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EPA

Project Summary

Surface Waters Implementation Plan—Northeast Lakes Pilot Survey, Summer 1991

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This document outlines the proposed implementation plan for the Environmental Monitoring and Assessment Program's Surface Waters Northeast Pilot Lake Survey, to be conducted from July through September, 1991. The pilot survey will evaluate not only the utility of the indicators selected thus far for the Surface Waters component but will provide an evaluation of the methods that have been identified for collection and analysis of samples.

This implementation plan is not intended to be a step-by-step delineation of field activities planned for the pilot; for more detailed discussion of concept, approach, and issues, please refer to either the Surface Waters Research Plan or the respective subject plans (e.g., the quality assurance project plan, the field operations manual, the information management plan). This plan outlines the objectives of the field pilot activities and the questions which we expect to answer as a result of these activities. In addition, the plan contains a description of the indicators, the measurement variables included in each indicator, the design rationale, and details including site selection criteria and a list of selected sites. Very brief descriptions of quality assurance, logistical considerations, and the information management approach are also presented.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Las Vegas, NV, 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 U.S. Environmental Protection Agency (EPA), in cooperation with other federal and state organizations, has designed the Environmental Monitoring and Assessment Program (EMAP) to periodically assess the condition of the nation's ecological resources. The program will assist decision makers, both within and outside the Agency, to evaluate the effectiveness of current environmental regulations in protecting the nation's natural resources, prioritize issues of concern and regions in which action is needed, and set environmental policy. EMAP is a strategy to identify and bound the extent, magnitude, and location of degradation or improvement in the environment.

EMAP-Surface Waters (EMAP-SW) is intended to estimate the condition of lakes, reservoirs, streams, and rivers on a national scale and on relatively broad, regional scales. The design of the program, which utilizes an integrated, statistical monitoring framework based on a global systematic grid, is explained in detail in the Surface Waters Research Plan. Data obtained from the program will allow estimation of the spatial extent and geographical distribution of various classes of surface waters. Additionally, the program will estimate the current status and changes or trends in indicators of ecological condition.

1991 Northeast Lakes Pilot Survey

Prior to full-scale implementation of EMAP-SW, a number of questions must be answered through a combination of analyses of existing data and of data derived from new field activities. We distinguish two types of field activities that we intend to undertake prior to full-scale implementation. These are pilot projects and demonstration projects. The pilot projects are intended to specifically answer questions about indicator performance, including sensitivity, components of variance for indicators, method considerations, and logistical constraints. Pilot studies are not intended to provide regional estimates of condition. A demonstration activity may be designed to answer many of the same questions outlined above, but also has as a fundamental objective the demonstration of the ability to estimate the condition of regional populations. We anticipate a combination of pilot and demonstration activities over the next three to four years before national implementation of EMAP-SW. The pilot activity will begin to answer the many questions that exist but will not answer them all. In conjunction with well designed followup studies, this pilot should provide the information needed to implement the program.

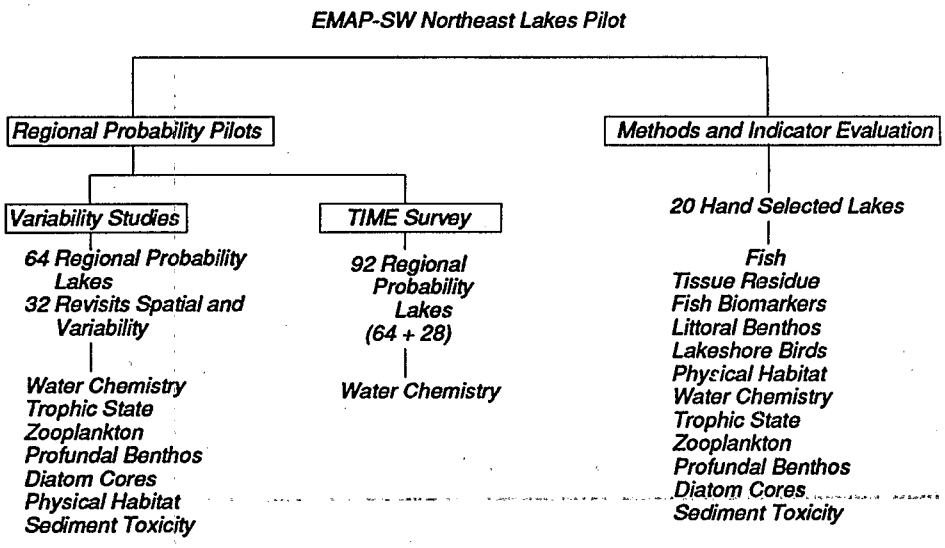

Figure 1. *Components of the pilot activities planned for EMAP-SW during FY91.*

Pilot Study Description and Objectives

A fundamental issue which prevented us from conducting a regional scale pilot on all indicators was our belief that we were not adequately prepared to collect an index sample of fish, littoral-zone macroinvertebrates, and lake physical habitat. Thus, a key question to be answered by the pilot is: How do we obtain an index sample of fish, macroinvertebrates, and physical habitat within reasonable budgetary constraints?

Figure 1 shows the basic components of the field pilot for Fiscal Year (FY) 91. The first is a demonstration of the EMAP design for sampling lakes on a regional scale. For this component, lakes to be sampled were selected from a grid framework using selection procedures described in the design section of the document. This demonstration has two subcomponents, one which begins the Temporally Integrated Monitoring of Ecosystems (TIME) program and the other in which we measure selected indicators which we believe we can effectively sample in an index mode. The difference between these two subcomponents is that the base EMAP grid has been intensified in two regions where subpopulations of lakes are especially sensitive to acidic deposition and sample sizes selected from the base grid were insufficient for trend detection. At these additional sites, only TIME indicators, primarily water chemistry, will be measured.

The second component of the pilot addresses the basic question about our ability to obtain a cost-effective index sample for fish, littoral macroinvertebrates, and physical habitat. During the discussions over the past year, it became evident that we were unable to select a sampling protocol (gear, locations) with which we could obtain a sample of the fish and macroinvertebrate assemblages effectively. Thus, the primary purpose of this part of the pilot activity is to obtain sufficient information by which to select an adequate sampling protocol to be used in later surveys. To conduct this evaluation, lakes were purposely selected to cover a variety of lake sizes and types of impacts to represent the range of conditions expected during routine surveys. An ancillary, though important, part of this study is an evaluation of the sensitivity of the suite of biological indicators across various impact gradients.

Questions exist relative to effective methods to use within EMAP-SW for the biological-response and physical habitat indicators currently under evaluation. These pertain to the gear to be used, habitats to be sampled within a lake, logistics of implementing all of the indicators, and the effectiveness of the suite of indicators when evaluated together. We are also interested in determining which indicators have information-to-cost ratios which might preclude future use in EMAP-SW. These issues will be addressed using the data generated from 20 subjectively selected lakes.

Indicators of Ecological Condition

EMAP has identified four types of indicators for determining ecological condition: response, exposure, habitat, and stressor. These categories have been provided as a guideline for use in the selection, evaluation, and development of the proposed indicators for EMAP-SW.

- **Response Indicators** are attributes that quantify the integrated response of ecological resources to individual or multiple stressors. Examples of this kind of indicator include fish assemblage, diatom assemblage, and macroinvertebrate assemblage.
- **Exposure Indicators** are physical, chemical, and biological attributes that can be used to suggest pollutant exposure and assist in the diagnosis of probable cause. In addition, exposure indicators are extremely critical for assessing water body types and expected conditions for aquatic systems. Examples of exposure indicators are sediment toxicity, chemical contaminants in fish, and ambient nutrient concentration.
- **Habitat Indicators** are attributes that describe the condition of the environment. They are used to suggest whether alteration or disturbance of

the physical habitat is the cause of poor condition in response indicators. Examples of this type of indicator are surface area, lake level, or hydrologic residence time.

- **Stressor Indicators** are economic, social, or engineering attributes that are used to identify the most probable sources of environmental impairment or exposure to impact. Some examples of this indicator type are human population density, land-use patterns, pesticide application rates, point-source pollutant loadings, and stocking and harvest records.

Table 1 provides a list of indicator measurements (grouped by indicator type) proposed for the Northeast Lakes Pilot. The program objectives, pilot objectives, and data collection and analysis procedures for each indicator listed in Table 1 are described in detail in Section 3 of the document.

Table 1. Indicator Measurements Proposed for the EMAP-SW Northeast Lakes Pilot

Response Indicators
Trophic State
Sediment Diatom Assemblage
Benthic Macroinvertebrate Assemblage
Zooplankton Assemblage
Fish Assemblage
Riparian Bird Assemblage

Exposure Indicators
Sediment Toxicity
Fish Biomarkers
Fish Tissue Contaminants
Fish External Anomalies
Water Chemistry

Habitat Indicators
Physical Habitat Quality

Stressor Indicators
Land Use
Landscape Cover
Human Population Density
Fish Management Practices
Transportation

Design

One of the design objectives for the FY91 Northeast Lakes Pilot is to select a set of lakes from the EMAP-SW grid for pilot field activities. The selection of these lakes must be in concordance with the criteria established for the EMAP probability sampling design. Analysis of indicators from these lakes will ultimately allow us to evaluate the effectiveness of the base-line grid probability sample design to adequately capture and characterize the diversity of lake resources.

A second design objective is to select approximately 20-30 special purpose lakes. These lakes will serve as reference sites and sites of known or estimated impact, chosen in consultation with state and local experts. This combination of sites will be used to help calibrate the sensitivity of the proposed indicators and evaluate various sampling techniques.

Field Operations

Field activities for EMAP-SW will start in July of 1991 with the lake pilot program in the Northeast. The general sequence of events and sampling procedures are described in the document, while details of field operations can be found in the field operations manual.

Quality Assurance Program

For the Northeast Lakes Pilot Survey and TIME project, quality assurance and quality control (QA/QC) is an integral part of all activities associated with the collection, measurement, and management of environmental data and information. The major purpose of a formalized QA program is to ensure that data are of adequate quality to provide information that can be used with confidence to satisfy the research objectives of the project. For the pilot survey, information is required to determine the adequacy of the proposed probability-based sampling design. Information is also required to evaluate the feasibility of several different types of ecological indicators being considered for use in large-scale lake monitoring efforts. For the TIME project, the research objectives relate primarily to determining the status and subsequent regional trends of lake chemistry relative to acidification.

For each indicator, critical points in the information acquisition process are identified and subjected to internal quality control procedures and/or measurements. Statistical process control methods (e.g., control charts) are used where possible to monitor the performance of the acquisition system. These methods provide rapid feedback on the performance of the system to allow for prompt corrective action, ensuring that data quality remains within established acceptance criteria during collection and measurement. Specific quality control requirements and procedures to be used for each indicator are described in the quality assurance project plan.

Information Management

EMAP-SW will be collecting a large volume of data during the FY91 Northeast Lakes Pilot Survey. More than 50,000 data points will be generated from the data collection activities at approximately 100 lakes; this estimate does not include the revisited lake sites. The ability of EMAP-SW to manage and disseminate this amount of information will have a major influence on the success of the program. Development of an adequate Information Management System is, therefore, as important to the success of EMAP-SW as is the collection of the data. A fully automated system for the FY91 field activities is being developed for use in the pilot survey that will ensure that data are properly collected and tracked in a timely manner for analysis.

Conclusions and Recommendations

The EMAP-SW Northeast Lakes Pilot Implementation Plan presents a description of activities that will be occurring during the summer of 1991. Detailed descriptions of pilot objectives, rationale for indicator selection, and sampling design are presented in this document. Companion documents (field operations and quality assurance) have been prepared to augment the information provided in this document.

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The complete report, entitled "Surface Waters Implementation Plan—Northeast Lakes Pilot Survey, Summer 1991," (Order No. PB92-139948/AS; Cost: $19.00, subject to change) will be available only from:
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