stream reaches with spring baseflow pH less than reference values (standard errors in parentheses).

Biennial Publications and Presentations Journal—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 covers 1985—1986 abstracts and is available through the mail order form in this *status*.

National Stream Survey-Phase I Major Report—Phase I of the National Stream Survey was conducted in the spring of 1986 (see Feature Article). The Phase I major report, a two-volume set entitled "Characteristics of Streams in the Mid-Atlantic and Southeastern United States," is available through the mail order form in this *status*.

CURRENT AERP ACTIVITIES

Current AERP activities include acidic deposition research projects either in progress or scheduled to commence by fall 1988.

Direct/Delayed Response Project—Data from DDRP studies in the Northeast and Southern Blue Ridge Province are being analyzed on three levels. Level I analyses include statistical association of watershed characteristics with water chemistry. Level II analyses involve estimates of the time required for key watershed characteristics to reach critical levels. Level III analyses use dynamic, integrated watershed models to estimate future responses to acidic deposition.

An additional 45 northeastern watersheds, which appear to be retaining sulfate, are being mapped this summer. DDRP scientists are also mapping 36 watersheds in the Mid-Appalachian Region. Criteria for site selection in these areas included watershed areas less than 3000 ha, ANC values less than 200 µeq/L, and minimal disturbances (especially from mine tailings). Sampling at these watersheds will commence in September. Figure 2 identifies selected mid-Appalachian sites by county.

Data from soil surveys in the Northeast and the Southern Blue Ridge Province will be released in spring 1989.

Address inquiries concerning the DDRP to:
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DDRP Technical Director
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FTS: 420-4666, ext. 304

Watershed Manipulation Project (WMP)—The WMP involves process-oriented research at a small number of watersheds. The project is designed to assess the quantitative and qualitative response of watershed soil and surface waters to altered levels of deposition. Hypothesis testing at East Bear Brook and West Bear Brook, watersheds located in southeastern Maine, is being conducted through an interdisciplinary approach and involves cooperative efforts of a site team, six supporting scientific task teams, a modelling team, and the EPA management team. Recent WMP work involved field activities by the site team and laboratory experimentation and soil analyses by the six supporting task teams.

Site team activities during winter and spring included baseline sampling and additional site instrumentation. Field scientists, under subcontract to the University of Maine Site Team, gauged weirs to measure discharge at the two Bear Brook watersheds. Throughout the winter, site teams collected weekly samples from two stations located immediately above the weirs and biweekly samples from other stations situated at various elevations above the weirs. They also made weekly collections of incoming precipitation and snowmelt.

Task teams completed soil analyses on samples collected from experimental external plots located adjacent to the Bear Brook watersheds. Parameters that were analyzed

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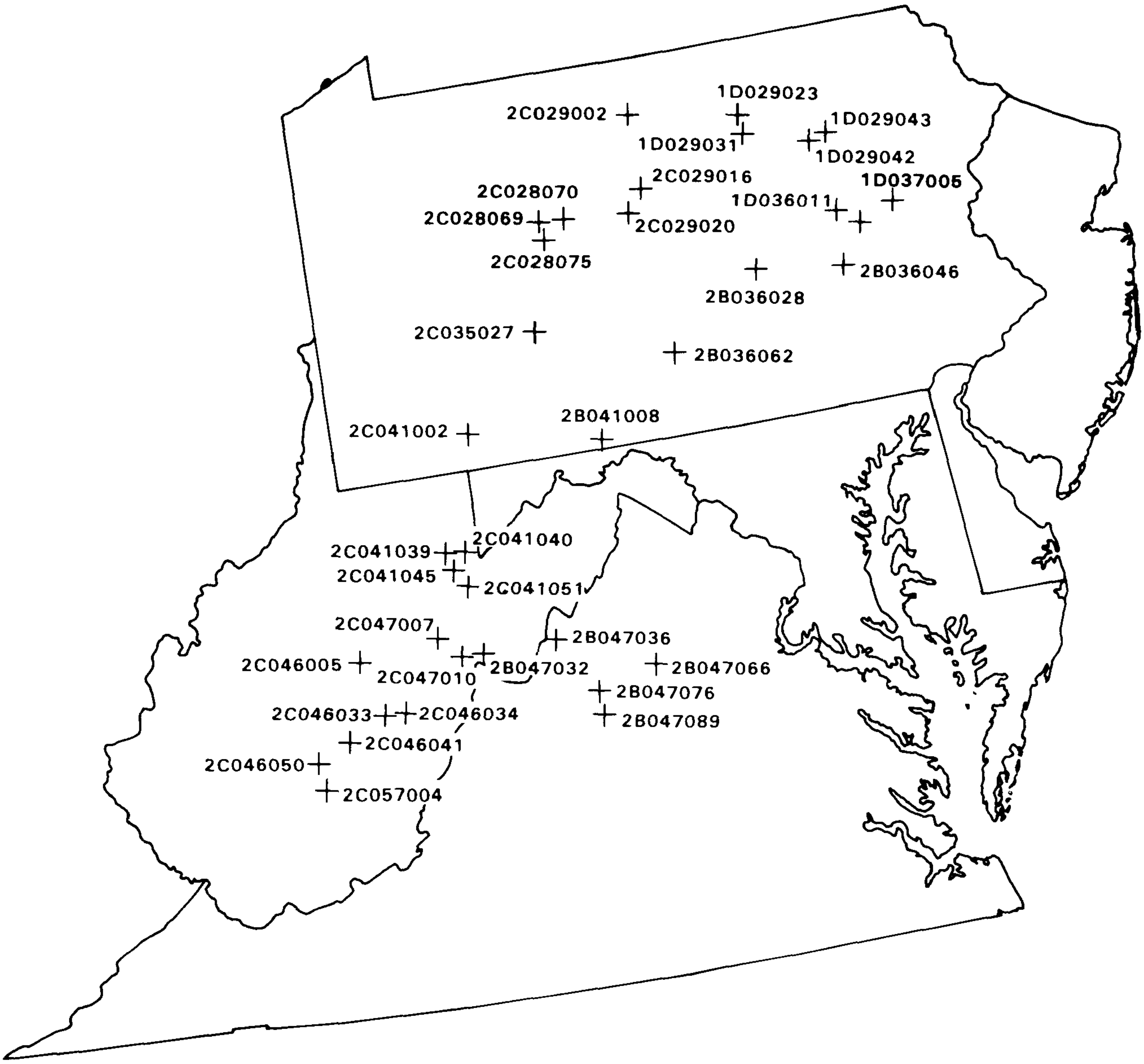
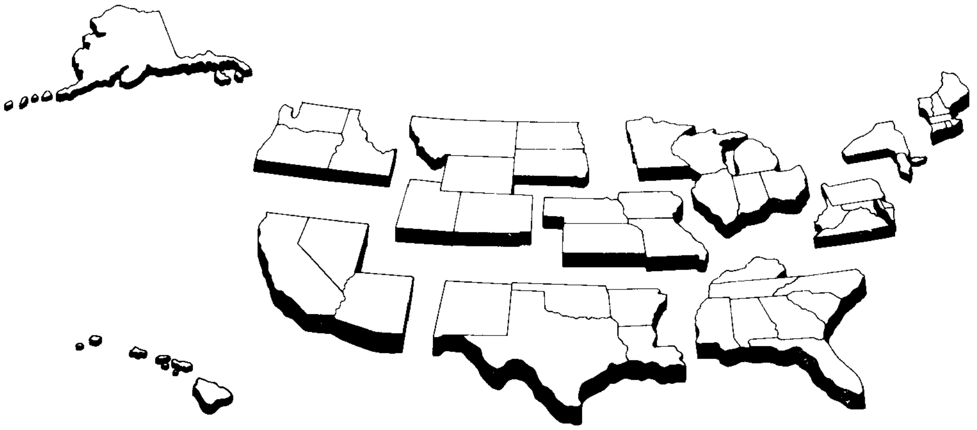


Environmental Research Lab - Corvallis

DDRP STREAMS

STREAM -- ID	ANC ueq/L	STREAM NAME	COUNTY
PENNSYLVANIA			
1D029023	31	NORTH BRANCH ROCK RUN	LYCOMING
1D029031	62	EAST BRANCH WALLIS RUN	LYCOMING
1D029042	13	HEBERLY RUN	SULLIVAN
1D029043	1	BOWMAN CREEK	LUZERNE
1D036011	14	STONY RUN	COLUMBIA/SCHUYLKILL
1D036017	102	NO NAME	SCHUYLKILL
1D037005	3	JEANS RUN	CARBON
2B036028	139	BOYERS RUN	JUNIATA/PERRY
2B036046	64	LOWER LITTLE SWATARA CREEK	SCHUYLKILL
2B036062	201	BURNS CREEK	PERRY/FRANKLIN
2B041008	137	PINEY CREEK	BEDFORD
2C028069	2	WHITNEY RUN	CLEARFIELD
2C028070	10	COLDSTREAM RUN	CLEARFIELD
2C028075	6	BEAR RUN	CLEARFIELD
2C029002	167	UPPER DRY HOLLOW	POTTER
2C029016	28	EAST BRANCH BIG RUN	CLINTON
2C029020	10	WOLF RUN	CENTER
2C035027	111	WILLIAMS RUN	CAMBRIA
2C041002	82	FULTON RUN	FAYETTE
VIRGINIA			
2B047036	77	BIBLE RUN	ROCKINGHAM
2B047066	168	NO NAME	MADISON
2B047076	6	LEWIS RUN	ROCKINGHAM
2B047089	166	NORTH FORK MOORMONS RIVER	ALBEMARLE
WEST VIRGINIA			
2B047032	95	NO NAME	PENDLETON
2C041039	77	BUFFALO CREEK	PRESTON
2C041040	49	NO NAME	TUCKER/PRESTON
2C041045	145	RIGHT FORK CLOVER RUN	TUCKER
2C041051	9	COAL RUN	TUCKER
2C046005	54	NO NAME	BRAXTON
2C046033	4	JOHNSON RUN	WEBSTER
2C046034	4	HATEFUL RUN	POCAHONTAS
2C046041	159	NO NAME	NICHOLAS
2C046050	87	HENDRICKS CREEK	FAYETTE
2C047007	92	NO NAME	RANDOLPH
2C047010	28	NO NAME	POCAHONTAS
2C057004	21	BUTLER BRANCH	FAYETTE

Figure 2. DDRP sites that will be mapped and sampled during the Mid-Appalachian Survey.



STATE

INFORMATION

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.

California

The Air Resources Board (ARB) has begun its final season of sampling at Emerald Lake, Sequoia National Park, an Integrated Watershed Study site. Information is being collected on the timing and chemistry of snowmelt at this high-elevation (9,200') ecosystem. During the snowmelt period in 1986, researchers from the University of California, Santa Barbara, detected a concentration of acidic anions in the initial fraction of melt-water entering Emerald Lake. This "ionic pulse" of acidic material could have an effect on emerging brook trout fry in the Emerald Lake outlet stream. These results are reported in two ARB final reports: Snow Deposition, Melt, Runoff and Chemistry in a Small Alpine Watershed, Emerald Lake Basin, Sequoia National Park and Integrated Watershed Study: An Investigation of Fish and Amphibian Populations in the Vicinity of the Emerald Lake Basin, Sequoia National Park.

Data collected at Emerald Lake and other lakes of the Sierra Nevada are being organized and analyzed as part of a lake watershed modelling effort sponsored by ARB. These models will predict the effects of different deposition scenarios on surface water quality in the Sierra. Preliminary results of the regional lake-acidification model will be included in an interim assessment of acidic deposition effects in California. This assessment is being prepared by ARB scientists and will be presented to the Governor and the Legislature in early fall.

Florida

The Florida Department of Environmental Regulation is supporting a project that will characterize the water chemistry and fisheries status of twelve sensitive Florida lakes. The department is also in the process of initiating a cooperative, four-year project of sensitive lakes that is designed to quantify the role of acidic deposition and hydrogeochemical factors in regulating alkalinity.

Minnesota

Seasonal Lake Chemistry - As part of the state's ongoing program to assess the impact of acidic precipitation on aquatic resources, the Minnesota Pollution Control Agency (MPCA) has been monitoring the water chemistr of 35 lakes since 1981 (*status*, September, 1987).

Beginning in 1988, a subset of 13 lakes will be monitore in the continuation of the seasonal lake program. The goals of the program include monitoring water quality of select low alkalinity lakes (<100 $\mu eq/L$) and evaluating lake response to changing levels of deposition. Figure S- illustrates the distribution of the 13 lakes. Lakes were sampled in early May and will be resampled in late July and mid-October.

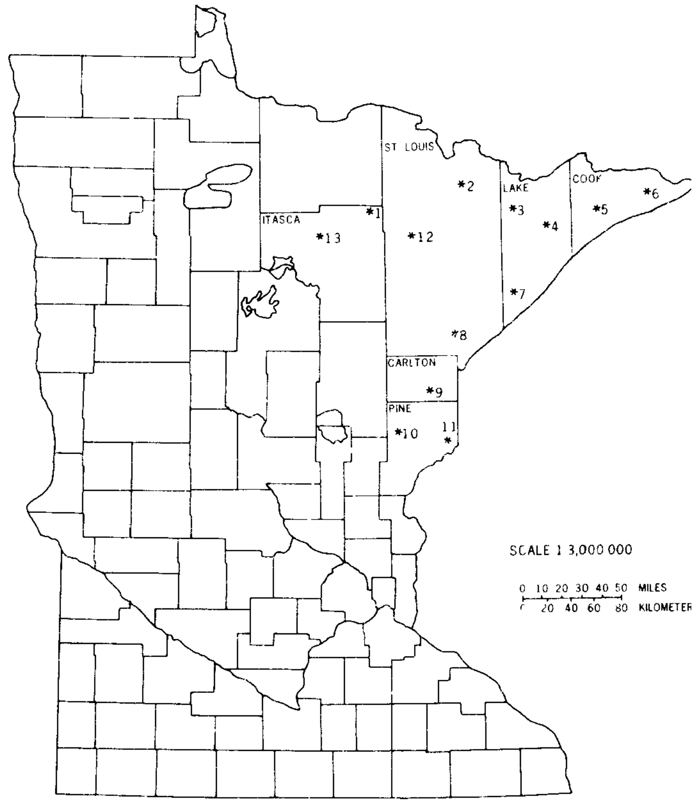


Figure S-1. Lakes monitored as part of Minnesota's Seasonal Lake Program.

Episodic Acidification Study - This study addresses the impact of snowmelt on seven trout streams in north-eastern Minnesota. Phase I studies, which were designed to provide background water chemistry and stream discharge characteristics, took place from March to May, 1988. Phase II activities will provide data on two of the stream watersheds. These streams will be monitored intensively to document the frequency and magnitude of acidic snowmelt on storm-related episodes. If warranted, Phase II will assess the biological significance of episodes.

Virginia

There are approximately 450 native brook trout streams in Virginia's mountainous western counties. These streams, which have retained the environmental conditions necessary to sustain trout populations, generally occur in the wildest and most pristine areas of the region. Despite the relative absence of direct watershed disturbance, the majority of these streams are at risk of degradation due to current levels of acidic deposition. This is a principal finding of the Virginia Trout Stream Sensitivity Study (VTSSS).

The occurrence of acidic deposition in Virginia has been identified through a number of monitoring programs. Precipitation is presently collected on a weekly basis at about twelve locations in Virginia. Precipitation pH averages about 4.3, indicating a tenfold increase in acidity over estimated preindustrial levels. Sulfate is currently deposited in precipitation at the rate of about 25 lbs per acre per year across the state. This compares with 2-3 lbs per acre per year in remote unpolluted environments.

The VTSSS project has proceeded in two phases. Phase I (*status*, April 1988) involved a survey of current streamwater chemistry. The objectives of this survey were to (1) establish a water chemistry baseline for the native trout streams, (2) allow classification of the streams with respect to current chemistry and sensitivity to acidic deposition effects, and (3) identify a set of optimum stream sites for establishment of long-term trend monitoring. Phase II involves initiating a long-term trend monitoring network. The primary objective of this project component is to allow early detection of future changes in streamwater chemistry that occur as a consequence of acidic deposition.

During Phase II, sixty-five native trout streams will be sampled on a quarterly basis. These streams, selected from among the most pristine of the streams sampled in the spring 1987 survey, were chosen to represent the range of potential sensitivity, geographic distribution, and watershed geology associated with the native trout stream resource. Quarterly sample collection was initiated in October 1987. Sample collection is provided primarily by the U.S.D.A. Forest Service and Trout Unlimited.

In addition to the 65 quarterly sampling sites, the trend monitoring network is supported by a weekly stream sampling program conducted in the Shenandoah National Park. This sampling program is maintained by the Shenandoah Watershed Study, a project of the University of Virginia Department of Environmental Sciences and the National Park Service. Four separate streams associated with four major bedrock types are represented in the weekly sampling.

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include: total carbon, total sulfur, total nitrogen, inorganic sulfur fractions, organic sulfur fractions, pH, cation exchange capacity, extractable iron, extractable aluminum, total acidity, and mineral composition. Personnel at Battelle Pacific Northwest Laboratory are using these soils data to initiate the modelling task, an effort to evaluate predictions from models used in the DDRP.

Various levels and combinations of deposition are being simulated by experimentally applying acids to a series of plots that represent the major soil and vegetation types within the Bear Brook catchments. Present WMP plans call for initiating acid irrigation experiments on external experimental plots and mineral weathering plots. To initiate soil processes that enable a field calculation of mineral weathering tasks, six mineral weathering plots will receive a greater acid loading than the external plots. Other activities planned for the 1988 field season include completing the instrumentation of internal plots located within the Bear Brook catchments, sampling soils within the catchments according to protocols established in DDRP, and continuing standard watershed sampling.

Address inquiries concerning the WMP to:
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FTS: 420-4666, ext. 354

Episodic Response Project (ERP)—Short-term episodic acidification during storm events and snowmelt is known to occur in many aquatic systems. The regional occurrence and effect of episodes on biology and chemistry, however, is unknown. The ERP addresses this uncertainty. Although ERP researchers ultimately intend to make regional inferences, the project is being conducted in two phases. Intensive field studies at four to six sites during Phase I will increase understanding of the causal factors and mechanisms controlling episodic acidification. Phase II extensive field studies at many more sites will emphasize calibration and extrapolation of these intensive, site-specific results to the region.

ERP Phase I intensive stream studies were implemented in the northern Appalachian Plateau (Pennsylvania), the Adirondack Mountains (New York), and the Catskill and Pocono Mountains (New York). These studies include measurements of deposition quantity and chemistry, stream discharge, stream chemistry, fish population status and response to episodes, and qualitative data on stream benthic invertebrate communities. The majority of measurements will be taken during major storm and snowmelt events, relying on automated data gathering devices for sample collection, chemistry, and flow.

Concurrent to the implementation of Phase I intensive field studies, AERP scientists have initiated research for Phase II extensive studies. During the second phase of ERP, empirical chemical models wil be structured and calibrated to estimate the number and proportion of surface waters in specific regions that are likely to experience acidic episodes. To date, research indicates that a model (the Wilson and Barrie model) holds promise as a means of developing qualitative regional assessments of the risk of acidic episodes associated with snowmelt events. This model can predict the timing of flow and pH fluctuations; however, conservative predictions of pH depression suggest that the model should be modified to include a mixing of snowmelt with more alkaline base flow. Statistically significant concentration-discharge relationships were found for all streams from which data were analyzed. Differences among streams were greater than differences among events within a single stream.

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)—The REAM Project (*status*, April 1988) will provide data useful in formulating, testing, and refining DDRP, WMP, and ERP models. These models are designed to predict surface water chemical changes in response to acidic deposition.

Site instrumentation and data collection activities have begun at the Fernow Experimental Forest in West Virginia. REAM personnel will record data from two separate pH probes at each minimonitor site and will check probe performances at times separated by at least 48 hours. University of Maine personnel will complete soil chemical analyses on samples collected from each soil series on the control and manipulation watersheds at Fernow.

Address inquiries concerning REAM to:
Timothy C. Strickland
REAM Technical Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext. 320
(FTS) 420-4666, ext. 320

Watershed Recovery Project (WRP)—The objectives of the Southeast Acidification Project and the Surface Water Recovery Project have been combined and are addressed by the WRP (*status* , September 1987).

Address inquiries concerning WRP to:
Timothy C. Strickland
WRP Technical Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext. 320
(FTS) 420-4666, ext. 320

Little Rock Lake Experimental Acidification Project—Results from the first two years of acidification showed a statistically significant increase in the mercury body burden of young perch, as pH dropped from 6.1 to 5.6. Body burdens in the treatment basin after one year of acidification (1986) were 18 percent higher than before acidification (1985); body burdens were 12 percent higher than in the reference basin. Results for the first and second years of acidification were almost identical. Total mercury in the sediments of both basins was similar and showed a strong positive correlation with organic content. Mercury concentrations in unfiltered lakewater were roughly equivalent in the two basins, indicating a speciation shift toward more strongly bound species in the treatment basin following acidification.

Ongoing activities of project scientists include conducting a series of in situ exposures on early life stages of fish in Little Rock Lake. Results will be compared to responses of laboratory tests on the same species in Lake Superior water.

Address inquiries concerning the Little Rock Lake Experimental Acidification Project to:
John Eaton
EPA/Environmental Research Laboratory-Duluth
6201 Congdon Blvd.
Duluth, Minnesota 55804
(218) 720-5557
(FTS: 780-5557

Temporally Integrated Monitoring of Ecosystems Project (TIME)—The TIME project, a long-term monitoring project designed to assess future effects of acidic deposition on aquatic systems, has four major objectives:

1. detect regional patterns and trends in surface water acidification or recovery,
2. detect early indications of trends in surface water acidification or recovery,
3. determine relationships between regional patterns and trends in surface water chemistry and regional patterns and trends in atmospheric deposition, and
4. compare observed patterns and trends in surface water chemistry with model forecasts of future patterns in surface water chemistry.

Currently in the design phase, the TIME project is scheduled for implementation in 1990. Five regions will be considered: the Northeast, Mid-Atlantic/Southeast, Florida, Upper Midwest, and West. The focus of the program 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 (Figure 3).

Data analysis protocols are a significant component of monitoring programs. A major TIME objective is to identify trends that may be related to acidic deposition. TIME scientists have compared several different statistical techniques for trend detection, based on information available from the NSWS and the EPA long term monitoring project, as well as on long-term data sets from Twin Lakes, Colorado, and Clearwater Lake, Ontario.

A workshop was held in March to explore the most informative and cost-effective strategies for using biological systems as early warning signals of surface water acidification and/or recovery. The workshop, which was cosponsored by the Department of Fisheries and Oceans in Canada and the Acid Precipitation in Ontario Study, was attended by 37 U.S., Canadian, and Norwegian scientists.

Address inquiries concerning the TIME project to:
Jesse Ford
Time Scientific Director
EPA/Environmental Research Laboratory-Corvallis
200 S.W. 35th Street
Corvallis, Oregon 97333
(503) 757-4666, ext. 442
FTS: 420-4666, ext. 442

SYNTHESIS AND INTEGRATION ACTIVITIES

1990 Report Activities—Plans to contribute to NAPAP's 1990 report to Congress on acidic deposition are underway. The report will be presented in two parts. The first document is a series of seven related state-of-science papers summarizing what is known about issues relevant to the aquatic effects of acidic deposition and what remains uncertain. The topics include processes controlling surface water acidification, factors controlling

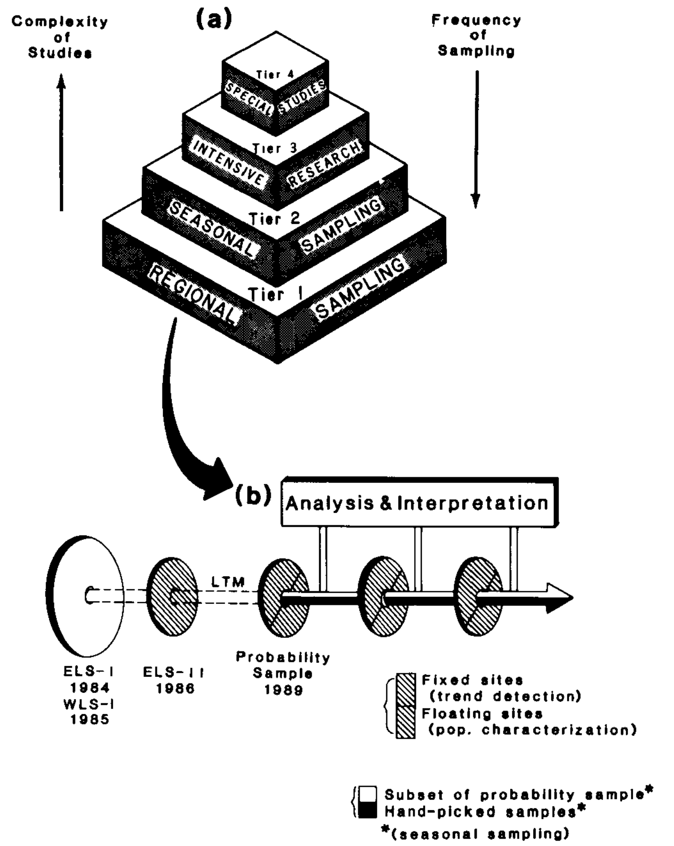

Figure 3. Evolution of the TIME Project concept. Change of focus from (a) regionally extensive sampling to (b) seasonal to bimonthly sampling at a core of early warning sites.

biological responses, historical and future change in surface water chemistry, episodic acidification, and mitigation of surface water acidification. This document will present technical information, methods, assumptions, data sources, and limitations and uncertainties associated with each method. The second document, the 1990 NAPAP Assessment, will contain the integrated results, conclusions, and uncertainty estimates generated from application of the procedures used in the state-of-science document.

AERP personnel are working closely with NAPAP and other members of the Aquatics Task Group to complete the documents. The state-of-science document is scheduled for release in the spring of 1990. The integrated assessment is scheduled for release late in 1990.

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. The Eastern Lake Survey - Phase I document set and the Western Lake Survey - Phase I document set are available through the mail order form in this *status*. The National Stream Survey Pilot Study major report and the National Stream Survey document set are also available; companion documents to the Pilot Study will be announced in the next issue of the *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 and how the quality of the data was assessed. Data bases for the Western Lake Survey - Phase I and the Eastern Lake Survey - Phase I are available through the mail order form in this *status*.

- Handbooks - The handbooks are guidance documents that contain procedures for field operations, laboratory operations, and quality assurance for surface water and soil chemistry monitoring. They are beneficial to those organizations involved in designing and implementing monitoring activities related to acidic deposition. The handbook for Laboratory Analyses for Surface Water Chemistry is available through the mail order form in this issue of the *status*. The handbook for 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. The first issue, covering the October 1987—September 1988 period, is available through the mail order form in this *status*.

- 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 compiled 1985—1986 abstracts and is available through the mail order form in this *status*.

Address inquiries concerning the AERP Technical Information Project to:
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Technical Director
AERP Technical Information Project
EPA/Environmental Monitoring Systems Laboratory - Las Vegas
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(FTS) 545-2358

AERP ANNOUNCEMENTS

A recent issue of Environmental Science & Technology (February 1988, Vol. 22, no. 2) contains four articles written by AERP scientists. The articles, which discuss results of the Eastern Lake Survey - Phase I, include:

- "Eastern Lake Survey, Regional Estimates of Lake Chemistry" (Feature Article) by D.H. Landers, W.S. Overton, R.A. Linthurst, and D.F. Brakke.
- "Chemical and Physical Characteristics of Lakes in the Northeastern United States" by D.F. Brakke, D.H. Landers, and J.M. Eilers.
- "Chemical and Physical Characteristics of Lakes in the Upper Midwest, United States" by D.F. Brakke, D.H. Landers, and J.M. Eilers.
- "Chemical and Physical Characteristics of Lakes in the Southeastern United States" by J.M. Eilers, D.H. Landers, and D.F. Brakke.
- "Evaluation of the Role of Sea Salt Inputs in the Long-Term Acidification of Coastal New England Lakes" by T.J. Sullivan, C.T. Driscoll, J.M. Eilers, and D.H. Landers.

If you would like to receive any of the following AERP products, please check the appropriate box(es).

MAJOR REPORT/COMPANION DOCUMENTS

Eastern Lake Survey - Phase I

Major Report—Characteristics of Lakes in the Eastern United States

- Volumes 1-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 ☐

National Stream Survey - Phase I Pilot Study

- Major Report .... 4026 ☐

* 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 ☐

- * Quality Assurance Plan .... 4044 ☐
- * Field Operations Report .... 4023 ☐
- * 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) .... 4032 ☐

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 ☐

ABSTRACT

- * Publications and Presentations, 1985-86 .... 9018 ☐

* Publications listed for the first time.

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