United States
Environmental Protection
Agency

Environmental Monitoring
Systems Laboratory
Las Vegas NV 89114

Research and Development

EPA/600/S4-86/010 July 1986

EPA

Project Summary

National Surface Water Survey: Eastern Lake Survey Phase I—Synoptic Chemistry Field Operations Report

Franklin A. Morris, David V. Peck, Michael B. Bonoff, and Kevin J. Cabble

The National Surface Water Survey is a three-phase program designed to address increasing concern over potential acidification of U.S. surface waters by atmospheric deposition. Phase I of the Eastern Lake Survey (ELS-I) was conducted during autumn 1984 as a synoptic chemical survey to characterize lakes located in regions of the eastern U.S. believed to be susceptible to the effects of acidic deposition. This document describes planning activities and summarizes field operations of the Eastern Lake Survey—Phase I.

Prior to Phase I field operations, preliminary experiments and pilot field studies were conducted to test field sampling methodology and assumptions, laboratory procedure and methodology, and logistical constraints. Eight locations in the eastern U.S. were selected as field station sites for the ELS-I. Lake water samples and *in situ* chemical and physical data from 1798 lakes were collected using helicopters. Field sampling methodologies are described in the final report. Water samples were returned to mobile laboratories located at the field stations. Certain analyses were performed at the mobile laboratories, and the samples were split into aliquots and preserved for later analyses at contract analytical laboratories.

In general, field sampling and field laboratory activities proceeded smoothly. Pertinent results, observations, and recommendations for improvement regarding field operations are included. These recommendations and observations may be valuable to planners of similar projects.

This Project Summary was developed by EPA's Office of Acid Deposition, Environmental Monitoring and Quality Assurance, Washington, DC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The National Surface Water Survey (NSWS) is a three-phase program designed and implemented by the U.S. Environmental Protection Agency (EPA) as part of the National Acid Precipitation Assessment Program (NAPAP) to address the increasing concern over potential acidification of U.S. surface waters by atmospheric deposition Phase I of the Eastern Lake Survey (ELS-I) was conducted during the fall of 1984 as a synoptic chemical survey to characterize lakes, at one point in time, located in regions of the Eastern United States believed to be susceptible to the effects of acid deposition. The EPA's Environmental Monitoring Systems Laboratory—Las Vegas, Nevada (EMSL-LV) was charged with overseeing and supervising the field operations for the ELS-I. Logistical and personnel support for ELS-I was provided by Lockheed Engineering and Management Services Company, Inc. (Lockheed-EMSCO). The final report describes the planning activities and summarizes field operations of the ELS-I.

The research plan for the ELS-I, drafted in October 1983, was reviewed by more than 100 scientists and other potential data users. A meeting of 50 scientists and policy-makers was held in December 1983 to review and modify the research plan. The revised research plan and its statistical design was subjected to further peer review before field operations began. Sampling and analytical methodologies, the quality assurance plan, and the logistics plan were developed for the ELS-I based on the revised research plan.

Preliminary Activities

Helicopters were chosen as the ideal tool to sample a large number of lakes over a broad geographic area in a short period of time. Because only one sample was to be taken from each lake, the most suitable time to sample was a period when the lakes would be mixed and the samples would be most representative of the chemistry of the entire lake. These mixing periods occur during the spring and again during the fall through early winter.

Two pilot studies were conducted during the winter and spring of 1984 to assess the proposed research and field operations plans of the ELS-I. The pilot studies provided an opportunity to establish the expected range of concentrations of the chemical variables, and to test the proposed analytical methods. The pilot studies also allowed evaluation of other aspects of the research plan: lake selection, proposed sampling protocols, quality assurance program, and data management. The winter survey demonstrated that sampling lakes through the ice was not an effective procedure, due to the difficulty of finding lakes covered by snow, sampling under hazardous conditions, and the increased time needed to collect samples at low temperatures. The spring pilot study was more successful, leading to the decision that sampling during the fall turnover period only would achieve the objectives of ELS-I.

During the pilot studies, several other assumptions related to field sampling were experimentally tested. One major concern was that the helicopter's exhaust fumes, might contaminate the samples. Samples were taken from a lake using a boat, then from a helicopter. No significant differences were found between the means of 22 chemical parameters (n=7) from the boat and helicopter samples, and it was concluded that the helicopter had no effect on the quality of the water samples collected.

Preparation for field operations included procurement of all the necessary equipment, training of the field and laboratory personnel, base site selection, and laboratory transportation and set up. All Lockheed-EMSCO personnel were trained in Las Vegas for aspects of either field or laboratory operations, including safety. Field samplers provided by EPA regional offices and state agencies were trained at several field stations Eight field stations were selected in the eastern U.S where the mobile laboratories were located: Bangor, ME; Lake Placid, NY; Lexington, MA; Mt. Pocono, PA; Duluth, MN; Rhinelander, WI; Asheville, NC; and Lakeland, FL Remote base sites were also established at some field stations as a base for helicopter operations, generally for sampling lakes outside a 150 mile radius from the field station

Field Station Operations

Fifteen people staffed each field station, including management personnel, helicopter pilots and mechanics, and laboratory and field crews. All personnel reported to the base coordinator, who was responsible for the overall operation of the field station Each station had a communications room where the field sampling activities could be closely monitored for safety and coordination. A communications center in Las Vegas was used to track the number and type of lakes sampled, compile helicopter flight hours and weather forecasts, coordinate and track quality assurance (QA) and analytical samples, and ship supplies to the field stations

Field Sampling Operations

Strict QA measures were followed to maintain consistency in field sampling protocols, and to ensure that field data and water samples would yield results of a high and known quality Hydrolab 4041* water quality analyzer units were calibrated every morning and checked before and after sampling with solutions of known pH and conductivity. Each field team collected a field blank sample every day to provide estimates of analytical detectibility and check for contamination in their sampling procedure. Duplicate samples were also collected daily for each field station to estimate the overall precision of ELS-I methodologies.

When a lake was approached from the air, the lake identity was verified from maps and from the LORAN-C guidance system in each helicopter, and then the lake was photographed. If the lake was accessible, the helicopter would land, and the pilot would locate the deepest point in the lake by use of a depth finder. Secchi disk transparency was determined using a Secchi disk. Temperature (for determination of the stratification status of the lake), pH, and conductivity were measured *in situ* with the Hydrolab unit. Water samples were collected from 1.5 m with a 6.2 L Van Dorn bottle. Two 60-ml syringes were rinsed and filled with water from the Van Dorn bottle. pH and dissolved inorganic carbon (DIC) were determined using these samples at the field lab. A 4-L Cubitainer was rinsed and filled with water from the Van Dorn. All field data was recorded on standardized forms. The data forms, syringes, and water samples were delivered to the field laboratory within 8 hours of collection.

Field Laboratory Operations

Field laboratory crews processed and preserved samples as soon as possible after collection, and conducted certain analyses Every trailer contained a laminar flow hood used as a contamination-free work area, a high-quality water purification unit, freezer and refrigerator space, instrumentation to perform measurements of DIC, pH, turbidity, and true color. Each laboratory was staffed by five persons each with clearly defined responsibilities. lab coordinator, lab supervisor, and three analysts.

The samples were organized into a batch for processing as they were received from field sampling crews. Audit samples of known composition were also added to the routine, duplicate, and blank samples from the field for quality assurance All the information from each batch, including the results of the chemical analyses performed on site were recorded onto a standardized batch form. Seven aliquots from each sample were prepared and preserved for more detailed chemical analyses. Preparation involved filtration (0.45 μm membrane filters) of or pouring aliquots of sample into amber polyethylene bottles. An aluminum extraction procedure using 8 hydroxyquinoline and methyl isobutyl ketone was carried out to prepare one aliquot. The preserved aliquots were shipped the next day for delivery to one of four contract analytical laboratories

*Mention of trade names does not constitute endorsement by the U.S. Environmental Protection Agency.

within 24 hours. Additional aliquots were also prepared and sent to the Environmental Research Laboratory in Corvallis, OR for elemental analyses Some field laboratories prepared aliquots that were shipped to laboratories in Norway and Canada. Data forms were sent daily to Oak Ridge National Laboratory, where the data base was managed and to quality assurance personnel in Las Vegas. A shipping form for each container of samples sent was also sent daily to the NSWS sample management office

Summary of Field Operations

Of the 1876 lakes initially selected for sampling during ELS-I, 1763 were visited and 1612 were actually sampled. Some of the selected lakes were not visited due to time constrictions coupled with bad weather. Visited lakes were not sampled if they were ice-covered, had a conductance over 1,500 $\mu S\ cm^{-1}$, had flowing water, or if landing conditions were hazardous. Only 5 percent of the lakes sampled were themally stratified when they were sampled. An additional 199 lakes were selected as "special interest" lakes on recommendation from various federal and state agencies. Samples were collected from 186 special interest lakes.

Field laboratories delivered 2,399 samples to the contract analytical laboratories, at an average daily processing rate of 20 samples per field laboratory per day.

Field operations for the ELS-I were conducted such that the project was completed on schedule A sufficient number of lake samples were collected and analyzed to satisfy the objectives of the research plan. To assist others planning operations similar to ELS-I, a summary of pertinent cost information, observations, and recommendations are provided in the final report. Similarly, the final report contains a section on recommendations and observations to improve the field operations of future NSWS activities or other similar surveys.

This report is submitted in partial fulfillment of contracts 68-03-3050 and 68-03-3249 by Lockheed Engineering and Management Services Company, Inc., under the sponsorship of the U.S. Environmental Protection Agency.

Franklin A. Morris, David V. Peck, Michael B. Bonoff, and Kevin J. Cabble are with Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV 89109.

***Robert E. Crowe** is the EPA Project Officer (see below).*

The complete report, entitled "National Surface Water Survey: Eastern Lake Survey, Phase I—Synoptic Chemistry—Field Operations Report," (Order No. PB 86-196 680/AS; Cost: $11.95, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
Las Vegas, NV 89114

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Official Business
Penalty for Private Use $300

EPA/600/S4-86/010