

POLLUTION MONITORING: ITS ROLE IN MARINE ENVIRONMENTAL MANAGEMENT

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ABSTRACT

In 1980-1981 the National Oceanic and Atmospheric Administration set out to determine the potential role of the federal government in ocean pollution monitoring. A series of monitoring workshops were conducted and the results are being analyzed to determine a suitable role for the Federal Government.

By using the preliminary findings from the workshops, a summary of prior and ongoing pollution monitoring attempts, overall goals and objectives for a national monitoring scheme are presented.

Recommended as a first step is that an agreed upon set of sediment sampling measurements be adopted and serve as the nucleus of the proposed national monitoring network. This data will serve as an integrating element to which other local and regional monitoring elements can relate. The resultant monitoring information must subsequently be translated into a form which assists decision makers having authority to manage oceanic resources.

INTRODUCTION

The responsibility assigned to the National Oceanic and Atmospheric Administration (NOAA) by the National Ocean Pollution Planning Act (PL 95-273) includes the establishment of a National Monitoring Program. While the legislation is relatively clear as to the need for such a program, it is not particularly evident as to the form or substance such a program should take. Nor does the legislation explicitly state the role the federal government should play vis a vis the local, state and private sector.

To assist in determining NOAA's (i.e. the Federal) role six regional workshops were held in late fall of 1980 and winter of 1981 to gather the necessary information to formulate the basis for a National monitoring program. The workshops, while helping to identify existing monitoring activities, did little in regard to providing direction for design and implementation of a national program. The information obtained did, however, raise several problems relative to overall ocean programs. Specifically in regard to coordination, standardizing data and data archival, and information dissemination. These problems while not exclusively related to monitoring are concerns which must be

addressed by the National program within the context of the totality of marine activities.

No systematic, broad scale, long-term surveillance of the quality of the nation's oceanic waters has been performed to date. Attempts have been made to assess the conditions of these waters based upon a "synthesis" of existing data and information coupled with a knowledge of marine environmental processes. The synthesis utilizes data which has been collected by a variety of federal, state and local governmental, and academic entities. Each of these has a specific purpose and utilizes a range of instrumentation and analytical techniques. For many reasons the resultant analysis is less than adequate in portraying an accurate picture of the conditions of the nation's coastal waters.

Ocean Pollution Monitoring has been defined as the continual, systematic, time-series observation of predetermined pollutants or pertinent components of the marine ecosystem over a period of time sufficient to determine the existing level, trend and natural variations of measured components in the water column, sediments or biota.¹ The specifics of what, where, how often and for who are not specified within the first Federal plan produced under PL 95-273 nor were they adequately developed by NOAA's regional workshops. What does seem to be emerging, however, is an identification of the role for monitoring as it relates to man's ability to manage the ocean resources.

WHY POLLUTION MONITORING

Indications are that the oceans are becoming increasingly stressed and may some day reach a point of no return. In the Global 2000 report the Council on Environmental Quality projects increasing destruction or pollution of coastal ecosystems, a resource on which the commercially important fisheries of the world depend heavily.² If decisions are delayed until problems reach the point of irreversibility management options are essentially eliminated. However, recognizing this concern the report recommended that, "Considering the magnitude of these short and long-term problems to be faced, a determined shift to a more anticipatory mode is now appropriate."³ The mechanism for meeting this need is fulfilled by a monitoring function.

As recently as January 1981 a panel of the National Advisory Committee on Oceans and Atmosphere (NACOA) under the Direction of Dr. Robert White - former head of NOAA, recommended specific Ocean Goals and Objectives for the 1980's. In regard to monitoring the ocean, the task group recommended that NOAA should establish as a goal, "To design and implement by the end of the decade a system for monitoring and assessing oceanic water quality and other parameters that affect life in the oceans and are required for fishery and pollution management".⁴

The anticipatory or early warning system has been presented in the past. In 1977 Waldichuk stated that, "There is a need for an 'early warning system' for pollutants entering the marine system, and then rapid implementation of control measures."⁵ We have to a great extent relied upon "compliance" monitoring to serve as our early warning system. Compliance monitoring programs are required primarily by the Environmental Protection Agency under Section 402 of the Clean Water Act as part of the National Pollution Discharge Elimination System, (NPDES). While these monitoring activities have accumulated vast amounts of data, little can be said relative to the health of the marine waters based upon these data other than crude generalities relative to levels of specific contaminants near the discharge itself. What we lack is a means to integrate these vast amounts of data being collected at great expense to the taxpayer (either directly through taxation, or indirectly through higher costs of goods and services) into an environmental picture so our resources can be managed more realistically.

It is our opinion that in the past monitoring has been construed in the very narrow sense and only in relationship to a specific parameter or problem. We now realize that monitoring must be looked at in a broader sense and must utilize the information gained to assist in the overall management of the environment. Monitoring is an integral part of managing the marine environment, but the marine environment is but one component of a larger system of environmental monitoring. Decisions in one area may well have a large impact on another area. A recent report by the National Advisory Committee on Oceans and Atmosphere (NACOA) recognized that ocean waste disposal should be determined in the context of the total impact on the environment and proposed that a total media management approach be adopted.⁶ For practical purposes we will concentrate this discussion upon marine waters while being continuously aware of the larger system.

Management of the environment is among the responsibilities of the nation's "decision makers" - mainly elected officials, congressmen, senators, governors and mayors (essentially politicians). It is important that these individuals be armed with the requisite tools to allow them to make informed decisions affecting the environment. The results of monitoring are one such tool. Results must be made available at the time and in a form which

will be useful to decisions makers in deciding the fate of the environment. At the same time the monitoring system must have the capability of defining long-term trends and variations in the environment in space and time scales which transcend election periods, geographical and/or political boundaries.

The goal of the monitoring system should be to determine the quality of our marine waters on a continuing basis. In performing this goal we must address the following objectives: 1. The creation of a short-term alarm system, 2. The creation of a long-term warning system and 3. A follow-up system of control or mitigation resulting from the monitoring information.

This then becomes the framework of our monitoring system. We are recommending a monitoring system which utilizes past experiences in conjunction with our view of the needs of the nation's decision makers. The system must be flexible enough to change as user's needs change and as advances are made in scientific knowledge and engineering technology. In many respects the system must be modified based upon its findings in the light of peer review and cost effectiveness. A schematic depiction of the system is shown in Figure 1.

PAST RECOMMENDATIONS FOR MONITORING

In the past 10 years several approaches have been suggested for monitoring oceanic and great lakes waters for pollution. In 1972 a report to the Administrator of the National Oceanic and Atmospheric Administration proposed a national network of fixed stations.⁷ In 1978 a sentinel organism approach to monitoring was described.⁸ Other's have proposed that monitoring programs be established on selected regional basis.⁹ These have been a variety of multidisciplinary approaches all with the common thread of defining trends of selected environmental variables in the marine environment.

A program currently in its second year of operation within the National Oceanic and Atmospheric Administration involves a merger of several elements of the agency into one monitoring activity called the Northeast Monitoring Program.¹⁰ This program is an attempt to monitor a wide geographical region of the nation's continental shelf waters for a variety of environmental measurements and relate these to marine pollution problems. It links traditional measurements with biological effects monitoring thus completing the picture of man's total effect upon the environment. Whether or not this approach is feasible as a technique in furthering our understanding of marine pollution has yet to be determined.

The United States Army Corps of Engineers has established specific monitoring requirements and guidelines to be followed by those authorized to dispose of dredge material in the ocean.¹¹ The guidelines are relatively new and long term data has yet to be collected. As implementation

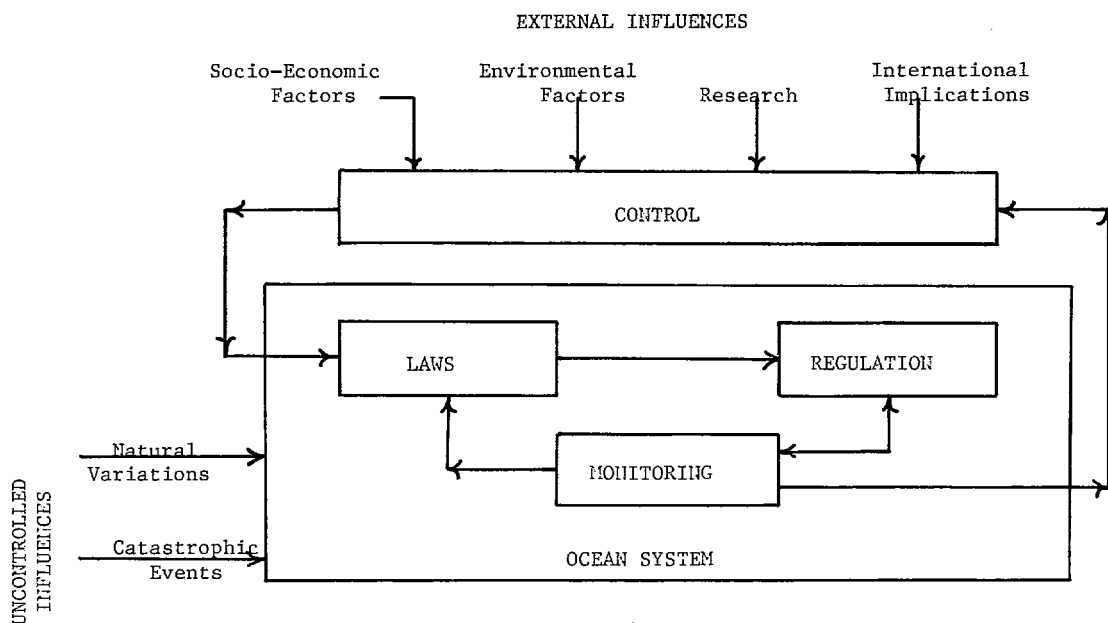


Figure 1. Monitoring in the Context of Man's Ability to Manage Ocean Resources.

proceeds it should prove useful for dredged material disposal monitoring, but again is a limited type of compliance monitoring.

On the overseas front France has developed a national system for observing the conditions of that nation's coastal waters. This system is called "Reseau National d'Observation de la Qualite du Milieu Marin";¹² it serves as short-term alarm system through the systematic and continuous observations of the biological/physical/chemical characteristics of the marine environment as well as contaminants introduced into coastal waters. Secondly, the network will create a medium and long-term alarm system through the detection of evolving trends of the quality of the coastal waters. Following these alarm mechanisms the system includes follow-up of protective and preventive measures taken and the formulation of recommendations designed to preserve the quality of the environment or bring about its improvement. While we have not thoroughly evaluated the French system it appears from the available literature that the necessary ingredients are incorporated so as to have a viable national system.

IMPLEMENTATION STRATEGIES

While there has been several general suggestions for a nation monitoring system, there has been a decided dearth of thought put into developing the necessary information required for implementation. There has been little consideration of the who, what, where, why, when, and most importantly how much such a program would cost. It is extremely difficult and impractical to deal with marine pollution issues at this high ethereal plane. As stated by Johnson in his excellent book on marine pollution, "Marine Pollution is a difficult multidisciplinary science and it is futile to attempt

to communicate its meaning by all-embracing generalities and foolish to expect that such generalities have value."¹³ Likewise, while it cannot be discussed in general terms it is unwise to discuss marine pollution problems in terms of single discipline or single problem approach. The majority of marine pollution research has focused upon a particular problem area, e.g. petroleum hydrocarbons or DDT, at the exclusion of the host of other concerns. Marine pollution and especially marine pollution monitoring must be looked at in a holistic multidisciplinary manner in order for us to begin to fully understand the overall, cumulative impacts. This is especially true in the case of low-level, chronic and sub-lethal effects of man's impact upon the marine environment.

PROPOSED MONITORING APPROACH

We are proposing an inter-related network of local-state-regional-national and international monitoring based upon a standardized suite of sediment measurements. Initially, a number of "compacts" should be established (similar to the river basin commissions) where-by the interested parties could pool their expertise and resources into a common approach to regional marine pollution problems, while operating under the umbrella of an overall federal stewardship.

Once the compacts have been established the implementation of the observing program would begin on an incremental basis. We propose to begin with sediment monitoring, as the framework (skeleton) upon which to base the remainder of the observing network. This information coupled with available information from NPDES monitoring programs and specific information on pollution occurrences, e.g. public health (closing swimming beaches), would allow us to meet the minimum requirements of the National monitoring program. Following this phase,

TABLE 1

Suggested Sediment Sampling Measurements Based Upon Existing Monitoring Requirements

Parameter	Ocean Dumping Criteria Section 228.13	Northeast Monitoring Program	London Dumping Convention Annex I & II	Recommended Analysis
Size Distribution	X	X		X
Major Mineral Constituents	X			
Texture	X			
Settling Rate	X			
Organic Carbon	X	X		X
Organic Nitrogen		X		X
Mercury	X	X	X	X
Cadmium	X	X	X	X
Copper	X	X	X	X
Chromium	X		X	X
Zinc	X		X	
Lead	X	X	X	X
Arsenic	X		X	
Selenium	X			
Vanadium	X		X	
Beryllium	X		X	
Nickel	X		X	
Pesticides	X		X	
Persistent Organohalogens	X	X(PCB)	X	X
Petroleum Hydrocarbons	X	X(PNAH)	X	X
Bacterial/Viral Indicators		X		X
Radioactive Waste			X	
Organosilicone			X	
Cyanides			X	
Fluorides			X	
Sulfides			X	X

water column and biological measurements would be added to further understand the processes involved in the movement and effects of contaminants in the system.

We have chosen sediment monitoring for several reasons: 1.) Alterations in sediment quality are early indicators of degradation of the environment. 2.) Sediments serve as an integrator of the accumulation of contaminants. 3.) Bottom dwelling organisms especially those of a relatively sedentary nature, e.g. filter feeding molluscs, are continuously exposed to the contaminants in the sediments and 4.) Sediments are the logical "sink" in the pollutant transport system.

In regard to observing parameters we have selected as the core of the observing program those measurements required by the Corps of Engineers by the Ocean Dumping Criteria¹⁴ in conjunction with NOAA's ongoing activities under the Northeast Monitoring Program¹⁵ and to include provisions for necessary monitoring requirements under the London Dumping Convention.¹⁶ A matrix of these measurements is included as Table 1.

While this approach is not all encompassing, and will find opposition from many of the community of biological scientists, we feel that this initial step must be taken as soon as possible. It is

important that a measurement system begin soon so as to develop the necessary background (benchmark) information upon which to make the continuing assessment of the quality of the environment as well as develop the national data base required.

Observing sites will be established based upon proximity to sources, known stressed and unstressed areas, areas of commercial significance and areas of potential use. A standardized sampling tool will be used, e.g. the Smith-MacIntyre grab sampler. Standardized sample preparation and analytical techniques will be utilized as much as possible so that the resulting data can be interpolated and interpreted. An existing national data bank will be utilized to archive all monitoring data in a common format so that proper statistical and interpretative manipulations can be applied.

The final phase of the program, i.e. remedial action, will lie with the various regional compacts under which the monitoring programs reside. It will be these bodies with the necessary authority to control the pollution once an impact is seen. As in the case of monitoring itself it makes little sense if corrective action is taken on a piecemeal, problem by problem, or a discipline basis. Rather, problems must be considered in a holistic fashion taking into account state, federal, and local governmental concerns; and be able to factor in

social, economic and related environmental factors.

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