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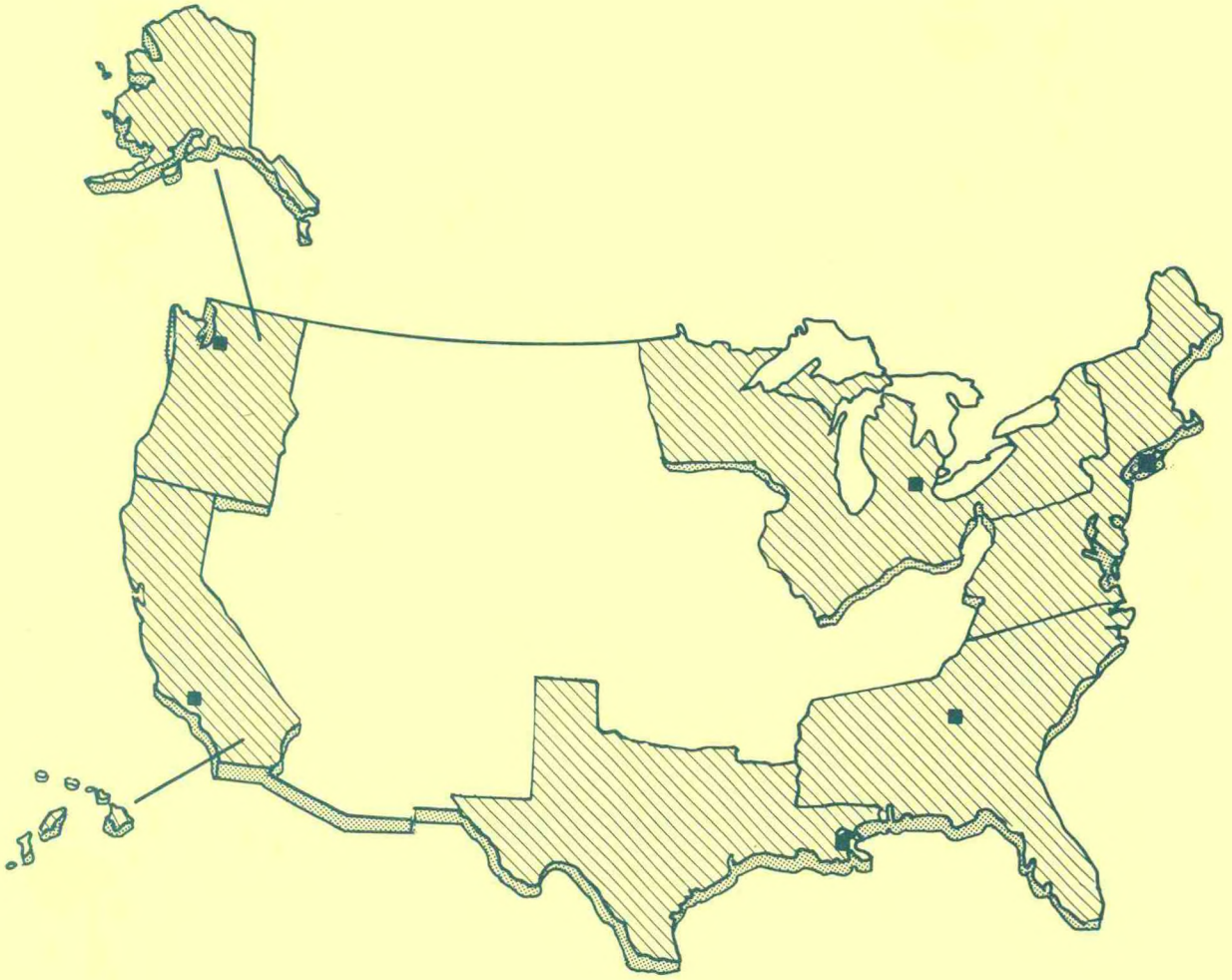

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An Assessment of Great Lakes and Ocean Pollution Monitoring in the United States

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Working Paper No. 7: Federal Plan for Ocean Pollution Research Development and Monitoring, FY 1981-1985

Boulder, Colorado
August 1981

UNITED STATES DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
John V. Byrne, Administrator

Office of Marine Pollution Assessment
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I. EXECUTIVE SUMMARY

During the development of the second Federal Plan for Ocean Pollution Research and Development, and Monitoring, the National Oceanic and Atmospheric Administration (NOAA) identified the need to address marine pollution monitoring needs and priorities separately from research and development. Accordingly, a series of regional workshops addressing marine pollution monitoring needs was planned with participants drawn from both technical and managerial communities directly involved with obtaining and using marine pollution monitoring data.

NOAA through its Office of Marine Pollution Assessment convened this series of six regional marine pollution workshops during the period between September 1980 and February 1981. Workshops were held as follows: Northeast - Stony Brook, New York, Southwest - Pasadena, California, Western Gulf - New Orleans, Louisiana, Northwest - Seattle, Washington, Southeastern - Atlanta, Georgia, Great Lakes - Ann Arbor, Michigan.

Invitees to the workshops were selected to achieve a balance:

a) among Federal, state, and local government, and industry,

b) between technical experts and managers, and

c) among the states within a given region,

and also to include representation by public interest groups.

The workshops were intended to address broad objectives concerning the development of guidelines, strategies, and approaches for interrelating operational ocean pollution monitoring programs and findings in order to improve overall effectiveness and minimize costs. The workshops aimed to generate descriptions and assessments of existing monitoring programs and a definition of additional monitoring needs.

This report summarizes findings of the six regional workshops in relation to the national marine pollution goals set forth by the Congress in PL 95-273 and other legislation. Results of each regional workshop are summarized in individual reports which contain details not included in this national overview.

The marine monitoring programs identified at the regional workshops are extremely diverse. No single program addresses the entire spectrum of marine pollution monitoring needs or goals. Within each region there exists a network of monitoring programs each addressing a limited aspect of the nation's ocean pollution problems. As a result of the complex hierarchy of marine pollution monitoring programs, information from many such programs within a given region must be brought together to assess the health of the marine ecosystem, and evaluate the impact of human activities.

Most marine monitoring programs are compliance monitoring programs, conducted in response to regulations or compliance orders. Compliance monitoring most often is performed to demonstrate that particular pollutant concentrations are not exceeded in some portion of the marine ecosystem. While compliance monitoring forms the majority of all marine pollution monitoring programs there are, in addition, many trend monitoring programs that respond to general statutory requirements to monitor the overall health of the marine ecosystem, and to perform research on the impact of man's activity on the marine environment.

The term "trend monitoring" refers to 1) measurements of pollutant concentration trends in the physical environment and the biota, 2) assessments of variations in the ecological components of the ecosystem (fisheries assessments, habitat investigations etc.), and 3) measurements of trends in the physical environment or "ocean climatology".

Compliance monitoring data are used to satisfy the monitoring agency and the regulator that the standards have not been exceeded. After this primary function has been served, such data are rarely used further, even though they could be of value for other management decisions. Secondary uses of compliance monitoring data identified by workshop participants were identification of requirements for research to determine the cause of the non-complying data, and on rare occasions support of legal enforcement proceedings.

Trend monitoring data are used to provide assessments of the impact of polluting activities on the marine environment and, therefore, as an input to the policy process leading to modification or generation of new legislation or

regulation. However, trend monitoring programs are rarely coordinated and often limited in extent. As a consequence their resulting data are often not adequate to separate natural variability from changes caused by pollution.

Marine pollution monitoring is performed by a variety of organizations ranging from small industrial organizations to multi-national corporations, from town and county government to federal agencies. Compliance monitoring is primarily performed by industrial or municipal dischargers or by local and state agencies. Trend monitoring is predominantly performed by the Federal government and state agencies. Organizations performing marine pollution monitoring activities vary widely in their technical capability and their ability to interpret and utilize complex technical information.

The costs of this nation's marine pollution monitoring programs are difficult to estimate because 1) it is difficult to identify all of the ongoing marine monitoring programs throughout the nation, and 2) program costs cannot be accurately estimated since often no clear distinction exists between marine research and monitoring and between marine and non-marine monitoring.

In each workshop a number of deficiencies and needs were identified. These ranged widely in their degree of specificity. However, many of the identified deficiencies were similar in all or several regional workshops, and probably represent general deficiencies which are common to monitoring activities throughout the regions. In this report the regional workshop results are synthesized and summarized to present an overview of the general deficiencies consistently identified among the regional workshops. The identified deficiencies fall under several categories A) coordination, B) data, information and quality assurance, C) synthesis, D) program evaluation, E) compliance monitoring, F) ecosystem investigations, G) trend assessment monitoring, and H) technology development.

A. Coordination.

The most critical deficiency in marine monitoring programs is the lack of coordination among the many individual programs. Needs were identified as follows:

1. AN APPROPRIATE MECHANISM SHOULD BE ESTABLISHED TO ENSURE THAT EFFECTIVE COORDINATION OF MARINE POLLUTION MONITORING PROGRAMS TAKES PLACE WITHIN EACH REGION AND AMONG THE VARIOUS REGIONS.

2. INFORMATION SHOULD BE MADE AVAILABLE CONCERNING THE ESSENTIAL CHARACTERISTICS OF ALL MARINE MONITORING PROGRAMS. INFORMATION SHOULD BE TARGETED PRIMARILY AT LOCAL, STATE, AND INDUSTRIAL INTERESTS WHO NEED TO EFFECTIVELY ASSESS THE AVAILABILITY OF EXISTING DATA AND INFORMATION, AND THE NEED FOR ADDITIONAL MONITORING DATA AND/OR INFORMATION TO ADDRESS THEIR SPECIFIC LOCAL PROBLEMS.

3. MARINE POLLUTION MONITORING PLANNING AND COORDINATION SHOULD BE ACHIEVED PRIMARILY ON A REGIONAL BASIS, SINCE THE CHARACTERISTICS OF MARINE ECOSYSTEMS AND THE POLLUTION PROBLEMS AFFECTING OR POTENTIALLY AFFECTING THEM DIFFER WIDELY FROM REGION TO REGION. MONITORING PROGRAM DESIGN SHOULD TAKE INTO ACCOUNT CONSIDERATIONS OF THE NATURE OF LOCAL AND REGIONAL ECOLOGY, POLLUTION INPUTS, AND OTHER IMPACTING ACTIVITIES.

B. Data, Information and Quality Assurance

In each regional workshop, participants stated that it is difficult to obtain data from other monitoring programs in useful form. They also stated that information concerning the quality assurance of data, and suitable information products summarizing marine pollution monitoring knowledge are in general not available. The following needs were identified:

1. ACQUISITION, STORAGE, AND DISSEMINATION OF MARINE POLLUTION MONITORING DATA SHOULD BE IMPROVED. ACCESS TO DATA BASES SHOULD BE SIMPLIFIED, AND MECHANISMS ESTABLISHED WHICH WOULD ACTIVELY PRODUCE AWARENESS OF THE DATA THAT ARE AVAILABLE AND FACILITATE ACCESS TO THE DATA BY USERS, PARTICULARLY OCCASIONAL USERS UNSKILLED IN MARINE POLLUTION DATA ACQUISITION.

2. ASSURANCE SHOULD BE ACHIEVED OF THE QUALITY OF MONITORING DATA SUCH THAT DATA FROM ALL MONITORING PROGRAMS CAN BE COMPARED. THE MOST CRITICAL NEEDS ARE FOR PUBLICATION OF A COMPILATION OF APPROVED METHODS AND STANDARD REFERENCE METHODS, FOR THE INCLUSION OF QUALITY ASSURANCE INFORMATION IN MARINE POLLUTION DATA BASES AND FOR STANDARDIZATION OF MEASUREMENT UNITS USED FOR DATA REPORTING.

3. INFORMATION GAINED FROM ASSESSMENT OF MARINE MONITORING DATA SHOULD BE MADE AVAILABLE TO MANAGERS IN A FORM SUITABLE FOR USE IN MAKING DECISIONS. A HIERARCHY OF INFORMATION PRODUCTS IS NEEDED TO SATISFY THE NEEDS OF THE RANGE OF USERS TO BE SERVED, BECAUSE OF THE WIDE VARIATION IN THE DEGREE OF COMPLEXITY OF MARINE POLLUTION PROBLEMS AND IN THE TECHNICAL EXPERTISE AVAILABLE TO THESE DECISION MAKERS.

4. ACCESS SHOULD BE IMPROVED TO INFORMATION CONTAINED IN THOSE IN-HOUSE MONITORING PUBLICATIONS AND REPORTS WHICH ARE NOT PUBLISHED IN A WIDELY DISSEMINATED FORM.

C. Synthesis

While syntheses of marine pollution data addressing major national marine pollution issues are routinely performed by Federal agencies with programmatic responsibilities in the area of interest, no adequate mechanism exists for them to be performed concerning local and individual marine pollution problems. Throughout each of the regional workshops, state and local managers consistently remarked on the lack of synthesis products which were useful in their decision making process.

The following synthesis needs were identified:

EXISTING AND NEW MARINE POLLUTION MONITORING DATA NEED TO BE ANALYZED AND ASSESSED ON A CONTINUING BASIS FOR THEIR APPLICATION TO CURRENT AND PROJECTED MARINE POLLUTION

PROBLEMS. MECHANISMS ARE NEEDED THROUGH WHICH SUCH EVALUATION IS PERFORMED ON A CONTINUING BASIS WITH RESPECT TO BROAD REGIONAL PROBLEMS. MECHANISMS ARE ALSO NEEDED SUCH THAT EVALUATIONS CAN BE PERFORMED, WHEN NEEDED, CONCERNING INDIVIDUAL MARINE POLLUTION PROBLEMS, ESPECIALLY THOSE PROBLEMS OF A LOCAL NATURE WHERE THE MANAGEMENT GROUP REQUIRING SUCH EVALUATION HAS LIMITED TECHNICAL EXPERTISE.

D. Program Evaluation

Many regional workshops participants felt that marine pollution monitoring program design was inadequate, in part because studies of the effectiveness of existing program designs have not been performed.

ALL TYPES OF POLLUTION MONITORING PROGRAMS SHOULD BE CRITICALLY ASSESSED ON A CONTINUING BASIS TO ESTABLISH THEIR EFFECTIVENESS IN MEETING STATED OBJECTIVES. THE RESULTS OF THESE ASSESSMENTS SHOULD BE USED TO REDESIGN EXISTING AND FUTURE MONITORING PROGRAMS.

E. Compliance Monitoring

Regional workshop participants, especially municipal and industrial representatives, voiced much dissatisfaction with the value of compliance monitoring in meeting national management objectives.

The following needs for improvement of compliance monitoring were identified:

1. COMPLIANCE MONITORING REQUIREMENTS SHOULD BE CONTINUOUSLY REVIEWED AND REDUCED TO THE MINIMUM NECESSARY TO SATISFY MANAGEMENT OBJECTIVES.

2. A STUDY SHOULD BE MADE OF THE MONITORING STRATEGIES THAT CAN IMPROVE THE EFFICIENCY AND EFFECTIVENESS OF COMPLIANCE MONITORING, PARTICULARLY THAT COMPLIANCE MONITORING WHICH TAKES PLACE IN RESPONSE TO LEGISLATIVE AND REGULATORY

REQUIREMENTS WHICH LIMIT THE EXTENT OF ECOLOGICAL CHANGE OCCURRING IN THE AFFECTED ECOSYSTEM. WHERE IT IS FOUND THAT STATE-OF-THE-ART ABILITY TO UNDERSTAND ECOSYSTEM STATUS, FUNCTION, AND CHANGE IS INADEQUATE TO ADDRESS STATUTORY AND REGULATORY STANDARDS, OR WHERE THE COSTS OF DOING SO ARE PROHIBITIVE, THE REGULATORY AND/OR STATUTORY STANDARDS SHOULD BE CHANGED.

F. Ecosystem Research

Workshop participants in all regions strongly expressed the need for additional research on marine pollution problems affecting their region.

REGIONWIDE MULTI-DISCIPLINARY ECOSYSTEM RESEARCH PROGRAMS ARE NEEDED IN POLLUTION IMPACTED COASTAL REGIONS WHERE NO SUCH EFFORTS HAVE PREVIOUSLY TAKEN PLACE. IN REGIONS WHERE MULTI-DISCIPLINARY REGIONWIDE ECOSYSTEM RESEARCH PROGRAMS HAVE BEEN PERFORMED IN RECENT YEARS OR ARE CURRENTLY UNDERWAY, THESE EFFORTS NEED TO CONTINUE AT AN APPROPRIATE LEVEL TO IDENTIFY AND RESEARCH NEW AND EMERGING POLLUTION PROBLEMS THAT SHOULD BE MONITORED, TO AID INTERPRETATION OF INFORMATION GAINED FROM MONITORING, AND TO AID DEVELOPMENT OF MORE EFFICIENT AND EFFECTIVE MONITORING STRATEGIES AND TECHNIQUES.

G. Trend Assessment Monitoring

Existing trend assessment monitoring programs are structured to address a variety of concerns other than marine pollution as well as a variety of marine pollution issues. Therefore, the results of these programs are not often integrated effectively into overall marine pollution management considerations.

With regard to marine pollutant concentration trend monitoring, the following needs were identified:

1. ALTERNATIVE STRATEGIES FOR MONITORING THE TREND OF MARINE POLLUTANT CONCENTRATION SHOULD BE STUDIED. THE PURPOSE OF THESE STUDIES SHOULD BE TO DETERMINE THE MOST EFFICIENT AND EFFECTIVE STRATEGY TO MEET THE GOAL OF PROVIDING SUFFICIENT INFORMATION TO DETERMINE THE CONCENTRATIONS OF POLLUTANTS IN CRITICAL COMPONENTS OF THE ECOSYSTEM, EITHER DIRECTLY OR BY MODELING. IN DETERMINING THE MOST EFFICIENT AND EFFECTIVE STRATEGY ACCOUNT SHOULD BE TAKEN OF THE LIMITATIONS OF COST AND AVAILABLE TECHNICAL RESOURCES WHICH MAY RENDER SOME STRATEGIES IMPOSSIBLE, OR LESS DESIRABLE THAN STRATEGIES WHICH LEAD TO EQUIVALENT SCIENTIFIC CERTAINTY OF RESULT.

2. THE SENTINEL ORGANISM APPROACH TO MARINE POLLUTION CONCENTRATION TREND MONITORING SHOULD BE THOROUGHLY RESEARCHED. IT SHOULD BE INTRODUCED TO ROUTINE APPLICATION ONLY IF AND WHEN SUFFICIENTLY DEVELOPED, AND IF NO MORE EFFICIENT AND EFFECTIVE STRATEGY IS PRACTICABLE.

With regard to marine ecological trend monitoring the following needs were identified:

1. DATA AND INFORMATION FROM ALL MARINE ECOLOGICAL TREND MONITORING PROGRAMS, INCLUDING THOSE TAKING PLACE IN RESPONSE TO MANAGEMENT NEEDS OTHER THAN MARINE POLLUTION, SHOULD BE REVIEWED ON A CONTINUING BASIS. INFORMATION CONCERNING OBSERVED TRENDS SHOULD BE MADE AVAILABLE FOR USE IN MARINE POLLUTION MANAGEMENT, AND IN THE DESIGN OF MARINE POLLUTION MONITORING AND RESEARCH PROGRAMS.

2. THERE IS A NEED TO MAKE BETTER USE OF RECREATIONAL AND COMMERCIAL FISHING ACTIVITIES TO GATHER DATA CONCERNING THE TRENDS IN MARINE POPULATIONS.

3. BIOCHEMICAL INDICATORS OF POLLUTANT STRESS IN MARINE ORGANISMS SHOULD BE INTENSIVELY RESEARCHED. WHEN AND IF TECHNIQUES

BASED ON THE USE OF SUCH INDICATORS ARE THOROUGHLY TESTED AND PROVEN, THEY SHOULD BE INTRODUCED TO MARINE MONITORING PROGRAMS TO REPLACE OR REDUCE, WHERE POSSIBLE, POPULATION AND DIVERSITY MONITORING.

With regard to marine environmental trend monitoring the following needs were identified:

A STUDY SHOULD BE MADE OF ENVIRONMENTAL TREND MONITORING STRATEGIES WHICH CAN ENSURE THAT MAJOR REGIONWIDE ECOLOGICAL CHANGES CAUSED BY NATURAL VARIABILITY ARE IDENTIFIED AND SEPARATED FROM POLLUTION INDUCED CHANGES. PROGRAMS EMPLOYING THE BEST AVAILABLE STRATEGY SHOULD BE INITIATED AS SOON AS PRACTICABLE.

H. Technology Development

Rather than suggesting needs for new technology with which to make more sophisticated environmental measurements, workshop participants expressed a number of concerns that the existing sampling and analysis technologies suffered operational problems which compromised the efficiency of marine monitoring programs. The operational problems of existing technology that were identified include: unreliability, difficulty of operation, high cost, and lack of adequate operator training programs.

TECHNOLOGY AND ENGINEERING PROGRAMS SHOULD BE REFOCUSED TO PLACE MAJOR EMPHASIS ON IMPROVEMENT OF THE RELIABILITY AND EASE OF OPERATION, AND LOWERING OF THE COST OF EXISTING MEASUREMENT, SAMPLING AND ANALYSIS SYSTEMS. DEVELOPMENT OF NEW TECHNOLOGY SHOULD EMPHASIZE THESE SAME FEATURES, AND NEW TECHNOLOGY SHOULD BE ACCOMPANIED BY ADEQUATE TRAINING PROGRAMS FOR THE TECHNICAL COMMUNITY PERFORMING DAY-TO-DAY MONITORING TASKS.

I. National Marine Pollution Monitoring Program Planning

Workshop participants felt that a national program should provide the framework for integration of the hierarchy of existing marine pollution and other marine monitoring programs, and should operate on a regional basis. In addition, since in most regions the hierarchy of programs is incomplete, the national program should seek to ensure that these information gaps are filled.

Workshop participants identified the following needs:

1. THE NATIONAL MARINE POLLUTION MONITORING PROGRAM SHOULD BE THE SUM OF A NUMBER OF REGIONALLY PLANNED AND COORDINATED PROGRAMS. IT SHOULD ENSURE THE AVAILABILITY OF DATA FROM ALL MARINE MONITORING PROGRAMS, AND THAT THESE DATA ARE INTEGRATED IN A MANNER LEADING TO USEFUL SYNTHESES AND INTERPRETATIONS. IT SHOULD ALSO ENSURE THAT USEFUL INFORMATION PRODUCTS ARE PRODUCED AND DISSEMINATED TO USERS. THE NATIONAL PROGRAM SHOULD IDENTIFY GAPS IN THE HIERARCHY OF MONITORING PROGRAMS AND SHOULD FIND MEANS TO FILL THESE GAPS.

2. THE ROLE OF THE NATIONAL MARINE POLLUTION MONITORING PROGRAM AT THE PRESENT TIME SHOULD BE THAT OF COORDINATION AND INTEGRATION OF EXISTING MONITORING ACTIVITIES. IT SHOULD NOT REPLACE OR SUBSUME EXISTING COMPLIANCE OR OTHER MONITORING PROGRAMS.

II. INTRODUCTION AND BACKGROUND

II.A. The National Ocean Pollution Planning Act

In spring 1978, Congress enacted and the President signed into law a statute to become known as the National Ocean Pollution Planning Act (Public Law 95-273, See Appendix A). In reviewing the importance of the coastal and offshore oceans to national well-being, the Congress found that the United States increasingly will be forced to rely on ocean resources. This increased use of the marine environment and its resources can have a profound short-term and long-term impact on the ability of the ocean and coastal systems to provide the needed resources. The ability to use the oceans wisely depends directly on the knowledge decision makers have about pollution-related consequences of such activities. Unfortunately, while the Federal Government supports and undertakes extensive ocean pollution research, development, and monitoring that can yield such knowledge, these activities often are uncoordinated and result in potential duplication or unfilled information needs. The Congress concluded that there was a need to develop a comprehensive Federal Plan that would better identify the needs for ocean pollution research, development, and monitoring, and demonstrate how the Federal effort was organized to meet the needs in a timely and efficient way. The overall goal of the Plan is to better assure that the Federal program for research, development, and monitoring provides the knowledge needed to make better decisions on ocean use activities that may cause pollution.

The National Ocean Pollution Planning Act has three basic purposes;

1. To establish a comprehensive 5-year plan for Federal ocean pollution research and development, and monitoring programs.

2. To develop the necessary base of information to support ocean use management decisions.

3. To designate the National Oceanic and Atmospheric Administration (NOAA) as the lead Federal agency for preparing the 5 year plan.

Section 4 of the Act specifies in detail the elements that the "comprehensive Federal Plan relating to ocean pollution" should contain. The key elements within this section are:

1. Assessment and ordering of national needs and problems.
2. Assessment of the existing Federal capability.
3. Policy recommendations.
4. Budget review.

Congress directed that in developing the 5-year Federal ocean pollution plan, NOAA work together with the Director of the President's Office of Science and Technology Policy and other Federal agencies. In accord with the Congressional directive, the approach to implementing the legislation has been to involve to the maximum extent possible all concerned Federal departments and agencies. In June 1978 the Director of the President's Office of Science and Technology Policy chartered the Interagency Committee on Ocean Pollution Research and Development and Monitoring (COPRDM) under the aegis of the Federal Coordinating Council for Science, Engineering, and Technology.

The Interagency Committee, chaired by the Deputy Administrator of NOAA, with EPA's Assistant Administrator for Research and Development as Vice Chairman, is made up of policy-level representatives from the Federal agencies and departments that have programs relating to ocean pollution and a representative from the Office of Management and Budget. The departments and agencies represented are:

- Council on Environmental Quality (CEQ)
- Department of Agriculture (DOA)
- Department of Commerce (DOC)
- Department of Defense (DOD)
- Department of Energy (DOE)
- Department of Health and Human Services (HHS)
- Department of the Interior (DOI)
- Department of Transportation (DOT)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)
- National Science Foundation (NSF)
- Nuclear Regulatory Commission (NRC)

NOAA, within its Office of Policy and Planning, established the National Marine Pollution Program Office (NMPPO) to lead the development of the Plan, to facilitate the implementation of the Plan, and to perform staff functions for COPRDM. In addition, the Office of Marine Pollution Assessment (OMPA) was created to facilitate planning and coordination within NOAA.

II.B. The First Federal Plan for Ocean Pollution Research, Development and Monitoring (1979-1983).

In preparing the First Federal Plan published in August 1979, the COPRDM formed four working subcommittees to develop specific portions of, and make recommendations for, the comprehensive 5-year Federal Plan. The subcommittees were:

1. Subcommittee on National Needs and Problems -- responsible for developing the statement of national needs and problems that forms the cornerstone for policy recommendations regarding changes in the overall Federal effort during the 5-year Plan period.

2. Subcommittee on Research and Development -- responsible for identifying all existing Federal research programs and facilities related to ocean pollution in order to analyze the extent to which the present programs meet national priorities, and to make recommendations to the parent committee regarding changes necessary to satisfy those priorities more fully.

3. Subcommittee on Monitoring -- responsible for identification and analysis of Federal monitoring programs in a manner similar to the role of the Research and Development Subcommittee.

4. Subcommittee on Data -- responsible for analyzing the current federal capability to respond to the requirements of Section 8 of the Act.

Each of the Subcommittees produced a comprehensive report. The monitoring subcommittee report identified existing and planned Federal ocean pollution monitoring programs and activities, addressed the extent to which they met national needs and priorities, and made recommendations for changes in the Federal ocean pollution monitoring effort in order to satisfy more fully those

needs and priorities. An initial problem was found to be a lack of agreement as to the definition and purposes of marine pollution monitoring. Therefore, the following definitions were established:

> Marine Pollution. Marine pollution is a condition brought about directly or indirectly by human activities in the marine environment (including estuarine waters and the Great Lakes) that may result in hazard to human health, harm to living resources and ecosystems, hindrance to fishing and other marine activities, impairment of quality for use of seawater, and reduction of recreational and aesthetic amenities.
>
> Marine Pollution Monitoring. Marine pollution monitoring is the continual systematic, time-series observation of predetermined pollutants or pertinent components of the marine ecosystem over a period sufficient to determine the (1) existing level, (2) trend, and (3) natural variations of measured components in the water column, sediments, or biota.
>
> Purposes for Monitoring Marine Pollution. The basic, overriding purpose for monitoring marine pollution is to obtain time-series data sets that can be used to detect significant changes in the environment, and to use this information to provide timely warning and other advice to management so appropriate actions may be taken.

The key concept of the above definition of purpose for monitoring marine pollution is the determination that monitoring should provide information that is useful to management. Since the publication of the first Federal Plan both the definition of monitoring and its management role have largely been accepted.

The Subcommittee on Monitoring concluded that, to meet the requirements of PL 95-273, it would be necessary to establish a program incorporating all private, local, state, and Federal ocean monitoring activities. Therefore, this program would become more comprehensive than the program addressing federal activities alone which is required by PL 95-273. The proposed National Ocean Pollution Monitoring Program would have the following two goals:

> "Provide information necessary to assess the health of the U.S. coastal ocean and Great Lakes ecosystems on a continuing basis; and

Provide information necessary to ensure present and future protection of human health, and the safe use and wise management of the U.S. coastal marine and Great Lakes resources."

The deficiencies identified by the Subcommittee in its review of the existing monitoring programs were: (1) the present effort is fragmented, and with that goes a presumption that duplications as well as gaps exist; (2) the present effort is reactive rather than anticipatory; (3) the current emphasis is on local problems--a regional focus is lacking; (4) monitoring efforts are independent of each other, with little exchange of information, technology, and data; (5) information is not readily available on all federal and non-federal marine pollution monitoring; (6) monitoring activities are generally site specific or pollutant specific; (7) an overall (national) rationale and strategy for monitoring is often lacking; (8) instrumentation development is lagging behind ocean pollution monitoring needs; and (9) national standards of accuracy are lacking for data-collection and analysis methodology which diminish the usefulness of the data.

The Subcommittee recommended that a National Ocean Pollution Monitoring Program be established with a single Federal agency responsible for its management and providing staff for a management group. They further recommended that an interagency steering group be formed to help establish and implement the National Program, with the following major tasks:

1. Assemble an inventory of private industry, local, state, and Federal programs for ocean pollution monitoring. This would form the basis of a management information system and central data bank for all existing marine pollution monitoring programs and data.

2. Designate coastal regions, and develop and coordinate regional coastal monitoring plans by these regions, including the designation of the responsible lead agency. The regions included are: Great Lakes, northeast Atlantic coast, southeast Atlantic coast, Gulf of Mexico coast, southwest Pacific coast, northwest Pacific coast, and Alaska.

3. Establish regional and national monitoring data banks, and develop mechanisms to convert data into information for management use. Establish guidelines for quality controls in acquisition and analysis technology for monitoring data and develop standardized formats for acquisition and storage of monitoring data.

4. Define regional marine pollution monitoring needs (those that are not already being met by existing programs) and implement new programs of marine pollution monitoring in the critical regions.

5. Implement increased efforts by Federal agencies to advance the technology of monitoring instrumentation (sensor development) and the development of analysis methodology, including standard marine bioassay methods for monitoring programs.

6. Implement the National Ocean Pollution Program in two phases: First, identify all monitoring and coordination functions of existing programs, including data and information distribution and the development of a regional monitoring plan. Second, implement new regional ecosystem monitoring programs that will use all information from existing programs and resources.

The recommendation to establish new regional ecosystem monitoring programs was made by the Subcommittee in response to the perceived inadequacy of current programs to address long-term chronic effects of coastal marine pollution and the lack of regional focus.

The recommendations made by the Subcommittee on Monitoring were substantially adopted by the COPRDM and were incorporated as part of the first Federal Plan. In the intervening period since publication of the first Federal Plan, emphasis has been placed on utilizing the limited available resources to implement recommendations of that Plan other than those related to monitoring. The majority of the recommendations on monitoring in the first Federal Plan have, in consequence, not been further defined or implemented.

II.C. The Planning Process for the Second Federal Plan.

In the summer of 1980, NOAA/NMPPO held five regional meetings to review needs and priorities for ocean pollution research and development, and monitoring for the Second Federal Plan. In each of these workshops strong recommendations were made for improvements in the effectiveness of marine pollution monitoring programs. However, concern was expressed that the needs for improvements in monitoring programs did not receive adequate consideration at these workshops since time was limited, and attendees were drawn primarily from the research and development community.

In response to these concerns, NOAA identified a need to address marine pollution monitoring needs and priorities in a separate series of regional workshops with participants drawn from both technical and managerial communities directly involved with obtaining and using marine pollution monitoring data. These communities are composed predominantly of local government and industry representatives, who had little previous opportunity to participate in the Federal marine pollution planning process. Their involvement in the planning process was felt to be vital in view of the importance of marine pollution monitoring data in the formulation of management decisions. Recommendations for marine pollution monitoring program improvements must be responsive to the needs of managers of all levels in the public and private sectors.

II.D. Marine Pollution Monitoring Workshops, Organization and Purpose.

NOAA, through its Office of Marine Pollution Assessment, convened a series of six regional marine pollution workshops during the period between September 1980 and February 1981. Each workshop was held in a geographical region which coincided with the designated regions of the Environmental Protection Agency (EPA), and was co-sponsored by the EPA region, except for the Great Lakes workshop which was cosponsored by the International Joint Commission.

The schedule of workshops and their geographical coverage were as follows:

Northeast - Stony Brook, New York.
September 10-12, 1980.
Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, Delaware, New Jersey, Maryland and Virginia.
EPA Regions I, II and III.

Southwest - Pasadena, California.
November 18-20, 1980.
California, and Hawaii.
EPA Region IX.

Western Gulf - New Orleans, Louisiana.
December 16-17, 1980.
Texas, Louisiana, Mississippi.
EPA Region VI.

Northwest - Seattle, Washington.
January 6-8, 1981.
Washington, Oregon and Alaska (with representation from British Columbia, Canada).
EPA Region X.

Southeastern - Atlanta, Georgia.
January 27-28, 1981.
North Carolina, South Carolina, Georgia and Florida.
EPA Region IV.

Great Lakes - Ann Arbor, Michigan.
February 11-13, 1981.
Wisconsin, Michigan, Ohio, Pennsylvania, Minnesota and New York, with representation from Canada.
EPA Region V.

Invitations to participate in the workshops were extended to a broad range of individuals and organizations. Emphasis was placed on obtaining participation from organizations actually performing marine pollution monitoring and those responsible for reviewing and using marine monitoring data and the resulting information in the management process. Invitees were selected to achieve a balance

a) among Federal, state, and local government, and industry,

b) between technical experts and managers and

c) among the states within a given region,

and also to include representation by public interest groups. Unfortunately, because of the inability of many invitees to attend the workshops, a balance was not adequately maintained in each workshop. A listing and breakdown of attendees at the individual workshops may be found in Appendix B.

This series of workshops represented the first opportunity for technical experts and managers responsible for generating and using marine pollution monitoring data to be brought together to define the needs and priorities for improvement of the existing marine pollution monitoring programs. Therefore, the workshops, beginning with the Northeast workshop at Stony Brook, N.Y., were intended to address broad objectives concerning the development of guidelines, strategies and approaches for interrelating operational ocean pollution monitoring programs and findings in order to improve overall effectiveness and minimize costs. The workshops aimed to generate

descriptions and assessments of existing monitoring programs and a definition of additional monitoring needs.

It became clear in the earlier workshops that it would not be possible to obtain a comprehensive overview of marine pollution monitoring programs, especially non-federal programs. Because of the proliferation of small local marine pollution monitoring programs, individual workshop participants were most often not fully apprised of the existing programs, even those in their local area.

No comprehensive inventory of monitoring programs exists and, therefore, the list of invitees to the workshops is known to have omitted individuals associated with numerous local programs. In addition, many invitees were unable to attend the workshops. However, for each region it is believed that a representative overview of the existing marine monitoring programs was obtained.

As the workshop series progressed, the objectives were focused more narrowly in two areas as follows:

1. Determine the extent to which existing monitoring programs address local and regional marine pollution problems and information requirements.

2. Assess the requirements for a region-wide marine ecosystem monitoring program, and discuss options of strategy.

In order to achieve these objectives, participants were asked to address a series of questions as follows:

1. What marine pollution monitoring activities are conducted in the region and what is their rationale (environmental problems, geographical area coverage, number of stations, sampling frequency (statistical design), types of data, types of data analyses), their ultimate use, availability, and disposition of data and information?

2. Who are the users of the monitoring information, and how do they use the data?

3. How effectively are monitoring data and information used in decision making (time delay from measurements to action, contributing factors in addition to monitoring data)?

4. What are the resource requirements for the present monitoring programs, and where do the major funds come from?

5. What new monitoring activities (modification of programs, new programs, program coordination, synthesis and information dissemination, change of pollutant emphasis, etc.) are necessary to address local and regional marine pollution problems, needs, and priorities, including those identified at the recent NOAA/NMPPO workshops?

6. Are there needs for ecosystem monitoring on a region-wide scale, and what are they?

7. How can some of the existing monitoring activities be incorporated into a region-wide ecosystem monitoring program, and which are they?

8. What is a reasonable cost-effective way of designing a rational region-wide ecosystem monitoring program?

9. What should be the roles of NOAA, EPA, other Federal, state and local agencies of regional monitoring activities?

10. What are the technology development needs to support effective marine monitoring programs?

The workshops had different formats including a mixture of panel discussions, small study groups, and plenary sessions. However, in each workshop the basic format was for short formal presentations to be made by participants of representative Federal, state, local government, and private industry of marine monitoring programs followed by extended open discussion periods. The National Marine Pollution Plan preparation process and some outlined approaches to establishment of a National Ocean Pollution Monitoring Program, including regionwide ecosystem monitoring, were presented and discussed.

This report summarizes the six regional workshops related to the national marine pollution goals set forth by the Congress in PL 95-273 and other legislation. Each of the regions in which workshops were held has its own spectrum of marine pollution problems and monitoring programs and needs. Appendix C of this report summarizes the findings of each of the six regional workshops and lists the principal conclusions reached. Each regional workshop resulted in a published report which contains details not included in this national overview. Copies of these regional reports may be obtained by writing NOAA/OMPA, 11400 Rockville Pike, Rm 320, Rockville, MD 20852.

III. PROFILE OF MARINE MONITORING PROGRAMS

One of the principal objectives of the marine pollution monitoring workshop series was to identify and describe the current marine pollution monitoring programs active within each region. The original objective was to produce a comprehensive inventory and description of all marine monitoring programs within each region. For reasons stated above, it was not possible to complete a comprehensive inventory. However, the major monitoring programs and many representatives of the large number of smaller marine monitoring programs taking place within each region were identified and described.

Although a complete and detailed inventory of monitoring programs was not obtained, some essential characteristics of marine pollution monitoring programs emerge from information resulting from the regional workshops.

III.A. Hierarchical Nature.

The identified marine monitoring programs are extremely diverse. Monitoring programs can be classified in many different ways by monitoring objective (e.g., food safety assurance, habitat protection, and bathing water quality assurance), by pollutant source (e.g., ocean dumping, outfall monitoring, or hazardous material spill monitoring), by parameters measured (e.g., water quality monitoring, food resources monitoring, dumpsite monitoring, and ecology monitoring). However, all of these classifications are somewhat artificial. Attempts to classify monitoring programs into categories may obscure the importance of the hierarchical nature of existing marine pollution monitoring programs.

The ultimate goal of all marine pollution monitoring programs is to identify and warn against the harmful effects of man's use of the marine environment not only to man himself but also to the marine ecosystem. Each existing monitoring program addresses some limited piece of this goal as its objectives. No single program addresses the ultimate goal in its entirety. Individual monitoring programs have been initiated in response to objectives

whose limits are defined by the jurisdictional boundaries within our society. These jurisdictional boundaries are complex enough to defy adequate description. However, some examples may serve to illustrate the complexity.

Monitoring responsibilities for ocean dumping and ocean outfall discharge are separated at the federal regulatory level. Though the material discharged or disposed may be the same (for example, sewage sludge), different statutes and regulations establish the monitoring requirements, and these requirements themselves differ greatly.

The Food and Drug Administration has responsibility for monitoring shellfish to determine whether or not they are safe for human consumption, while NOAA and EPA have responsibilities for monitoring to ensure the health of the shellfish populations themselves.

Beach water quality monitoring is performed primarily by local government authorities while outfalls which can affect those beaches are monitored by the dischargers themselves in compliance with discharge regulations.

The diversity of marine pollution monitoring programs and their objectives tends to obscure the essentially hierarchical nature of the national effort. For example, local effects of marine pollution are monitored by permit compliance monitoring performed by the discharger. Local but larger-scale pollution is monitored by local and state government programs, and regional pollution is primarily monitored by state and Federal programs. Alternatively, the effects of pollution in a given region may be monitored through a series of individual programs addressing such issues as water quality, seafood quality and safety, fisheries stock changes, benthic biological integrity studies, etc. These individual programs were activated one by one to address specific pollution problems when they were identified. Only collectively do they address the broader questions of management of marine pollution inputs.

As a result of the complex hierarchy of marine pollution monitoring programs, information from many such programs within a given region must be brought together to assess the health of the marine ecosystem, and evaluate the impact

of human activities. Assessments of the health of the marine ecosystem have generally not been succesful. This failure is most often due to the existence of critical gaps in the hierarchy and/or the lack of adequate synthesis of information available from all the existing programs. The hierarchical nature of marine pollution monitoring programs is an important factor that must be recognized in the further development of a comprehensive national marine monitoring program.

III.B. Monitoring Program Objectives.

Most of marine monitoring programs are compliance monitoring programs, conducted in response to regulations or compliance orders. The goal of these programs is to ensure that imminent or immediate harmful impacts of pollution are anticipated and avoided. It should be noted that compliance monitoring is not restricted to monitoring performed by dischargers, but also includes monitoring programs responsive to regulations protecting a particular ocean use, for example, bathing water quality regulations and seafood safety regulations. Such programs are normally performed by government entities at the Federal, state and local levels.

Compliance monitoring most often is performed to demonstrate that particular pollutant concentrations are not exceeded in some portion of the marine ecosystem, for example, marine water quality criteria, shellfish mercury criteria, bathing water quality criteria, and effluent pollutant concentration criteria. However, in recent years statutory and regulatory goals have incorporated more complex standards such as the requirement of the Ocean Dumping Act to prevent "unreasonable degradation" of the marine ecosystem and the Clean Water Act's requirement of maintenance of a "balanced indigenous population". Some implications of this change in the nature of monitoring criteria are discussed further in a later section of this report.

While most marine pollution monitoring programs are compliance monitoring programs, there are many monitoring programs that do not address specific regulatory requirements. Instead they respond to general statutory

requirements to assess the overall health of the marine ecosystem on a continuing basis, and to perform research on the impact of man's activity on the marine environment. Such monitoring programs may generally be categorized as trend monitoring programs and satisfy the need for evaluation of the cumulative and/or long-term impacts of polluting activities and the need to forecast such impacts. Examples of such programs are fisheries stock monitoring and habitat monitoring. Other examples are the few existing ecosystem health monitoring programs such as the NOAA Northeast Monitoring Program, the Southern California Coastal Water Research Project, and the Great Lakes International Surveillance Program.

III.C. Uses of Monitoring Data

Most existing monitoring programs are compliance monitoring programs which seek to ensure that certain standards are not exceeded. Compliance monitoring data are used to satisfy the monitoring agency and the regulator that the standards have not been exceeded. After this primary function has been served, such data are rarely used farther, even though they could be of value for other management decisions. The major reason for this lack of secondary use seems to be that monitoring data are not generally made available to managers in a manner or format usable beyond the primary purpose.

Compliance monitoring programs are generally not designed such that a relationship between the level of pollutant discharge and the environmental effects are established, and there is usually a considerable delay, sometimes months, before data are completed and reported to managers. Therefore, monitoring data are rarely used for day-to-day management of waste inputs. Industrial dischargers argued during the regional workshops that compliance monitoring data had little, if any, value for pollution control management in their plant operations.

Workshop participants reported that the major secondary uses of compliance monitoring data were to generate recommendations for research which could determine the cause of the non-complying data, and on rare occasions to

support enforcement proceedings. However, they reported that, since few compliance monitoring programs result in observation of out-of-compliance data, compliance monitoring data are rarely used even for these purposes.

Compliance monitoring data are used to influence changes in regulations only infrequently. Regional workshop participants felt that, when compliance monitoring resulted in data which always met the regulatory standards, this finding should be used to reduce regulatory monitoring requirements. However, it was felt that this was never done.

Trend monitoring data are used to provide assessments of the impact of polluting activities on the marine environment and, therefore, as an input to the policy process leading to modification or generation of new legislation or regulation. However, trend monitoring data are often not useful because trends identified can rarely be separated from natural variability, and the data fail to adequately demonstrate a cause-and-effect relationship between any trend identified and any one or a combination of polluting activities.

III.D. Organization Performing Monitoring

Marine pollution monitoring is performed by a variety of organizations ranging from small industrial organizations to multinational corporations, from town and county government to Federal agencies. Compliance monitoring is primarily performed by industrial or municipal dischargers or by local and state agencies. Trend monitoring is predominantly performed by the Federal Government and state agencies, although some trend monitoring is carried out by local governments and municipalities in limited areas of the country. Federal, state and local government and industrial monitoring programs are in some instances contracted out to academia.

The large variety of organizational entities performing marine monitoring is an important consideration in designing both marine monitoring programs and the products generated by these programs. While the Federal Government and major industries are able to perform extremely sophisticated marine monitoring

programs using expensive technology and highly trained personnel, the major portion of marine monitoring must be performed by technically unsophisticated personnel who must have inexpensive, simple, and reliable methodologies to follow.

At the user end of the monitoring program, similar considerations apply. Federal and state governments and major industries have managers and support staff who are technically trained and able to assimilate and understand complex information products resulting from marine monitoring. Many local managers have limited technical expertise especially in marine sciences, and have only a limited technical staff. In order to make necessary decisions, these managers require marine monitoring information products which are designed for the non-technical user.

III.E. Monitoring Program Costs

One objective of the regional marine pollution workshop series was to obtain an approximate accounting of the costs of all Federal and non-Federal marine monitoring programs. This objective was not met in these workshops for two reasons: first, because it was not possible to identify all or perhaps even the majority of the ongoing marine monitoring programs throughout the nation (see section III.D above), and second, because, for those marine monitoring programs that were identified, it was impossible to arrive at an estimate of the costs due to different accounting procedures.

In many instances, the organization performing marine monitoring was unable to estimate its program costs since its accounting procedures made no clear distinction between marine monitoring and other monitoring activities, for example, air and stream water quality monitoring. Additionally, in estimating costs, there appears to be no uniformity of procedure whether or not or how certain items should or should not be included in the cost estimates. Such items include monitoring personnel salaries, data processing and archival costs, vessel costs (particularly where vessel time was obtained "free" by the monitoring agency on another organization's research or other cruise), end of the pipe monitoring, and capital costs of laboratory and other equipment.

Further complicating the estimation of marine monitoring program costs is the lack of a clear-cut division between marine research and marine monitoring. Many marine observation programs are a combination of research and monitoring, and proportional assignment of costs is a difficult task.

These limitations will have to be overcome before costs of marine monitoring programs can be identified.

IV. IDENTIFIED NEEDS AND DEFICIENCIES IN NATIONAL MARINE MONITORING EFFORTS.

In each regional workshop, participants were asked to provide information concerning the deficiencies of the marine monitoring efforts in their region and to address the needs created by these deficiencies. In each workshop, a number of deficiencies and needs were identified. These ranged widely in their degree of specificity to the region, to individual programs, or to individual discharge assessments. However, many of the identified deficiencies were common to all or several regional workshops, and probably represent deficiencies which are common to monitoring activities in all the regions. In this national report, the regional workshop results are synthesized and summarized to present an overview of the general deficiencies which were consistently identified among the regional workshops. The general deficiencies identified fall under each of the several categories which compose the essential elements of the national marine pollution monitoring effort. These are A) coordination, B) data, information and quality assurance, C) synthesis, D) program evaluation, E) compliance monitoring, F) ecosystem research G) trend assessment monitoring, and H) technology support. In this chapter, the general deficiencies are described under these categories.

It should be emphasized that no attempt was made at the regional workshops to assign priorities to the identified needs. However, since the deficiencies and needs identified in this chapter represent those that were most consistently identified among the regional workshops, they should be considered as the highest priority items at the national level, and in the further development of the "comprehensive, coordinated and effective ocean pollution ... monitoring program" mandated by PL 95-273.

The existing marine monitoring effort comprises a multitude of individual programmatic efforts and serves many different user groups. Deficiencies and needs identified by the regional workshops compromise optimum utilization of

the results of these programmatic efforts in supporting attainment of local regional and national management goals. However, the majority of the component programs of the national marine monitoring effort are effective in fulfilling the limited primary management goals to which they are addressed. A national marine pollution program, if and when it is established, should not replace or subsume existing programs. It should combine information resulting from existing programs, foster improvement of these programs, and initiate new programs only when necessary to fill critical information gaps.

IV.A. Coordination.

The most critical deficiency in marine monitoring programs is the lack of coordination among the many individual programs, large and small. This was consistently identified thoughout all regional workshops as a serious factor limiting effectiveness of marine monitoring programs in addressing management goals.

In each region there is a lack of an effective planning mechanism or process by which the requirements and findings of the various individual marine monitoring programs can be coordinated to minimize overlap of efforts and ensure maximum utilization of the information gained. In some regions, coordination among some programs is more effective than in others. Better coordination is related to the existence of, and substantially takes place through, the operation of large scale regional environmental studies where these exist. Examples of such programs are the NOAA New York Bight Program, the Southern California Coastal Water Research Project, and the Great Lakes International Surveillance Program. However, even in regions where these programs exist, coordination is still poor, particularly between major Federal efforts and local compliance monitoring programs.

The most critical deficiency in coordination of the national marine monitoring effort is the lack of a focal point to which marine monitorers and managers can refer for information concerning other completed, ongoing, or planned marine monitoring programs which may be relevant to their own needs. When seeking such information, local marine pollution managers often find they must

contact many individual Federal and state agencies, each of which can provide information only about activities in its own limited sphere of jurisdiction and responsibilities. No Federal, state or local agency currently provides the necessary regional focal point.

Coordination is somewhat better in those regions where major regional environmental study programs exist. These programs generally are well known to local managers. They have central staffs willing to provide advice based on their sophisticated knowledge of available information and of current research and monitoring programs within their study region. Nevertheless, these regional environmental programs are not designed or funded to fulfill all the coordination needs in the region.

Based upon the opinions expressed at the regional workshops, the following critical need for better coordination was identified:

> AN APPROPRIATE MECHANISM SHOULD BE ESTABLISHED TO ENSURE THAT EFFECTIVE COORDINATION OF MARINE POLLUTION MONITORING PROGRAMS TAKES PLACE WITHIN EACH REGION AND AMONG THE VARIOUS REGIONS.

Various options exist for the structure of this coordination mechanism, but the essential characteristics are 1) that a central source of information concerning marine pollution programs be created in each region, and 2) that this source should be readily accessible to interested Federal, state, local, or private organizations, particularly those with little knowledge of marine pollution research and monitoring.

In order to facilitate communication, the coordinating body or mechanism must be able to make available to users relevant information concerning all marine monitoring programs. These should include but not be limited to marine pollution monitoring programs that may overlap with or be relevant to the users' activities. The lack of knowledge of other monitoring programs taking place within any given region, and the difficulty of obtaining this information, was frequently cited by participants in the regional marine pollution monitoring workshops as a constraint on effective conduct of their own programs.

Therefore, the need was identified that:

> INFORMATION SHOULD BE MADE AVAILABLE CONCERNING THE ESSENTIAL CHARACTERISTICS OF ALL MARINE MONITORING PROGRAMS. INFORMATION SHOULD BE TARGETED PRIMARILY AT LOCAL, STATE, AND INDUSTRIAL INTERESTS WHO NEED TO EFFECTIVELY ASSESS THE AVAILABILITY OF EXISTING DATA AND INFORMATION, AND THE NEED FOR ADDITIONAL MONITORING DATA AND/OR INFORMATION TO ADDRESS THEIR SPECIFIC LOCAL PROBLEMS.

The establishment of an inventory of monitoring programs could serve some of the needs identified. However, such an inventory must be maintained current and complete, and information from the inventory must be readily accessible by, and actively disseminated to, user groups. In the past, computerized inventories of monitoring programs have not succeeded because they have not been maintained current and have not been readily accessible to potential users.

The existence of a mechanism through which communication among interested parties at all levels of Federal, state, and local government, and private industry can take place is one of the most critical aspects of the needed coordination. Effective coordination requires that several other elements, including the coordination of data and information dissemination, be addressed. These other elements are described in Section IV.B thru G.

Throughout the regional marine pollution monitoring workshops, there was a strong expression that the national interest would be best served through a regional focus with regard to coordination and other aspects of marine pollution monitoring program planning. Therefore, it was concluded that:

> MARINE POLLUTION MONITORING PLANNING AND COORDINATION SHOULD BE ACHIEVED PRIMARILY ON A REGIONAL BASIS SINCE THE CHARACTERISTICS OF MARINE ECOSYSTEMS AND THE POLLUTION PROBLEMS AFFECTING OR POTENTIALLY AFFECTING THEM DIFFER WIDELY FROM REGION TO REGION. MONITORING PROGRAM DESIGN SHOULD TAKE INTO ACCOUNT CONSIDERATIONS OF THE NATURE OF LOCAL AND

REGIONAL ECOLOGY AND POLLUTION INPUTS AND OTHER IMPACTING ACTIVITIES.

IV.B. Data, Information and Quality Assurance

In each regional workshop participants stated that it was difficult to obtain data in useful forms from other monitoring programs, and that information concerning the quality assurance of data is, in most instances, not available. Additionally, both managers and technical participants in the workshops identified the need for a wide range of information products based on existing data and information concerning marine pollution. The needed information products range from popular scientific press style summaries and overviews of existing marine pollution problems, strategies for monitoring, and options for management, to detailed technical reports of monitoring programs.

The deficiencies in the national marine pollution monitoring effort in the areas of data, information, and quality assurance either are to a large degree caused by, or are considerably exacerbated by, the lack of coordination described above. Therefore, the workshop conclusions listed under this subsection are complementary with the conclusion that there is a need to establish a coordination mechanism (Section IV.A.). Data acquisition and dissemination, information dissemination, and assurance of data quality should be performed by, or in close association with, the organizational entity established to ensure program coordination.

Although some users had not experienced problems with accessing historical marine pollution data from existing electronic data bases such as maintained by the Environmental Protection Agency (STORET), or NOAA's National Oceanographic Data Center, many other users had found difficulty with use of these data bases. Difficulties cited included the incomplete program coverage of the data bases, the lack of timely updating, and the lack of adequate quality assurance information. Transcending these, however, was the difficulty experienced by non-sophisticated user groups in determining what data are available and obtaining useful reduced data products as opposed to raw data compilations. It was concluded that:

ACQUISITION, STORAGE, AND DISSEMINATION OF MARINE POLLUTION MONITORING DATA SHOULD BE IMPROVED. ACCESS TO DATA BASES SHOULD BE SIMPLIFIED, AND MECHANISMS ESTABLISHED WHICH WOULD ACTIVELY PRODUCE AWARENESS OF THE DATA THAT ARE AVAILABLE AND FACILITATE ACCESS TO THE DATA BY USERS, PARTICULARLY OCCASIONAL USERS UNSKILLED IN MARINE POLLUTION DATA ACQUISITION.

Some of the regional workshop participants who were familiar with data systems felt strongly that new data bases would not be needed, and that instead efforts should be focused on improving communicability among the existing data bases and remote access. Communicability between electronic and hard copy data sets would be simplified considerably if greater uniformity or standardization of data reporting formats was achieved. There is also a need to ensure that units for concentration and other measurements are consistent or readily convertible.

The need to provide quality assurance information together with archived data and reduced data products was consistently identified in the regional workshops. However, the degree to which such information has any impact on management decisions was seriously questioned. For most management decisions, high precision data does not appear to be necessary. However, there is a critical need for information on the accuracy of data, particularly where data from a number of different programs are to be combined. In light of these considerations, the following was concluded:

ASSURANCE SHOULD BE ACHIEVED OF THE QUALITY OF MONITORING DATA SUCH THAT DATA FROM ALL MONITORING PROGRAMS CAN BE COMPARED. THE MOST CRITICAL NEEDS ARE FOR PUBLICATION OF A COMPILATION OF APPROVED METHODS AND STANDARD REFERENCE METHODS, FOR THE INCLUSION OF QUALITY ASSURANCE INFORMATION IN MARINE POLLUTION DATA BASES AND FOR STANDARDIZATION OF MEASUREMENT UNITS USED FOR DATA REPORTING.

A quality assurance program is needed. However, this program must be flexible. The use of approved methods and standard reference methods and

intercalibration exercises is preferred to the establishment of standard methods. Methodology and measurement technology are changing rapidly in marine pollution analysis and the range of sophistication of entities performing monitoring is wide. It is important that reliable methods using simple inexpensive equipment be developed in addition to those that rely on expensive and sophisticated instrumentation, and that results obtained with simple and sophisticated methods be intercomparable.

Although the availability of both raw and reduced data was seen by regional workshop participants as important to the national marine monitoring effort, they saw an even greater importance for the availability of information products based on these data that would be useful to marine pollution managers both in designing their monitoring program and in making management decisions. Adequate information products are currently not available. The need is particularly strong for those products that would be useful to managers not having sophisticated marine sciences support staff.
It was concluded that:

> INFORMATION GAINED FROM ASSESSMENT OF MARINE MONITORING DATA SHOULD BE MADE AVAILABLE TO MANAGERS IN A FORM SUITABLE FOR USE IN MAKING DECISIONS. A HIERARCHY OF INFORMATION PRODUCTS IS NEEDED TO SATISFY THE NEEDS OF THE RANGE OF USERS TO BE SERVED, BECAUSE OF THE WIDE VARIATION IN THE DEGREE OF COMPLEXITY OF MARINE POLLUTION PROBLEMS AND IN THE TECHNICAL EXPERTISE AVAILABLE TO THESE DECISION MAKERS.

In order to produce adequate information products, data resulting from marine pollution and the monitoring and research programs must be synthesized and interpreted on a continuing basis. Such synthesis is not currently performed adequately. Synthesis is of such fundamental importance that it will be addressed separately in a subsequent section of this report.

Among the information products that are currently available and would be valuable to marine pollution monitoring program participants are the large number of technical reports generated by marine monitoring programs. However,

this body of literature is not easily accessed since much of it is not cited in computerized bibliographic data bases. It was concluded that:

> ACCESS SHOULD BE IMPROVED TO INFORMATION CONTAINED IN THOSE IN-HOUSE MONITORING PUBLICATIONS AND REPORTS WHICH ARE NOT WIDELY DISSEMINATED.

Several options for achieving this improvement exist. However, workshop participants favored the creation of regional library centers which would actively disseminate information on the contents and acquisitions of the library.

IV.C. Synthesis

The body of historical data which is relevant to marine pollution problems is very large, continues to grow rapidly and, as we have stated above, is poorly coordinated. As discussed in sections IV.A and IV.B, there is a need to improve the coordination and accessibility of these data, and to improve the dissemination of information generated from them. Between the data retrieval and information dissemination steps discussed above, the critical step of synthesis must be performed. The synthesis step consists of interpretation of the available data and information to address a specific identified problem in marine pollution. The range of synthesis requirements can be very large since the specific problem addressed can be narrow, such as determining the effect of a single discharge pipe or dredging project, or broad, such as determining the effect of increased coal burning on ocean water chemistry.

While syntheses addressing major national marine pollution issues are routinely performed by federal agencies with programmatic responsibilities in the area of interest, no adequate mechanism exists for them to be performed concerning local and individual marine pollution problems. Throughout each of the regional workshops, state and local managers consistently remarked on the lack of synthesis products which were useful in their decision making process. The lack of such products was identified as a critical problem which is

compounded by the difficulty of obtaining suitable synthesis studies from commercial sources. Many local, industrial, and even state program managers stated that they neither have staffs with ability and expertise to perform adequate synthesis studies, nor have the knowledge of where such efforts can be obtained. Where managers knew of commercial sources they were not confident of their ability to ensure reliability of the acquired synthesis efforts.

In the absence of adequate syntheses at all levels of marine pollution problem solving, many marine pollution management decisions are based on insufficient information. There is a critical need to ensure that synthesis at all levels of problem specificity is adequately performed on a continuing basis. This need may be expressed as follows:

> EXISTING AND NEW MARINE POLLUTION MONITORING DATA NEED TO BE ANALYZED AND ASSESSED ON A CONTINUING BASIS FOR THEIR APPLICATION TO CURRENT AND PROJECTED MARINE POLLUTION PROBLEMS. MECHANISMS ARE NEEDED THROUGH WHICH SUCH EVALUATION IS PERFORMED ON A CONTINUING BASIS WITH RESPECT TO BROAD REGIONAL PROBLEMS. MECHANISMS ARE ALSO NEEDED SUCH THAT EVALUATIONS CAN BE PERFORMED, WHEN NEEDED, CONCERNING INDIVIDUAL MARINE POLLUTION PROBLEMS, ESPECIALLY THOSE PROBLEMS OF A LOCAL NATURE WHERE THE MANAGEMENT GROUP REQUIRING SUCH EVALUATION HAS LIMITED TECHNICAL EXPERTISE.

Such synthesis products would serve as the basis for many of the products required to fulfill the information needs addressed above (section IV.B).

IV.D. Program Evaluation

Many regional workshops participants felt that marine pollution monitoring program design was inadequate, in part because little account was taken of previous experience in the effectiveness of various program designs. They cited a belief that no adequate study has been made to determine the

effectiveness of various marine pollution monitoring program designs and strategies in addressing management needs. Therefore, there is a need that:

> ALL TYPES OF POLLUTION MONITORING PROGRAMS SHOULD BE CRITICALLY ASSESSED ON A CONTINUING BASIS TO ESTABLISH THEIR EFFECTIVENESS IN MEETING STATED OBJECTIVES. THE RESULTS OF THESE ASSESSMENTS SHOULD BE USED TO REDESIGN EXISTING AND FUTURE MONITORING PROGRAMS.

The need to determine effectiveness and incorporate the resulting information in program design is particularly great for compliance monitoring programs.

IV.E. Compliance Monitoring

Most marine monitoring occurring in the United States takes place in compliance with the requirements of a variety of Federal, state and local laws, regulations, and ordinances. Despite their potential value to other users, compliance monitoring data are rarely used beyond the initial purpose for which they were obtained, that is satisfaction of the revelant regulatory criteria. This problem could be alleviated if data and information storage and retrieval, and synthesis capability improvements are made as discussed above (Sections IV.B. and IV.C.).

Regional workshop participants, especially municipal and industrial representatives, voiced much dissatisfaction with the value of compliance monitoring in meeting management objectives and/or specific regulatory requirements. They expressed a strong belief that compliance monitoring programs often require that measurements which have no value be made, or that certain parameters be measured at a higher frequency than justifiable.

The following need was identified:

> COMPLIANCE MONITORING REQUIREMENTS SHOULD BE CONTINUOUSLY REVIEWED AND REDUCED TO THE MINIMUM NECESSARY TO SATISFY MANAGEMENT OBJECTIVES.

The nature of the regulatory requirements critically affects the degree to which monitoring data are perceived as satisfying these requirements, and thus the management objectives. Fundamentally different monitoring program strategies and designs are required to adequately address different forms of compliance monitoring requirements.

Compliance monitoring requirements, for the most part, consist of numerical limitations on pollutant concentration in the discharge or in the ecosystem. Examples are the suspended particulate and biochemical oxygen demand limitations on secondary treated effluents from sewage treatment plants, and the mercury limitation in fish and shellfish for human consumption.

If the concentration of the parameter regulated exceeds the numerical limit, then non-compliance with the criteria is established. However, interpretation of data indicating failure of the criteria in many instances may not be simple. Some numerical standards are established at levels that may not be exceeded at any time without endangering human health or the environment. Others are established at levels that may be exceeded safely for short periods of time but which cannot be safely exceeded over longer periods. However, once it has been decided whether or not the numerical criteria have been violated, monitoring data of this type have totally fulfilled the intended purpose. This fact is often not recognized by monitorers who believe that since out-of-compliance data never show up in their programs, such programs are useless.

Other compliance monitoring requires that concentrations of pollutants be determined in the effluent stream and/or the ecosystem, even though no specific numerical limitation is applicable to the pollutant concentration in the discharge. These determinations are required to ensure that certain pollutants, known to have caused adverse impacts elsewhere in the environment, do not appear in the discharged material in higher concentration than normally present, and so constitute a possible environmental hazard.

Since there is no numerical standard to pass or exceed, interpretation of the results of monitoring programs addressing such standards is not simple. In most instances, unless the data show marked increases in concentration

compared to previous time periods, the data are simply not used. This simple treatment of such data is inadequate, since this form of monitoring has the potential to address whether or not long-term inputs of some pollutant will accumulate to a point at which the assimilative capacity of the ecosystem (including man) is exceeded.

Still other compliance monitoring responds to an ecological requirement. This much more complex requirement is responsive to an ecologically based legislative or regulatory standard, such as the requirement of the Ocean Dumping Act that "unreasonable degradation" of the environment must be avoided, or the Clean Water Act which requires maintenance of a "balanced indigenous population".

The basic rationale for an ecological standard is that marine environments into which pollutants are discharged should be protected from changes which reduce their value to man by an amount greater than the benefit to man of using the ocean for waste disposal. The value comparisons on which such a standard is based include human health risk, and social, aesthetic, and economic values of alternative ocean and land based alternatives. In some instances, such as the Ocean Dumping Act, the statute and regulations require that this comparative benefit/risk/cost analysis is performed as part of the permit process itself. In other instances, such as section 301h of the Clean Water Act, these comparisons are not performed as part of the permit process, but in essence are embodied in the legislative process leading to the establishment of the criteria requiring maintenance of a "balanced indigenous population" in the discharge ecosystem.

Ecological requirements exist in Federal, state, and local environmental legislation and regulations, and vary greatly as to whether the value comparison process is specifically incorporated in the permit process or only considered in the establishment of the statutory or regulatory criteria. Where the value comparison process is not incorporated in the permit process, implementation of regulations and monitoring of compliance would seem to be simpler, since the comparison process, which always must be performed with incomplete information and which must involve some subjective judgement, is avoided. However, workshop participants identified problems of similar

dimensions with implementation of the simpler type of ecological standard. These problems include the inflexibility of regulations which do not take into account differences in the ability of different ocean, land, and air ecosystems to safely accommodate wastes.

In order to properly address the ecological regulatory standard through monitoring, it is necessary not only to observe and quantify ecological changes taking place in the marine ecosystem where pollutants are discharged, but also to determine whether or not such changes were induced by natural events. Our understanding of natural changes in ocean ecosystems is generally very poor. Therefore, this task is often impossible. Because of the large expense and difficulty of conducting biological surveys, most, if not all, monitoring programs are severely restricted as to the number of locations within the discharge ecosystem that are studied and the number of replicate samples taken for analysis. The result is invariably that, although a large amount of data is gathered, these data are inadequate to describe with statistical validity any ecological changes that do occur, and totally inadequate to separate any pollution-induced changes from natural change. Workshop participants who were familiar with the interpretation of data resulting from this type of monitoring uniformly expressed their experience that the information gained from their monitoring program was in most instances inadequate to provide statistically valid and technically sound conclusions that ecological change had or had not been caused by the monitored activity. In many instances the variability of the data obtained are such that no trends of any kind can be discerned, particularly where the monitoring frequency is low (several times per year) and the monitoring has only been performed for a small number of years.

If ecological compliance monitoring requirements are to continue to be used, then major reassessment and modification of current monitoring strategies will be needed in order that such monitoring programs can be effective. Two major options for modifying monitoring program strategy were discussed at regional workshops. First, the monitoring programs could be greatly expanded in geographical and temporal coverage, and number of replicate samples. Alternatively, such programs could be simplified by designing them to identify only major ecological changes that take place. Many workshop participants

felt that the first option is probably prohibitively expensive and likely beyond the boundaries of our current ability to understand marine ecology, while the second option is not adequately studied and defined to establish its potential usefulness.

Suitable studies need to be made of the effectiveness of monitoring strategies in addressing ecological requirements. Such studies form part of the program evaluation needs expressed in section IV.C above. If it is determined that these ecological requirements cannot be adequately addressed through monitoring because of limitations in our ability to understand ecosystem structure and function, or because to do so would require prohibitively expensive monitoring programs, then the requirements should be changed.

The following needs for improvement of compliance monitoring were identified:

> A STUDY SHOULD BE MADE OF THE MONITORING STRATEGIES THAT CAN IMPROVE THE EFFICIENCY AND EFFECTIVENESS OF COMPLIANCE MONITORING, PARTICULARLY THAT COMPLIANCE MONITORING WHICH TAKES PLACE IN RESPONSE TO LEGISLATIVE AND REGULATORY REQUIREMENTS WHICH LIMIT THE EXTENT OF ECOLOGICAL CHANGE OCCURRING IN THE AFFECTED ECOSYSTEM. WHERE IT IS FOUND THAT STATE-OF-THE-ART ABILITY TO UNDERSTAND ECOSYSTEM STATUS, FUNCTION, AND CHANGE IS INADEQUATE TO ADDRESS STATUTORY AND REGULATORY STANDARDS, OR WHERE THE COSTS OF DOING SO ARE PROHIBITIVE, THE REGULATORY AND/OR STATUTORY STANDARDS SHOULD BE CHANGED.

IV.F. Ecosystem Research

Workshop participants in all regions strongly expressed the need for additional research on marine pollution problems affecting their region. There was a consensus in each workshop that, for monitoring to be an effective management tool, this additional research is needed on a continuing basis to aid interpretation of monitoring information. Continued research is also needed to enable identification of new problems to be monitored and development of more efficient and effective strategies for monitoring current problems.

Participants in several of the regional workshops, particularly the Southeastern and Western Gulf workshops, expressed concern that, at the present time, the sources and effects of pollution, and marine ecosystem structure and function are not understood sufficiently to permit design and development of adequate monitoring programs. In these regions, a major need was identified that the necessary research efforts be performed to improve ecosystem understanding and knowledge of pollutant sources and effects before instituting monitoring efforts to assess regionwide pollution impacts, particularly long-term impacts.

In the Great Lakes, Northeast and Southwest participants generally felt that the base of research information was at least adequate to begin the planning and implementation of regionwide coordinated marine monitoring programs. In each of these regions there has been, during the last decade, a multi-year, multi-disciplinary regionwide (or partial regionwide) ecosystem research program addressing the effects of marine pollution. These programs are the Southern California Coastal Water Research Project in the Southwest; the NOAA Marine Ecosystem Analysis Program, New York Bight Project (followed by the NOAA Northeast Monitoring Program) in the Northeast; and the research activities taking place under the auspices of the American/Canadian International Joint Commission in the Great Lakes.

Workshop participants in all regions felt that regionwide ecosystem research programs were a necessary precursor to, and continuing component of, effective regionwide monitoring efforts. It was felt that sufficient experience with this type of research program has been gained to demonstrate both the precursor need and the value of continuing ecosystem research efforts in parallel with monitoring efforts.

> REGIONWIDE MULTI-DISCIPLINARY ECOSYSTEM RESEARCH PROGRAMS ARE NEEDED IN POLLUTION IMPACTED COASTAL REGIONS WHERE NO SUCH EFFORTS HAVE PREVIOUSLY TAKEN PLACE. IN REGIONS WHERE MULTI-DISCIPLINARY REGIONWIDE ECOSYSTEM RESEARCH PROGRAMS HAVE BEEN PERFORMED IN RECENT YEARS OR ARE CURRENTLY UNDERWAY, THESE EFFORTS NEED TO CONTINUE AT AN APPROPRIATE LEVEL TO IDENTIFY AND RESEARCH NEW AND EMERGING POLLUTION PROBLEMS THAT

SHOULD BE MONITORED, TO AID INTERPRETATION OF INFORMATION GAINED FROM MONITORING, AND TO AID DEVELOPMENT OF MORE EFFICIENT AND EFFECTIVE MONITORING STRATEGIES AND TECHNIQUES.

IV.G. Trend Assessment Monitoring

Each regional workshop addressed itself in detail to the possible approaches toward a national marine monitoring program and the recommendations of attendees about possible implementation strategies. Several approaches were discussed including three working papers by Swanson/O'Connor, Segar, and Bascom which are reproduced or summarized in the regional reports. Each of the working papers agreed that a national monitoring program should rely on the existing and future compliance monitoring programs as a major data source. However, the working papers and workshop participants had several different concepts of the additional marine monitoring that would be necessary. Despite this disagreement they did agree that major improvements and/or additions were needed in marine trend assessment monitoring. This section summarizes those findings and the basic concepts that underlie the alternative approaches discussed at the workshops.

Workshop participants agreed that, while compliance monitoring should fulfill the need to warn against imminent harmful impacts of marine pollution, there is also a need to provide long-term evaluation and forecast of impacts. This need should be fulfilled by trend assessment monitoring.

Trend assessment monitoring programs are currently performed by many agencies at state, local and federal levels and to a lesser extent by academic and private industry. The "trend" that is monitored under the various programs can be variations in pollutant concentration in the ecosystem, variations in the marine ecology or variations in other environmental parameters in the marine environment. A large proportion of the marine trend assessment monitoring relevant to marine pollution is not performed directly in response to marine pollution problems but in response to other marine resource concerns such as fisheries management, seafood safety, mapping and navigation, channel maintenance, and ocean/atmosphere linkage as it affects weather and climate.

Because existing trend assessment monitoring programs are structured to address a variety of concerns other than marine pollution as well as a variety of marine pollution issues, the results of these programs are not integrated effectively into overall marine pollution management considerations. Since the trend assessment programs are somewhat fragmented there may be significant gaps and overlaps which limit the effectiveness of the overall effort. This problem is addressed in section IV.G (see below).

IV.G.1. Pollutant Concentration Trend Monitoring

Pollutant concentration trend monitoring programs determine whether or not pollutants introduced to the marine ecosystem are accumulating.

In the design of pollutant concentration trend monitoring surveys, a trade-off must be made between taking sufficient samples from enough locations to obtain reliable average pollution concentration values from which to discern a trend, and keeping the cost of the monitoring within reasonable economic bounds and within the capacity of available analysis capability and expertise. An important factor in this trade-off is the cost and capability limitations for analysis of the very low concentrations of toxic compounds in environmental samples.

As a result of budgetary restraints, overambitious or unclear objectives, and compromise in the sampling design, many pollutant concentration trend programs are unsuccessful in achieving the desired goals. The data obtained are usually highly variable and trends can only be identified reliably when they are large compared to this variability. Therefore, such programs are not useful in determining the quality of the marine environment and forecasting changes or pollutant accumulations before such have reached serious or catastrophic proportions.

The significant problems encountered with pollutant concentration trend assessment monitoring were discussed in detail at the regional workshops. Some participants felt that every effort should be made to increase our capability to sample and analyze marine samples for pollutant concentrations and to enlarge current programs until they become effective. However, there

was considerable discussion of the possibility of establishing different approaches. Two possible approaches were discussed: first, to rely on input pollutant concentration monitoring alone; and, second, to use the sentinel organism approach.

Current marine pollution monitoring philosophy dictates that first we should observe a change in the environmental concentration of a pollutant and then rely upon research to establish its cause. The alternate philosophy would be to monitor all inputs of pollutants to the marine environment, and, based on knowledge of the changes in these inputs and on a detailed knowledge of the behavior and fate of the pollutants in the marine environment, predict what the changes in environmental concentrations will be. In order to do this, we would need to have better knowledge than presently available of the behavior and fate in the marine environment.

As either an alternative to the stategy of relying more heavily on input monitoring or perhaps as an interim measure until this strategy can be implemented, the use of sentinel organisms has been proposed. This approach relies on periodic pollutant analysis of samples of a single species, or of a small number of different species from selected coastal locations.

A number of research questions must be answered before the sentinel organism approach can be fully implemented. These research areas include determination of the degree to which concentration of a pollutant in a single species is representative of the environment at and near any given sampling location. For example, factors that must be considered include genetic changes in a population or differences between populations which affect the ability of individual organisms to control their body burdens of some contaminants, and the degree to which food source changes or differences can affect organism tissue concentrations of toxic metals or organics.

The sentinel organism approach, if it can be proven by adequate research, would offer substantial cost savings over broad environmental pollutant trend monitoring. However, it does not at present appear to be adequately developed for large-scale routine application.

With regard to marine pollutant concentration trend monitoring, the following needs were identified:

> ALTERNATIVE STRATEGIES FOR MONITORING THE TREND OF MARINE POLLUTANT CONCENTRATION SHOULD BE STUDIED. THE PURPOSE OF THESE STUDIES SHOULD BE TO DETERMINE THE MOST EFFICIENT AND EFFECTIVE STRATEGY TO MEET THE GOAL OF PROVIDING SUFFICIENT INFORMATION TO DETERMINE THE CONCENTRATIONS OF POLLUTANTS IN CRITICAL COMPONENTS OF THE ECOSYSTEM, EITHER DIRECTLY OR BY MODELING. IN DETERMINING THE MOST EFFICIENT AND EFFECTIVE STRATEGY, ACCOUNT SHOULD BE TAKEN OF THE LIMITATIONS OF COST AND AVAILABLE TECHNICAL RESOURCES WHICH MAY RENDER SOME STRATEGIES IMPOSSIBLE, OR LESS DESIRABLE THAN STRATEGIES WHICH LEAD TO EQUIVALENT SCIENTIFIC CERTAINTY OF RESULT.

More specifically with regard to the sentinel organism approach:

> THE SENTINEL ORGANISM APPROACH TO MARINE POLLUTION CONCENTRATION TREND MONITORING SHOULD BE THOROUGHLY RESEARCHED. IT SHOULD BE INTRODUCED TO ROUTINE APPLICATION ONLY IF AND WHEN SUFFICIENTLY DEVELOPED, AND IF NO MORE EFFICIENT AND EFFECTIVE STRATEGY IS PRACTICABLE.

IV.G.2. Marine Ecological Trend Monitoring

Monitoring of the status of marine ecology takes place through many monitoring programs in which continuing series of surveys are made of the abundance and/or diversity of species and/or the health of certain species. The purpose of such monitoring is to determine whether or not changes are taking place in the population structure.

Changes in population structure may be caused by the natural variability of the ocean environment, by naturally occuring diseases, or by man's activities, including overfishing or harvesting and pollution. While many ecological trend monitoring programs take place in conjunction with or are closely associated with marine pollution studies, many such programs take place in

response to other management objectives such as fisheries management. Workshop participants reported difficulties in obtaining and using information available from those ecological trend monitoring programs which have no direct relationship with pollution studies and expressed the following need:

> DATA AND INFORMATION FROM ALL MARINE ECOLOGICAL TREND MONITORING PROGRAMS, INCLUDING THOSE TAKING PLACE IN RESPONSE TO MANAGEMENT NEEDS OTHER THAN MARINE POLLUTION, SHOULD BE REVIEWED ON A CONTINUING BASIS. INFORMATION CONCERNING OBSERVED TRENDS SHOULD BE MADE AVAILABLE FOR USE IN MARINE POLLUTION MANAGEMENT, AND IN THE DESIGN OF MARINE POLLUTION MONITORING AND RESEARCH PROGRAMS.

It was generally agreed by workshop participants that the spectrum of ecological trend monitoring programs which take place in response to concerns other than marine pollution may be adequate to fulfill marine pollution program needs. However, the existing ecological trend monitoring programs need not only to be continued, but also to be refined and improved, and their data and information better used. One particular improvement that is needed is the better use of commercial and recreational fishing activities to gather ecological trend data.

> THERE IS A NEED TO MAKE BETTER USE OF RECREATIONAL AND COMMERCIAL FISHING ACTIVITIES TO GATHER DATA CONCERNING THE TRENDS IN MARINE POPULATIONS.

While most ecological trend monitoring programs address the abundance and diversity of species in the marine ecosystem, a number of programs have addressed the health of the species present in the ecosystem. Most such studies have been conducted by examining fish or other organisms for lesions, tumors, etc. The results of these programs with a few exceptions have been ambiguous and difficult to interpret since the incidence of lesions, tumors, etc. is small and highly variable, and statistically valid data concerning trends are very difficult and expensive to obtain.

Recently, a series of new techniques have been investigated for determining the health of marine organisms. These techniques are based on the measurement of specific biochemicals or biochemical functions of the organism which are known to change in response to stress. If they can be perfected, such measurements would provide the capability to monitor the effects of pollution on organisms in the marine ecosystem directly, and without the need to wait until these effects have induced measurable population changes. Substantial additional research on these new techniques needs to be completed before this capability can be used reliably on a routine basis. For example, biochemical responses must be found that are generic to a single pollutant or group of pollutants and it must be demonstrated that the responses are unaffected by other stress factors. The effects of genetics and adaptability of the biochemical response to a long-term low-level stress also must be properly characterized. Therefore, the following need was identified:

> BIOCHEMICAL INDICATORS OF POLLUTANT STRESS IN MARINE ORGANISMS SHOULD BE INTENSIVELY RESEARCHED. WHEN AND IF TECHNIQUES BASED ON THE USE OF SUCH INDICATORS ARE THOROUGHLY TESTED AND PROVEN, THEY SHOULD BE INTRODUCED TO MARINE MONITORING PROGRAMS TO REPLACE OR REDUCE, WHERE POSSIBLE, POPULATION AND DIVERSITY MONITORING.

IV.G.3. Environmental Trend Monitoring.

Most major changes in the marine ecosystem are driven by changes in the natural environment which take place in association with, or as a result of, variations in weather and climate. Ocean water mass movements, which are controlled by climatic variations, affect the physical and chemical parameters which control the growth of primary producers. These primary producers in turn affect higher levels of the food chain. The time scales on which such changes occur and cause major ecological impacts are season to season and over periods of years.

The concern was expressed at the regional workshops that the results of marine monitoring programs aimed at identifying pollution-induced ecological changes cannot be interpreted because natural ecological changes induced by natural

environmental variability are not well understood or monitored. Only in limited instances, and then almost always in the immediate vicinity of a pollutant input, has it been possible to conclude, with acceptable certainty from available scientific evidence, that an observed adverse change in marine ecosystem structure was, or was not, natural, or was, or was not, pollution induced. As a result, even though many instances of adverse ecological change have been observed that appear to parallel changes in contaminant inputs, it has rarely been possible to demonstrate a cause and effect relationship with the contaminant inputs, particularly where the ecological changes take place throughout a large area of ocean.

Since our current monitoring programs fail in most instances to enable distinction to be made between natural variability and pollutant-induced changes, improvements must be made in marine monitoring programs if we wish to ensure that those ecological changes which do occur are not induced by pollution.

Natural marine ecological change is induced primarily by changes in water mass characteristics and movements. Therefore, if our knowledge of the relationships between water mass characteristics and ecological change were adequate we could simply measure water mass structure changes in order to identify and predict natural changes. Further projecting this logic, we would be able to identify and predict most naturally induced marine ecological change based solely on meteorological data if we adequately understand ocean-atmospheric interaction. Even if possible, adequate understanding of ocean-atmosphere interactions is generations away. Therefore, in developing an environmental trend monitoring system we should aim to measure the critical marine environmental trends including water mass changes and not rely on our knowledge of atmospheric climate changes.

On the simplest level marine environmental trend monitoring could be restricted to the measurement of temperature, salinity, and possibly turbidity distributions in sufficient detail to detect major water mass changes. However, water mass chemistry, which directly controls primary production, may vary independently of these physical variables. Therefore, an environmental trend monitoring program should include measurements of chemical species known

to be major biological controlling factors. To the best of our current knowledge, changes in nitrogen, phosphorus, and silicon species concentrations are probably responsible for most of the natural variation of primary production (qualitative and quantitative) within any regional marine ecosystem. It may not be necessary, except in certain specific ecosystems, to monitor other chemical species to ensure that environmental trend monitoring is successful in identifying and predicting major naturally induced ecological changes.

There was no clear agreement at the regional workshops on the best approaches to follow for marine environmental trend monitoring, but it was recognized that no adequate environmental trend monitoring program of the nature of that described appears to be currently in place in any of the regions. With regard to environmental trend monitoring, workshop participants identified the following need:

> A STUDY SHOULD BE MADE OF ENVIRONMENTAL TREND MONITORING STRATEGIES WHICH CAN ENSURE THAT MAJOR REGIONWIDE ECOLOGICAL CHANGES CAUSED BY NATURAL VARIABILITY ARE IDENTIFIED AND SEPARATED FROM POLLUTION INDUCED CHANGES. PROGRAMS EMPLOYING THE BEST AVAILABLE STRATEGY SHOULD BE INITIATED AS SOON AS PRACTICABLE.

IV.H. Technology Development

One of the principal aims of the regional workshop series was to identify deficiencies in the available technologies utilized for marine monitoring. Very limited information was obtained concerning such needs. The lack of input from workshop participants may have been due to the fact that most marine pollution monitoring programs are designed around existing technology, and workshop participants had in general not adequately studied the types of data, which are currently not available due to technology limitations, and which could help their programs.

Rather than suggesting needs for new technology with which to make more sophisticated environmental measurements, workshop participants expressed a number of concerns that the existing sampling and analysis technologies suffered operational problems which compromised the efficiency of marine monitoring programs. The operational problems of existing technology that were identified include: unreliability, difficulty of operation, high cost, and lack of adequate operator training programs.

It was felt that many sampling and analysis systems used for marine monitoring were unreliable and difficult to use. One particular problem identified in this area was that sampling and analysis equipment used in many marine monitoring programs were not specifically designed for, or even re-engineered for, marine use.

Many of the available measurement sampling and analysis systems are complex and require trained individuals to operate and maintain them. Where the system's complexity can not be reduced workshop participants felt that engineering design should favor ease of operator use, with the necessary redundancy built into the system to reduce downtime due to the operator's inability to repair the complex equipment. Workshop participants also felt strongly that development of adequate training programs for operational and maintenance personnel was a vital component of the engineering of measurement, sampling, and analysis systems, and that this component was currently lacking for most systems.

The high cost of sampling and analysis equipment was cited as a major problem by workshop participants. They were concerned that too much emphasis was being placed on development of high-cost, high-capability systems to the exclusion of low-cost, reliable, alternative systems of lesser but still useful capability.

The following needs for technology development were expressed:

> TECHNOLOGY AND ENGINEERING PROGRAMS SHOULD BE REFOCUSED TO PLACE MAJOR EMPHASIS ON IMPROVEMENT OF THE RELIABILITY AND EASE OF OPERATION, AND LOWERING OF THE COST OF EXISTING

MEASUREMENT, SAMPLING AND ANALYSIS SYSTEMS. DEVELOPMENT OF NEW TECHNOLOGY SHOULD EMPHASIZE THESE SAME FEATURES, AND NEW TECHNOLOGY SHOULD BE ACCOMPANIED BY ADEQUATE TRAINING PROGRAMS FOR THE TECHNICAL COMMUNITY PERFORMING DAY-TO-DAY MONITORING TASKS.

IV.I. National Marine Pollution Monitoring Program Planning

Under the Ocean Pollution Planning Act, NOAA, through the COPRDM, has the responsibility to develop a "comprehensive, coordinated and effective ocean pollution...monitoring program."

The regional monitoring workshops revealed that the present array of monitoring programs is very complex. Most programs are conducted in response to regulations that require those who must discharge into the marine ecosystem assure that no harm is caused by their activity. The Federal role is to assure that 1) appropriate safeguards (regulations) are in effect and 2) efforts are continuously made to synthesize, simplify, and increase the utility and cost-effectiveness of the programs. The resolution of the issues identified in sections IV.A thru IV.G would considerably improve the present marine pollution monitoring programs. However, in order to resolve those issues there is a need to provide a framework or approach to a national program. Since marine pollution problems and issues are inherently different in each geographical region, workshop participants saw a need for the national program to be the sum of separately planned and coordinated regional programs.

The framework of a national program should be based on the dual roles of monitoring: 1) to warn against imminent harmful impacts, and 2) to evaluate and forecast long-term impact. The warning role could be accommodated by compliance monitoring programs. Trend assessment programs could satisfy the long-term impact evaluation and forecast needs. In a national program framework, activities under compliance monitoring and trend-assessment monitoring should be integrated. They represent a hierarchy from the monitoring of an effluent, on one end of the scale, to monitoring region wide ecological or oceanographic changes, on the other.

The national program should provide the framework for integration of the hierarchy. In addition, since in most regions the hierarchy of programs is incomplete, the national program should seek to ensure that these information gaps are filled. The critical gaps in the hierarchy of programs are, at present, not well identified and should be further studied in each region. However, in each region the lack of adequate environmental trend assessment monitoring addressing natural environmental variability has emerged as an issue needing immediate assessment.

Accordingly, the following needs can be identified:

THE NATIONAL MARINE POLLUTION MONITORING PROGRAM SHOULD BE THE SUM OF A NUMBER OF REGIONALLY PLANNED AND COORDINATED PROGRAMS. IT SHOULD ENSURE THE AVAILABILITY OF DATA FROM ALL MARINE MONITORING PROGRAMS, AND THAT THESE DATA ARE INTEGRATED IN A MANNER LEADING TO USEFUL SYNTHESES AND INTERPRETATIONS. IT SHOULD ALSO ENSURE THAT USEFUL INFORMATION PRODUCTS ARE PRODUCED AND DISSEMINATED TO USERS. THE NATIONAL PROGRAM SHOULD IDENTIFY GAPS IN THE HIERARCHY OF MONITORING PROGRAMS AND SHOULD FIND MEANS TO FILL THESE GAPS.

THE ROLE OF THE NATIONAL MARINE POLLUTION MONITORING PROGRAM AT THE PRESENT TIME SHOULD BE THAT OF COORDINATION AND INTEGRATION OF EXISTING MONITORING ACTIVITIES. IT SHOULD NOT REPLACE OR SUBSUME EXISTING COMPLIANCE OR OTHER MONITORING PROGRAMS.

APPENDIX A

THE NATIONAL OCEAN POLLUTION PLANNING ACT

PL 95-273

Public Law 95-273
95th Congress

An Act

May 8, 1978
[S. 1617]

To establish a program of ocean pollution research, development, and monitoring, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Ocean Pollution Research and Development and Monitoring Planning Act of 1978".

National Ocean Pollution Research and Development and Monitoring Planning Act of 1978.
33 USC 1701 note.

SEC. 2. FINDINGS AND PURPOSES.

33 USC 1701.

(a) FINDINGS.—The Congress finds and declares the following:

(1) Man's activities in the marine environment can have a profound short-term and long-term impact on such environment and greatly affect ocean and coastal resources therein.

(2) There is a need to establish a comprehensive Federal plan for ocean pollution research and development and monitoring, with particular attention being given to the inputs, fates, and effects of pollutants in the marine environment.

(3) Man will increasingly be forced to rely on ocean and coastal resources as other resources are depleted. Our ability to protect, preserve, develop, and utilize these ocean and coastal resources is directly related to our understanding of the effects which ocean pollution has upon such resources.

(4) Numerous departments, agencies, and instrumentalities of the Federal Government sponsor, support, or fund activities relating to ocean pollution research and development and monitoring. However, such activities are often uncoordinated and can result in unnecessary duplication.

(5) Better planning and more effective use of available funds, personnel, vessels, facilities, and equipment is the key to effective Federal action regarding ocean pollution research and development and monitoring.

(b) PURPOSES.—It is therefore the purpose of the Congress in this Act—

(1) to establish a comprehensive 5-year plan for Federal ocean pollution research and development and monitoring programs in order to provide planning for, coordination of, and dissemination of information with respect to such programs within the Federal Government;

(2) to develop the necessary base of information to support, and to provide for, the rational, efficient, and equitable utilization, conservation, and development of ocean and coastal resources; and

(3) to designate the National Oceanic and Atmospheric Administration as the lead Federal agency for preparing the plan referred to in paragraph (1) and to require the Administration to carry out a comprehensive program of ocean pollution research and development and monitoring under the plan.

33 USC 1702.

SEC. 3. DEFINITIONS.

As used in this Act, unless the context otherwise requires—

(1) The term "Administration" means the National Oceanic and Atmospheric Administration.

(2) The term "Administrator" means the Administrator of the Administration.

(3) The term "Director" means the Director of the Office of Science and Technology Policy in the Executive Office of the President.

(4) The term "marine environment" means the coastal zone (as defined in section 304(1) of the Coastal Zone Management Act of 1972 (16 U.S.C. 1453(1))); the seabed, subsoil, and waters of the territorial sea of the United States; the waters of any zone over which the United States asserts exclusive fishery management authority; the waters of the high seas; and the seabed and subsoil of and beyond the Outer Continental Shelf.

(5) The term "ocean and coastal resource" has the same meaning as is given such term in section 203(7) of the National Sea Grant Program Act (33 U.S.C. 1122(7)).

(6) The term "ocean pollution" means any short-term or long-term change in the marine environment.

SEC. 4. COMPREHENSIVE FEDERAL PLAN RELATING TO OCEAN POLLUTION.

33 USC 1703.

(a) LEAD AGENCY FOR PLAN.—The Administrator, in consultation with the Director and other appropriate Federal officials having authority over ocean pollution research and development and monitoring programs, shall prepare, in accordance with this section, a comprehensive 5-year plan (hereinafter in this Act referred to as the "Plan") for the overall Federal effort in ocean pollution research and development and monitoring. The Plan shall be prepared and submitted to Congress and the President on or before February 15, 1979, and a revision of the Plan shall be prepared and so submitted by February 15 of each odd-numbered year occurring after 1979.

Responsibility.

Submittal to President and Congress.

(b) CONTENT OF PLAN.—The Plan shall contain, but need not be limited to, the following elements:

(1) ASSESSMENT AND ORDERING OF NATIONAL NEEDS AND PROBLEMS.—The Plan shall—

National priorities.

(A) identify those national needs and problems, which relate to specific aspects of ocean pollution (including, but not limited to, the effects of ocean pollution on the economic, social, and environmental values of ocean and coastal resources), which exist and will arise during the Plan period;

(B) establish the priority, based upon the value and cost of information which can be obtained from specific ocean pollution research and development and monitoring programs and projects, in which such needs should be met, and such problems should be solved, during the Plan period; and

(C) contain, if pursuant to the preparation of any revision of the Plan required under subsection (a) it is determined that any national need or problem or priority set forth in the preceding version of the Plan should be changed, a detailed explanation of the reasons for the change.

(2) EXISTING FEDERAL CAPABILITY.—The Plan shall contain—

Existing Federal capability.

(A) a detailed listing of all existing Federal programs relating to ocean pollution research and development and monitoring (including, but not limited to, general research on marine ecosystems), which listing shall include, with respect to each such program—

(i) a catalogue of the Federal personnel, facilities, vessels and other equipment currently assigned to, or used for, the program, and

(ii) a detailed description of the existing goals and costs of the program, including, but not limited to, a categorical breakdown of the funds currently being expended, and planned to be expended, to conduct the program; and

(B) an analysis of the extent to which each such program, if continued on the basis and at the funding level described pursuant to subparagraph (A)(ii), will assist in meeting the priorities set forth pursuant to paragraph (1)(B) during the Plan period.

(3) POLICY RECOMMENDATIONS.—If it is determined, as a result of the analysis required to be made under paragraph (2)(B), that the priorities set forth pursuant to paragraph (1)(B) will not be adequately met during the Plan period using the existing Federal capability described pursuant to paragraph (2)(A), the Plan shall contain those recommendations for changes in the overall Federal effort in ocean pollution research and development and monitoring which would ensure that those priorities are adequately met during the Plan period. Such recommendations may include, but need not be limited to—

(A) changes in the goals to be achieved under various existing Federal ocean pollution research and development and monitoring programs;

(B) suggested increases and decreases in the funding for any such existing program consistent with the extent to which such program contributes to the meeting of such priorities;

(C) specific proposals for interagency cooperation in cases in which the pooling of the resources of two or more Federal departments. agencies, or instrumentalities under existing programs could further efforts to meet such priorities or would eliminate duplication of effort; and

(D) suggested legislation to establish new Federal programs considered to be necessary if such priorities are to be met.

Budget review.

(4) BUDGET REVIEW.—The Plan shall contain a description of actions taken by the Administrator and the Director to coordinate the budget review process for the purpose of ensuring interagency coordination and cooperation in (A) the carrying out of Federal ocean pollution research and development and monitoring programs; and (B) eliminating unnecessary duplication of effort among such programs.

"Plan Period."

(c) For purposes of this section, the term "Plan period" means—

(1) with respect to the Plan as required to be submitted on February 15, 1979, the period of 5 fiscal years beginning on October 1, 1978; and

(2) with respect to each revision of the Plan, the period of 5 fiscal years beginning on October 1 of the year before the year in which the revision is required to be prepared under subsection (a).

33 USC 1704.

SEC. 5. COMPREHENSIVE OCEAN POLLUTION PROGRAM IN THE ADMINISTRATION.

Establishment.

(a) ESTABLISHMENT OF PROGRAM.—The Administrator shall establish within the Administration a comprehensive, coordinated, and effective ocean pollution research and development and monitoring program. The Administrator shall carry out all projects and activities under the program in a manner consistent with the Plan.

(b) CONTENT OF THE PROGRAM.—The program required to be established under subsection (a) shall include, but not be limited to—

(1) all projects and activities relating to ocean pollution research and development and monitoring for which the Administrator has responsibility under provisions of law (including, but not limited to, title II of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1441–1444)) other than paragraph (2);

(2) such projects and activities addressed to the priorities set forth in the Plan pursuant to section 4(b)(1)(B) that can be appropriately conducted within the Administration; and

(3) the provision of financial assistance under section 6.

SEC. 6. FINANCIAL ASSISTANCE.

33 USC 1705.

(a) GRANTS AND CONTRACTS.—The Administrator may provide financial assistance in the form of grants or contracts for research and development and monitoring projects or activities which are needed to meet priorities set forth in the Plan pursuant to section 4(b)(1)(B), if such priorities are not being adequately addressed by any Federal department, agency, or instrumentality.

Grants and contracts.

(b) APPLICATIONS FOR ASSISTANCE.—Any person, including institutions of higher education and departments, agencies, and instrumentalities of the Federal Government or of any State or political subdivision thereof, may apply for financial assistance under this section for the conduct of projects and activities described in subsection (a), and, in addition, specific proposals may be invited. Each application for financial assistance shall be made in writing in such form and manner, and contain such information, as the Administrator may require. The Administrator may enter into contracts under this section without regard to section 3709 of the Revised Statutes of the United States (41 U.S.C. 5).

Contract authority.

(c) EXISTING PROGRAMS.—The projects and activities supported by grants or contracts made or entered into under this section shall, to the maximum extent practicable, be administered through existing Federal programs (including, but not limited to, the National Sea Grant Program) concerned with ocean pollution research and development and monitoring.

(d) ACTION BY ADMINISTRATOR.—The Administrator shall act upon each application for a grant or contract under this section within six months after the date on which all required information is received by the Administrator from the applicant. Each grant made or contract entered into under this section shall be subject to such terms and conditions as the Secretary deems necessary in order to protect the interests of the United States. The total amount paid pursuant to any such grant or contract may, in the discretion of the Administrator, be up to 100 percent of the total cost of the project or activity involved.

(e) RECORDS.—Each recipient of financial assistance under this section shall keep such records as the Administrator shall prescribe, including records which fully disclose the amount and disposition by such recipient of the proceeds of such assistance, the total cost of the project or activity in connection with which such assistance was given or used, the amount of that portion of the cost of the project or activity which was supplied by other sources, and such other records as will facilitate an effective audit. Such records shall be maintained for three years after the completion of such project or activity. The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and examination, to any books, documents, papers, and

Recordkeeping.

Accessibility.

records of receipts which, in the opinion of the Administrator or of the Comptroller General, may be related or pertinent to such financial assistance.

33 USC 1706.

SEC. 7. INTERAGENCY COOPERATION.

The head of each department, agency, or other instrumentality of the Federal Government which is engaged in or concerned with, or which has authority over, programs relating to ocean pollution research and development and monitoring—

(1) shall cooperate with the Administrator in carrying out the purposes of this Act;

(2) may, upon written request from the Administrator or Director, make available to the Administrator or Director, on a reimbursable basis or otherwise, such personnel (with their consent and without prejudice to their position and rating), services, or facilities as may be necessary to assist the Administrator or the Director to achieve the purposes of this Act; and

(3) shall, upon a written request from the Administrator or Director, furnish such data or other information as the Administrator or Director deems necessary to fulfill the purposes of this Act.

33 USC 1707.

SEC. 8. DISSEMINATION OF INFORMATION.

The Administrator shall ensure that the results, findings, and information regarding ocean pollution research and development and monitoring programs conducted or sponsored by the Federal Government be disseminated in a timely manner, and in useful forms, to relevant departments, agencies, and instrumentalities of the Federal Government, and to other persons having an interest in ocean pollution research and development and monitoring.

33 USC 1708.

SEC. 9. EFFECT ON OTHER LAWS.

Nothing in this Act shall be construed to amend, restrict, or otherwise alter the authority of any Federal department, agency, or instrumentality, under any law, to undertake research and development and monitoring relating to ocean pollution.

33 USC 1709.

SEC. 10. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Administration for the purposes of carrying out this Act not to exceed $5,000,000 for the fiscal year ending September 30, 1979.

Approved May 8, 1978.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 95-626 pt. 1 (Comm. on Science and Technology) and 95-626 pt. 2 (Comm. on Merchant Marine and Fisheries).

CONGRESSIONAL RECORD:

Vol. 123 (1977): Aug. 3, considered and passed Senate.

Vol. 124 (1978): Feb. 28, considered and passed House, amended.
Apr. 24, Senate agreed to House amendment.

○

Public Law 96-255
96th Congress

An Act

May 30, 1980
[H.R. 6615]

To amend the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 to authorize appropriations to carry out the provisions of such Act for fiscal years 1981 and 1982, and for other purposes.

National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, amendment.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 10 of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, as amended (33 U.S.C. 1709), is amended—

(1) by striking out "and" after "1979,", and

(2) by striking out "1980." and inserting in lieu thereof "1980, not to exceed $3,000,000 for the fiscal year ending September 30, 1981, and not to exceed $4,000,000 for the fiscal year ending September 30, 1982.".

Lead Federal agency for plan.

SEC. 2. Section 4(a) of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 (33 U.S.C. 1703(a)) is amended by striking out "February" immediately after "submitted by" and inserting in lieu thereof "September".

Name change. 33 USC 1701 note.

SEC. 3. Section 1 of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 is amended by striking out "Research and Development and Monitoring".

Approved May 30, 1980.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 96-893, Pt. 1 (Comm. on Merchant Marine and Fisheries) and No. 96-893, Pt. 2 (Comm. on Science and Technology).

SENATE REPORT No. 96-691 accompanying S. 2687 (Comm. on Commerce, Science, and Transportation).

CONGRESSIONAL RECORD, Vol. 126 (1980):

May 5, considered and passed House.

May 15, considered and passed Senate in lieu of S. 2687.

○

59-139 O - 80 (78)

APPENDIX B

INVITEES AND ATTENDEES AT REGIONAL WORKSHOPS

SUMMARY AND LISTING

B.I.a. NORTHEAST REGIONAL WORKSHOP
Stony Brook, NY, September 10-12, 1980.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	7	6	20
State Agencies	5	1	2
Universities	3	2	6
Private Sector	1	2	2
Local/Municipal Agencies	2	1	1
Public Interest and Other Organizations	7	1	1

B.I.b. SOUTHWEST REGIONAL WORKSHOP
Pasadena, CA, November 18-20, 1980.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	NA	7	27
State Agencies	NA	6	10
Universities	NA	4	6
Private Sector	NA	10	14
Local/Municipal Agencies	NA	9	12
Public Interest and Other Organizations	NA	5	5

NA - Information not available.

B.I.c. WESTERN GULF REGIONAL WORKSHOP
New Orleans, LA, December 16-17, 1980.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	11	7	16
State Agencies	15	5	6
Universities	7	3	4
Private Sector	14	8	9
Local/Municipal Agencies	5	1	1
Public Interest and Other Organizations	9	3	4

B.I.d. NORTHWEST REGIONAL WORKSHOP
Seattle, WA, January 6-8, 1981.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	NA	8	37
Federal Agencies (Canadian)	NA	2	2
State Agencies	NA	3	7
Universities	NA	6	14
Private Sector	NA	19	19
Local/Municipal Agencies	NA	4	8
Public Interest and Other Organizations	NA	8	8

NA - Information not available.

B.I.e. SOUTHEASTERN REGIONAL WORKSHOP
Atlanta, GA, January 27-28, 1981.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	8	7	25
State Agencies	15	9	13
Universities	9	5	6
Private Sector	17	8	9
Local/Municipal Agencies	6	3	4
Public Interest and Other Organizations	4	1	1

B.I.f. GREAT LAKES REGIONAL WORKSHOP
Ann Arbor, MI, February 11-13, 1981.
Summary of Invitees and Attendees.

	No. of Invited Agencies	No. of Agencies Attending	No. of Individuals Attending
Federal Agencies (U.S.)	7	7	18
Federal Agencies (Canadian)	3	1	3
Canadian Provincial	2	2	2
State Agencies	10	6	9
Universities	7	8	11
Private Sector	4	2	2
Local/Municipal Agencies	2	2	2
Public Interest and Other Organizations	7	5	11

B.II.a. NORTHEAST REGIONAL WORKSHOP

List of Invitees (by organization)

Federal Agencies

U.S. Army Corp of Engineers,
-Waltham, MA
-New York, NY
National Park Service, Gateway National Recreation Area,
Brooklyn, NY
National Oceanic and Atmospheric Administration
-MESA New York Bight Project, Stony Brook, NY
-National Oceanic Survey, Rockville, MD
-Northeast Fisheries Center, Sandy Hook, NJ
-National Marine Fisheries Service, Narragansett, RI
Environmental Protection Agency,
-Region I, Boston, MA
-Region II, Edison, NJ
-Region III, Philadelphia, PA
Geological Survey
-Eastern Region, Washington, DC
-Atlantic City, NJ
Fish and Wildlife Service,
-Newton Corners, MA
-Dover, DE
Food and Drug Administration, Davisville, RI

State Agencies

N.Y. Department of Environmental Conservation, New York, NY
Pennsylvania Fisheries Commission, Harrisburg, PA
N.J. Department of Environmental Protection, Trenton, NJ
Virginia Marine Resources Commission, Newport News, VA
Coastal Zone Management, Boston, MA
MD Department of Natural Resources, Tidewater Administration,
Annapolis, MD

Universities

University of Rhode Island, Microbiology Department,
Kingston, RI
Virginia Institute of Marine Science, Gloucester Point, VA
State University of New York, Marine Science Research Center,
Stony Brook, NY

Private Sector

SEAMOcean, Inc., Wheaton, MD

Local/Municipal Agencies

Nassau County Health Department, Mineola, NY
Philadelphia Water Department, Philadelphia, PA

Public Interest and Other Organizations

American Littoral Society, Highlands, NJ
Mid-Atlantic Fisheries Management Council, Dover, DE
New England River Basin Commission, Boston, MA
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B.II.b. SOUTHWEST REGIONAL WORKSHOP

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B.II.c. WESTERN GULF REGIONAL WORKSHOP

List of Invitees (by organization)

Federal Agencies

Bureau of Land Management
-Outer Continental Shelf Office, New Orleans, LA
Coast Guard, New Orleans, LA
Corps of Engineers, New Orleans, LA
Department of Energy
-Strategic Petroleum Reserves, New Orleans, LA
Environmental Protection Agency, Dallas, TX
Fish and Wildlife Service, Galveston, TX and Slidell, LA
Food and Drug Administration, Houston, TX and New Orleans, LA
Geological Survey, Metairie, LA
National Oceanic and Atmospheric Administration
-Atlantic Oceanographic and Meterological Laboratory, Miami, FL
-Environmental Data and Information Service, Miami, FL
-National Marine Fisheries Service, Galveston, TX
-National Ocean Survey, Rockville, MD
-Ocean Technology & Engineering Services, Rockville, MD
-Office of Marine Pollution Assessment, Boulder, CO, Rockville, MD, and NSTL Station, MS
National Park Service, Corpus Christi and Padre Island, TX
National Wildlife Refuge, Alamo, Rio Hondo, Austwell and Angleton, TX

State Agencies

Louisiana Department of Health & Human Resources, New Orleans, LA
Louisiana Department of Natural Resources, Baton Rouge, LA
Louisiana Department of Public Works, Baton Rouge, LA
Louisiana Department of Wildlife and Fisheries, New Orleans and Baton Rouge, LA
Louisiana Food and Drug Administration, New Orleans, LA
Texas Air Control Board, Austin, TX
Texas Coastal and Marine Council, Austin, TX
Texas Councils of Government, Corpus Christi, Victoria, Houston, and McAllen, TX
Texas Department of Health, Austin, TX
Texas Department of Parks and Wildlife, Austin and Rockport,TX
Texas Department of Water Resources, Corpus Christi, Austin, and Deer Park, TX
Texas General Land Office, Austin, TX
Texas Railroad Commission, Austin, TX
Texas (Southeast) Regional Planning Commission, Nederland, TX

Universities

Florida Institute of Oceanography, Melbourne, FL
Gulf Universities Research Consortium, Houston, TX
Louisiana State University, Baton Rouge, LA
-Center for Wetland Resources
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-Department of Wildlife & Fisheries
University of New Orleans, New Orleans, LA
-Center for Bio-organic Studies
University of Texas, Austin, TX
-Center for Research in Water Resources
University of Texas Marine Laboratory, Port Aransas, TX

Private Sector

Champlin Petroleum, Ft. Worth, TX
Conoco, Inc., Houston, TX
Continental Shelf Associates, Inc., Tequesta, FL
Dow Chemical Co., Freeport, TX
Exxon Co., Houston, TX
Houston Power & Light Co., Houston, TX
LGL Ecological Research Associates, Bryan, TX
Rohm & Haas Texas, Inc., Deer Park, TX
SEAMOcean,Inc., Wheaton, MD
Shell Oil Co., Houston, TX. and New Orleans, LA
Southwest Research Institute, Houston, TX
TerEco Corp., College Station, TX

Local/Municipal Agencies

City of Houston Pollution Control, TX
Galveston County Health Department, TX
Harris County Pollution Control, TX
Jefferson Parish Environmental & Development Control Department, LA
Plaquemines Parish Mosquito Control, LA

Public Interest and Other Organizations

Ecology Center of Louisiana, New Orleans, LA
"For the People, Inc.", Dallas, TX
Gulf Coast Waste Disposal Authority, Houston, TX
Gulf Fisheries Council, Beaumont, TX and Metairie, LA
League of Women Voters, Cypress, TX and New Orleans, LA
Louisiana Offshore Terminal Authority, Baton Rouge, LA
Shrimp Producers Association, Brownsville, TX
Texas Environmental Coalition, Lake Jackson and Port Aransas, TX
Vieux Carre Council for a Better New Orleans, New Orleans, LA

List of Participants

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B.II.d. NORTHWEST REGIONAL WORKSHOP

List of Participants

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- -Environmental Research Labs., Boulder, CO
- -EDIS, Rockville, MD
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APPENDIX C

SUMMARY OF

REGIONAL WORKSHOP FINDINGS

The major purpose of the regional workshops was not to identify objectives for specific marine pollution programs within the regions or local areas, but rather to address the generic needs and priorities for improvement of the entire spectrum of existing programs. As a consequence of this focus many of the findings of individual regional workshops are similar.

The following summaries of regional workshop findings are included here in as nearly an identical form and language as possible to the contents of the regional reports themselves. Only a minimum of editing has been done to reduce extraneous material and improve the clarity of presentation of ideas.

A. Northeast Regional Workshop on Marine Pollution Monitoring
Stony Brook, New York, September 10-12, 1980.

This regional report cites or may otherwise reflect those findings of subsequent workshops which serve to clarify some of the issues which arose but which were not fully developed at Stony Brook.

It was found that existing inventories of ocean pollution monitoring programs were incomplete and that further investigation is needed to determine the significance of the omissions. No specific additional monitoring information needs were revealed. However, there was a consensus that there are high priority needs for (1) a regional monitoring data and information archival and retrieval service at minimal or no charge and (2) for analysis, synthesis, and assessments of existing data and information resulting from the monitoring programs in the region. These will permit all users, from interest groups to resource managers, to make better recommendations and decisions.

Present ocean monitoring programs in the northeast include NOAA's (pilot) Northeast Monitoring Program (NEMP), Region II EPA's New York Bight Monitoring Program, Region III EPA's ocean dumping monitoring program, FDA/State shellfish sanitation programs, and a number of municipal and industrial compliance monitoring programs.

In general, some (not all) compliance monitoring data are used. Few ambient monitoring data are used except for research or for measuring improvements resulting from remedial works. This is presumably because insufficient resources are committed to monitoring data planning, management and assessment as compared to data collection.

The participants' assessment of regional ocean pollution problems was that there are needs for generic ocean pollution research and for systems to provide better monitoring data management and assessment. Monitoring data assessment is expensive. These factors lead to the conclusion that, unless approximately the same resources can be committed to data management and assessment as to data collection, data collection efforts should be adjusted accordingly.

Regional and local elements in a national ocean pollution monitoring network include Federal, state, and local programs. All of these can fit into or support a hierarchical approach in which only essential information is collected and assessed, if the necessary resources and the institutional

framework and interagency and intra-agency coordination for monitoring data planning, collection, and assessment are provided.

B. Southwest Regional Workshop on Ocean Pollution Monitoring
Pasadena, California, November 18-20, 1980.

Participants identified more than 75 individual needs related to marine pollution monitoring. The majority of those needs relate to specific monitoring programs or methodologies. Other, more generalized needs regarding monitoring were also stated. The key findings of the workshop were:

A coordinating body should be established to investigate methods, evaluate data, identify agency activities and evaluate new needs of monitoring. It should also assure productive, nonduplicating programs which will provide bases for sound management decisions.

Standardization, intercalibration, and quality control of monitoring data collection and analysis procedures should be investigated. Participants made the point that an apparent weakness of monitoring programs is the lack of standardized methods or procedures.

Evaluation of the current compliance monitoring programs is needed to determine their responsiveness to current management needs. It was recommended that such reviews should be based on the utility of monitoring data. Participants believed that all concerned organizations would benefit from this periodic reassessment.

Ad hoc committees, which would evaluate the need for improved, more cost-effective sampling, analysis, technology, etc., should be established.

A regional data and information center should be established that would archive and disseminate data and would serve also as a data and information referral center.

Also included in the workshop were three papers about approaches toward a national monitoring program and the recommendations of the attendees about possible implementation strategies. The approaches of the Swanson/O'Connor and the Segar papers basically rely on the existing and future compliance monitoring programs as a major data source to be used for regional environmental and ecological effects monitoring purposes. The first paper, however, recommends a broad, national surveillance program using sentinel organisms in addition to compliance monitoring. The second paper recommends adding ecology and "ocean climatology" monitoring programs, along with pollutant concentration trend monitoring and selected ecosystems research. The paper by Bascom suggests a departure from existing programs and recommends: (1) establishment of "normal" ecological conditions from the shoreline to 1,000 meters in depth; (2) pollutant source/input identification; (3) monitoring of boundaries of contaminated areas; and (4) establishing long-term time-series measurements of oceanographic characteristics. The paper maintains that such a program designed with the use of advanced technology (satellites, telemetry, etc.) would be more cost-efficient in the long run than the present programs, and would yield the desired results sooner.

C. Western Gulf Regional Workshop on Ocean Pollution Monitoring
New Orleans, Louisiana, December 16-17, 1980.

The discussion of monitoring programs was divided into three sessions: Federal programs, state programs, and industry programs.

Most Federal agencies reported that their monitoring programs are performed for compliance or regulatory purposes. Failure of compliance shown by monitoring data usually leads to either re-evaluation of the problems through detailed research surveys or studies, instructions to dischargers, legal enforcement proceedings, modification of regulations, or recommendations for new regulations. Better interagency coordination, both among Federal agencies and between the Federal and the state and local agencies, seemed to be the major need identified.

The industry representatives expressed an opinion that further assessment of existing data are needed before new local or regional monitoring programs are implemented. They felt that the available information should be fully evaluated in order to draw conclusions on whether existing monitoring activities could reasonably predict environmental impact, based on this monitoring data base. It was suggested that assessment of the monitoring information available only in the gray literature should be part of the evaluation. The strongest industry recommendation was the need for regional input into monitoring program designs and requirements. Industry wishes to participate in the design of their compliance monitoring requirements, and wants to assure flexibility for later improvement of the design based on data obtained.

The representatives from the state agencies identified several key issues which seemed to be typical needs in Region VI. One most frequently mentioned was the need for standardization of data collection and processing techniques and laboratory procedures in order to achieve the desired data quality assurance. Following data collection improvements, better data storage and access methods were indicated, including an update of STORET. Another weak link identified in monitoring programs was the proper assessment of data in data banks.

The lack of sufficient funds and qualified personnel were identified as a serious problem influencing the monitoring efforts of state agencies. A final concern of the state agencies was the need for more frequent and effective communication and cooperation between the various agencies (both intra- and interstate). For example, it became evident that about 30 percent of the sampling stations were not shared, thus resulting in duplicative efforts. It was disclosed that many of the marine pollution monitoring problems are long-standing and are generally based on the absence of state legislative support.

In summary, the key finding and recommendations of the monitoring workshop include the need to develop: 1) Better assessments of existing monitoring programs and their data; 2) More reliable, cost-effective sampling and analysis technology; 3) Better coordination among the various monitoring agencies; 4) A regional data and information dissemination and referral center; 5) A mechanism for standardization, intercalibration, and quality control of data collection and analysis methods.

To assess the requirements for a region-wide ecosystem monitoring program a background paper, "A Recommended Direction for a National Marine Pollution Monitoring Program" by Swanson and O'Connor and an alternative on this approach were presented. The basic strategy of both approaches is to incorporate information from existing programs where possible and initiate new programs only where necessary and justifiable by the expected results. The most important functions of the National Program are coordination, integration, and sythesis of information. These would be facilitiated through regional centers, operated as cooperative entities with participation from state and local groups and concerned Federal agencies. NOAA would provide leadership under its reponsibilities pursuant to the National Ocean Pollution Planning Act of 1978.

In response to the proposed hierarchical approach, the workshop participants questioned if all the Gulf problems have been adequately defined to support present and future regional plans which must be coordinated with the Second Federal Plan. Concern was expressed for the types of questions that are not being asked or assessed by present monitoring activities. Participants indicated that present programs should be evaluated to determine who is doing what and where as a first priority. Subsequent to this evaluation, needs could be better defined in terms of what improvements, coordination, etc. are needed. The overall opinion expressed by the participants was that there is no need for a regional program until a good data base on existing monitoring activities has been established.

D. Northwest Regional Workshop on Marine Pollution Monitoring
Seattle, Washington, January 6-8, 1981.

Workshop recommendations were not given priorities nor were they intended to represent concensus opinion of conference participants. Those items which could be considered key findings of the workshop include the following:

Standardization and other methods of assuring procedures should be investigated. If applied, however, standardized methods should be implemented on a regional before a national basis. Also recommended was production of a generic technical guide with standard procedures for station locating, reports, reporting units, etc., which would have a wide distribution. A generic quality assurance manual for the range of monitoring programs was also suggested.

A regional marine pollution monitoring data management center should be established. Speakers recognized that a great amount of marine monitoring information is available but difficult to locate. The center would provide for locating, collating, archiving, synthesizing and disseminating current data and documentation on marine pollution.

Some speakers identified a need for a coordinated regional marine pollution monitoring program, which would be tailored to the region. Existing data sources should be used as much as possible in such a program.

Other speakers, particularly those representing industry, felt that in most areas a regional or national program is not necessary. Before establishing a

regional ecosystem monitoring program, existing problems should be clearly defined and priorities set, and all available data should be identified, organized and assessed. Some speakers felt that most problems, if localized, can be addressed within existing programs and jurisdictions. For regional problems, an ecosystem monitoring program may be necessary.

A coordinated region-wide assessment is needed to investigate methods, evaluate data, monitor activities and evaluate needs of monitoring agencies with an annual update. Along the same lines, ad hoc committees representing agencies and industry should be established and convened biannually to identify specific monitoring objectives and make recommendations to appropriate Federal agencies.

Nonregulatory agencies, such as NOAA, should conduct any regional monitoring program. Also monitoring regulations should be flexible to take into account regional differences in ecology.

Furthermore, at the international level, it was recommended that both the United States and Canada conduct some type of integrated monitoring of their respective inland seas--the Straits of Georgia and Puget Sound. There is also a need for international cooperation to ensure integrated appraisal and protection of the international straits.

E. Southeastern Regional Workshop on Marine Pollution Monitoring.
Atlanta, Georgia, January 27-28, 1981.

The regional report includes discussion of examples of monitoring programs as presented by various Federal, state, and local agencies and industry, as well as discussion of the approaches to a national ocean pollution monitoring program.

It was agreed by participants that after the primary functions of the monitoring programs are served, monitoring data are rarely used further, even though they may be of value for other management decisions. A mechanism is needed to continually evaluate these monitoring programs so that they meet changing management needs and that their data are useful for broader environmental assessments.

Furthermore, no additional new local or regional monitoring programs were recommended. As a first priority, an adequate inventory of the existing activities must be made, including the identification of agency responsibilities. The establishment of a regional planning and coordination mechanism, possibly in connection with the regional data and information function was discussed and generally supported, provided the regional agencies retain a lead role.

There were concerns about the adequacy of the existing data and information dissemination systems. A high priority was placed on the establishment of a regional data and information storage and referral office that would update and verify existing data and information bases.

Agencies emphasized that the outstanding regional concern is on the protection of fisheries. In this regard, the need was advocated for additional baseline

data on most of the estuaries and wetlands. Since wetlands are one of the critical habitats, it was recommended that more research and monitoring should be conducted on them.

The participants agreed there is a need to establish a mechanism whereby concerned agencies can agree on standards of data collection and analysis, including intercalibration and intercomparability of data sets for quality assurance. Also, the improvement of the reliability of existing sampling and analysis methods received strong support, along with improved training programs and better methodologies and assessments for biological monitoring.

A possible hierarchical marine pollution monitoring approach was presented. In response to this, the workshop participants questioned if all the Gulf and South Atlantic problems have been adequately defined to support present and future regional plans which must be coordinated with the Second Federal Plan. Concern was expressed for the types of questions that are not being asked or assessed by present monitoring activities. Participants indicated that present programs should be evaluated to determine who is doing what and where as a first priority. Subsequent to this evaluation, needs could be better defined in terms of what improvements, coordination, etc., are needed. The overall opinion expressed by the participants was that there is no need for a regional program until a good data base on existing monitoring activities has been established.

F. Great Lakes Regional Workshop on Ocean Pollution Monitoring
Ann Arbor, Michigan, February 11-13, 1981.

The key points of consensus identified in the plenary session and obtained from analysis of individual work group findings and recommendations are:

The characteristics of the Great Lakes Basin are unique, differing markedly from other U.S. marine environments. Surveillance and moitoring programs will require planning, design and operations that respond to those characteristics.

The Great Lakes International Surveillance Plan (GLISP) has been developed in the binational context as a framework for monitoring and surveillance in the Great Lakes. As an operating regional monitoring program, it is recommended that GLISP be incorporated as part of the National Ocean Pollution Research, Development and Monitoring Plan.

GLISP, the 1978 Water Quality Agreement, and the Canada-Ontario Agreement are flexible and responsive to changing conditions and monitoring requirements in the Lakes. The State-EPA Agreements need to be improved to be specific to GLISP needs.

The forthcoming Federal Plan for Ocean Pollution Research, Development and Monitoring should acknowledge the water quality objectives established under international agreement, with particular reference to public and environmental health.

Surveillance priorities have not been established for regional monitoring in the Great Lakes. The United States is responsible for half the costs of monitoring under GLISP. Economic cuts may cause states and local governments to do only that monitoring required by law. Consideration needs to be given to monitoring priorities established under GLISP to meet Water Quality Agreement commitments.

The problems related to GLISP are mainly those related to implementation due to limited resources, difficulties in communication, and data access management.

The use of biotic indicators and integrators should receive more emphasis with a view to increasing the efficiency and sensitivity of water quality and ecosystem surveillance.

Identification, definition, and monitoring of ecosystem health are needed.

Design and planning of monitoring programs at all jurisdictional levels (and under GLISP) should be responsive to the needs of the users and should include requirements of public health decision makers with respect to risk/hazard assessment. Programs should add new parameters when appropriate to monitor emerging problems. Improved monitoring of atmospheric deposition, total loadings and mass balance is required. Increased attention should be given to monitoring fate, transport and effects of toxic pollutants.

There is need to address the role of analytical quality control in Great Lakes pollution monitoring.

The allocation of resources for monitoring programs should commit in advance essential funds for the assessment and analysis of data. Allocations for GLISP should reflect this need.

There is need for a more precise definition of Great Lakes "coastal areas" under PL 95-273 to reflect the requirement for pollution control programs and monitoring to be conducted throughout the entire Great Lakes Basin ecosystem, which is defined in the 1978 Water Quality Agreement to include the drainage basin to the international boundary in the St. Lawrence River.

Research, monitoring and assessment efforts to date have not resulted in informing the IJC (except for selected geographic problem areas) as to whether things are getting better, whether there is coordination, whether state and local people know what is going on, Xnd whether or not the IJC should take its message directly to the people.

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