

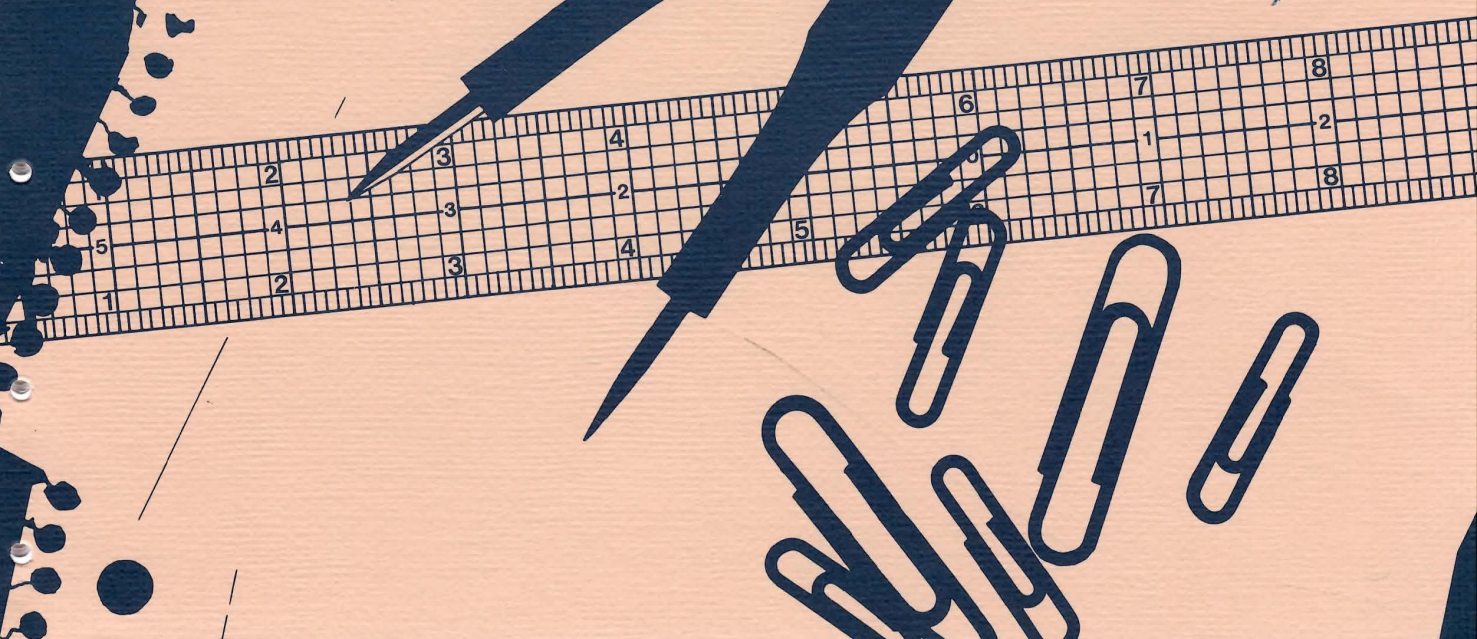
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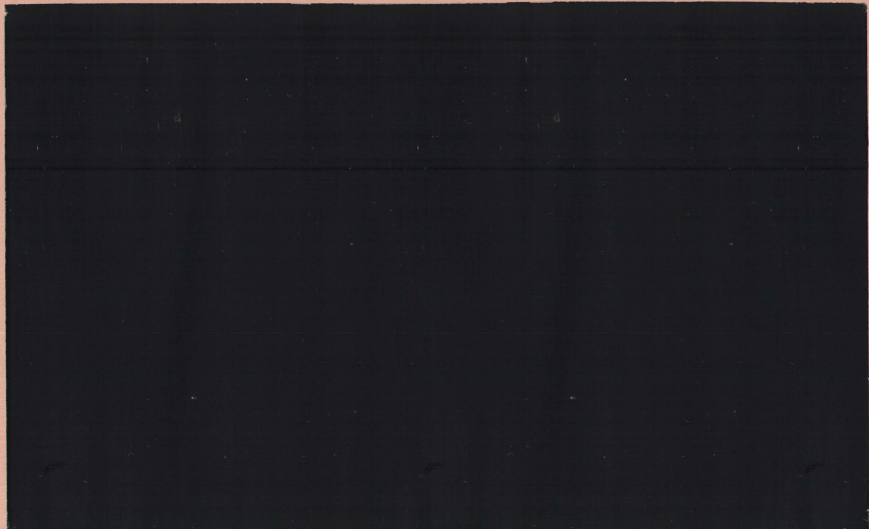
**ON DEVELOPMENT OF AN ESTUARINE  
SCIENCE-MANAGEMENT PARADIGM**

**Report of a Workshop  
23-24 April 1991**

**COAST Institute  
of the  
Marine Sciences Research Center**



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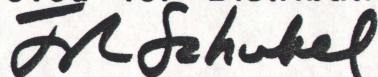
**COAST Institute  
of the  
Marine Sciences Research Center**

**J.R. Schubel  
Project Director**

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## PREFACE

This working paper is the second in a series of reports that will be prepared as part of a project to develop a model program -- a paradigm -- for research, monitoring and education in support of management of New York's estuaries. The first report was Working Paper 46 of the Marine Sciences Research Center.

## INTRODUCTION

This report is a summary of the conclusions and recommendations of a workshop held at the Marine Sciences Research Center on 23 - 24 April 1991. The goals of the workshop were (1) to review, revise, refine and enhance the Estuarine Science-Management Paradigm described in Working Paper 46 (Schubel 1990) and (2) to identify and to make a preliminary evaluation on various models for funding application of the Estuarine Science-Management Paradigm for each of New York's major estuaries. The project is based upon the assumption that a new paradigm for science in support of management is required for significant improvements in our management of estuarine systems.

The overall goal of the project is to improve the management of New York's major estuarine systems to ensure that the values, assets and uses of each system important to present and future generations are conserved and, if necessary, restored. The conservation of ecosystem integrity ranks high among values of importance.

Most of the problems in estuaries today are not significantly different from those faced by managers 10 to 20 years ago and even longer. They differ primarily in degree, not in kind. There are many reasons for this. The failure of society to resolutely tackle the fundamental causes of the problems of estuarine degradation is at the top of the list. The failure to set and announce specific goals and objectives, to develop strategies to achieve them and to monitor progress toward the goals and objectives are

not far behind. And woven through these deficiencies are the inadequacies of scientific and technical understanding of the natural processes that characterize coastal waters and of how humans have affected those processes. The proposed paradigm is rooted in the belief that if we know more, if we understand better and if we can create and sustain critical partnerships, we can develop strategies to allow humans to live in greater harmony with their environment and, by so doing, create a better future for society and for our coastal environments.

The paradigm recognizes that new environmental knowledge is not enough; it must be responsive to management issues and it must be cast into forms that are directly useful to decision makers in designing, developing and implementing management strategies. The only way to ensure responsiveness of scientists to the needs of management, the timely translation of research results into forms useful to managers, and the incorporation of new scientific information into management strategies is through strong and sustained partnerships among managers, scientists, educators and the public in the pursuit of shared values and goals. The Estuarine Science-Management Paradigm is designed to foster and sustain those partnerships.

## COMPONENTS OF THE ESTUARINE SCIENCE-MANAGEMENT PARADIGM

The essential elements of the Estuarine Science-Management Paradigm identified by the participants in the first workshop (20 September 1990) were

- Research
- Modelling
- Monitoring
- Education
- Analysis/Synthesis/Interpretation  
of data for decision makers
- Partnerships among scientists, managers  
and other decision makers.

Participants in the second workshop revised these elements to include

- Research
- Monitoring
- Education
- Analysis/Synthesis/Interpretation  
of data for decision makers.
- Management



While modelling and partnerships remain very important to the ES-MP, they were eliminated from the list of separate components of the Paradigm, and management was added. Participants in the first workshop pointed out that modelling is research, but that its importance and distinctive character justified separating it out. Participants in the second workshop acknowledged the importance of modelling to estuarine management but disagreed that it should be singled out. Indeed, they argued persuasively that often modelling and models take on a life of their own and are not coupled tightly enough to the other components of science-management programs. They pointed out that there are cases where this decoupling of modelling from other program elements has resulted in development of models that were not responsive to management needs and that were not based upon the best science. In the revised paradigm, modelling has been fully integrated into the research program.

In a similar way, there was a strong sentiment among participants in the second workshop that while the number, quality and strength of partnerships among managers, scientists, educators and public leaders must be one of the essential and distinguishing features of the ES-MP if it is to succeed, to single it out diminishes its apparent importance to all components of the ES-MP. And it conveys the impression that the creation of such partnerships is a separate, distinct and singular activity. It is not. The partnerships must be forged at the outset, woven through all program elements and nurtured throughout the entire process, if they are to have the intended characteristics and power. Still, for purposes of this written discussion, they must be singled out. To stress their uniqueness

and their importance to the ES-MP, we have moved them up in the presentation and in the diagram of the ES-MP we have shown them embedded in and linking all program elements.

The management component was added explicitly to the ES-MP to highlight its importance. Indeed, the *raison d'être* of the ES-MP is to improve the quality of estuarine management.

The components of the ES-MP -- research, monitoring, education and management -- are inextricably interconnected and should perhaps be portrayed like the arrows in the often used recycling logo; each activity feeds the others. And the partnerships among scientists, managers, educators, environmentalists and the public are the energy sources that fuel and sustain the cycle and give it its unique character. These partners are the key parties who must be involved in the ES-MP. Each has important roles to play. In the ES-MP, the whole is greater than the sum of its parts. It is the range and quality of these partnerships that will set the ES-MP apart from other regional programs of science in support of environmental management.

## PARTNERSHIPS

The ES-MP is designed to nurture and sustain partnerships among scientists, managers, other decision makers, educators, environmentalists and public leaders. The success of the ES-MP will depend ultimately upon the range and quality of these partnerships. Partnerships are the single most important factor in distinguishing the ES-MP from other approaches to science in support of coastal management.

Successful and sustained partnerships must be based upon sharing a vision that is translated into goals, objectives and actions; open, frequent exchange of ideas; respect and trust; and an identification and acceptance of appropriate roles.

For each major estuary, as part of the ES-MP, a roundtable should be created which brings together leaders from the coastal marine scientific community, the environmental community, the management community and the education community. The roundtable should meet on a periodic basis, perhaps monthly, to explore major findings and issues. These explorations should involve discussions with key researchers, managers and educators. If this mechanism is to work, it will require a commitment from individuals at the highest levels of important institutions. The activity must be a priority with the leaders of these institutions. The creation of a roundtable is a worthwhile experiment. The chances of success will be enhanced if the roundtable is moderated by someone who commands the respect of other members of the roundtable and who is able to articulate

the issues, to keep the vision alive and to keep meetings on track so that participants feel that they are engaged in an important undertaking -- one that is making a difference. Membership in the roundtable must be restricted. If membership exceeds 20 to 25, it is unlikely that the roundtable can succeed.

A good model to follow is the Government-University-Industry Research Roundtable created in 1983 by the National Academy of Science, the National Academy of Engineering and the Institute of Medicine which focuses on the interfaces of government, university and industry. Most of its work is done through working groups; each chaired and vice-chaired by members of the roundtable. Other members of working groups are selected from the community at large on the basis of their expertise on the specific issue. The working group is dissolved once it completes its assignments.

Recently, the Long Island Environmental-Economic Roundtable was formed following this same model. With less than a year's experience it is too early to assess its effectiveness, but most of the signs are positive.

## A RECAP OF KEY POINTS

### **PARTNERSHIPS AMONG SCIENTISTS, MANAGERS, OTHER DECISION MAKERS, EDUCATORS, ENVIRONMENTALISTS AND THE PUBLIC**

#### Some Characteristics of Partnerships of ES-MP

- Success of the ES-MP will depend upon the range and quality of sustained partnerships among scientists, managers, other decision makers, educators, environmentalists and public leaders.
- These partnerships are the distinguishing feature of the ES-MP.
- Successful and sustained partnerships depend upon
  - Sharing a vision and commitment
  - Open, honest, frequent exchange of ideas
  - Respect and confidence
  - Identification and acceptance of appropriate roles
  - Pursuit of important goals
  - Action that produces results
- The partnerships should be built around major management-science issues; not individual projects.
- The partnerships should be periodically reviewed to assess their effectiveness.
- For each estuary a management/science/environmental roundtable should be created; modelled after the Federal university-industry-government roundtable.

## RESEARCH

Research is necessary for progress in estuarine management, but not sufficient. Research in and of itself is not very useful to managers -- even outstanding research. Managers don't have time to read the papers and reports most scientists typically produce. And if they did, they would not find most of them very helpful. Managers need information -- they need informational products tailored to their specific needs, and they need answers to their specific questions. Information "off the rack" won't work. If science is to be an effective tool in estuary management, the job is not done when the research project has been completed and the manuscript describing the results has been submitted to a prestigious journal for publication. Mechanisms are needed to take advances in understanding and fashion them into tools that can be used for management.

Most of the research important to managing estuaries is fundamentally and inextricably interdisciplinary in nature. It is research which can be conducted effectively only by teams of specialists from different disciplines who work together to design the observational programs, who collaborate in carrying out those programs and who work together to analyze and interpret the data. In almost all cases, each of these teams should include experimentalists and modelers.

Research in support of estuarine management requires patience, persistence and constancy of commitment.

The ES-MP is designed to be regional in scope. It can make -- indeed it must make -- important contributions to our understanding of coastal processes and of how humans have affected those processes if it is to succeed. This means it must have a strong fundamental research component, but it is not intended as a substitute for a sustained, federally-funded program of basic research directed at generic issues (themes) that cut across a large number of similar coastal environments. A new, imaginative federal program of sustained fundamental research in the nation's estuaries is essential. It does not exist. The program must be sufficiently exciting and flexible to engage some of the best minds. This requires that it be sufficiently flexible to embrace wild ideas, to take chances. "Science is an occupation for gamblers. Of course, journeyman science can be done without much risk taking, but highly creative science almost always requires a calculated gamble. By its very nature, scientific discovery derives from exploring previously unexplored lands. If it were already known which path to take, there would be no major discovery -- and the path would most likely have been previously explored by others" (Herbert A. Simon 1986).

In estuarine science -- in programs at all levels -- there has been far too much "journeyman science", relative to more imaginative science. Estuarine scientists need to learn from their deep water colleagues. They need to design "big science" projects; to form multidisciplinary teams of the best scientists not only from throughout the U.S., but from throughout the world. They need to get out of their own backyards and go to the

environments where the phenomena to be studied are expressed most clearly and richly.

As Herbert Simon has observed, one can't predict a priori where payoffs will come. It is only through such an imaginative program of unfettered research that major advances in understanding will be made and that significant and cost effective management strategies can be formulated for the nation's estuaries.

These are appropriate goals for a federally-funded program of basic research. But the State also has a role to play in research. New York ranks number 1 in terms of the percentage of its total population and the number of people living in coastal counties. Among all 23 coastal states, New York ranks number 13 in the length of its coastline. Among all coastal states, New York almost certainly ranks significantly lower in terms of its support of coastal research. The exact ranking is difficult to establish, however, because the data are poor. Considering the value of New York's coastal environments and the lack of attention they have received to date, it would be appropriate for New York State to make a major and sustained commitment to developing the scientific information needed to manage these invaluable resources.



## A RECAP OF KEY POINTS

### RESEARCH

#### Some Characteristics of the ES-MP Research Program

- The Research Program should be directed by a scientist who is nationally recognized and respected in an appropriate field and who has demonstrated a commitment to shaping the results of science for management and policy applications.
- The first step in developing the Research Program should be the formulation of conceptual models of the natural system (including the drainage basin and contiguous water bodies) and human interactions with it. It is part of an interactive system.
- The Research Program must be responsive to management issues (goals) and to other ES-MP components.
- A variation of the "Tight-Loose" concept of management of Peters and Waterman could be helpful in developing the Research Program. In the ES-MP context, the concept translates into "Tight" to environmental management themes; "Loose" in the freedom for scientists to pose questions and hypotheses, to design experiments and to conduct the research. Some % (~10%) should be reserved for high risk, innovative research that may not appear to be immediately applicable to management issues, but which may lead to important scientific breakthroughs and critical understanding needed in the long run.
- Research should span the spectrum from short-term to long-term, with the emphasis on medium to long-term (three to five years).

- The Program should foster multi-institutional, multi-disciplinary research on important scientific questions and respond to management issues. This collaboration should be nurtured at the proposal development phase.
- All proposals should receive rigorous peer review.
- The Program should work to ensure multi-year support for appropriate projects.
- Observational/Experimental/Modelling/Monitoring components should be encouraged in each project.
- The Research Program should be characterized by patience and constancy of commitment.
- The Research Program of the ES-MP should contribute to taking estuarine research to the next level: making significant contributions to understanding and managing New York's estuaries. The important perennial questions to be tackled are the same questions of importance in many of the nation's other estuaries.
- The Research Program should foster development of partnerships of scientists with managers from the outset (Science-Management Teams) and partnerships with educators, environmentalists and the public.
- The Research Program must be a research program with a capital "P" -- not just a collection of research projects, but a fully integrated Program.
- The Research Program should support research on management structures and research on important social science questions.

- **The Research Program should encourage publication of results in peer-reviewed journals.**
- **The Research Program must ensure broad dissemination of results in a rich variety of forms appropriate for different user groups.**
- **At the outset and on a periodic basis, the Research Program should conduct workshops for scientists, managers and environmentalists to summarize the current status of knowledge and to identify high priority research areas and themes.**
- **Periodically (perhaps every two years) the Program should create opportunities to evaluate what the research effort has produced -- in new understanding and in information for management -- and to evaluate how much of that new knowledge has been incorporated into management strategies.**
- **The Research Program administration should ensure a built-in flexibility to make appropriate modifications to the Research Program.**
- **The Research Program must support both research on processes and on how the particular estuarine system operates as a system; research must include the coupling of human activities in the drainage basin with the estuary as well as coupling of the estuary to open shelf waters and to contiguous coastal water bodies.**
- **The ES-MP should ensure development of a coordinated network of Research Programs for all New York State estuaries under a single research administration.**

- **There must be coordination among New York State estuarine programs and between these programs and other programs, including national and international programs.**

## A RECAP OF KEY POINTS

### Modelling -- A Component of the Research Program

Modelling is singled out as a special category of research deserving special attention because of the importance of models to management, because of the great faith placed in them by many and because of the potential for abuse and for large expenditures of money.

- The Program should start with a conceptual model of the entire system, referred to above.
- In this Program, special attention needs to be devoted to developing linkages among individual conceptual models of specific processes and phenomena.
- The Program should recognize that models are tools that come in all sizes, varieties and degrees of sophistication.
- The Program must achieve and sustain a good match between models and management needs, and between models and evolving scientific knowledge. This can be ensured if the partnerships described earlier are created at the outset and maintained.
- A few basic descriptive physical models and water quality models are required for each coastal system. All others should be developed only after specific management issues have been identified.
- The Program must nurture partnerships among modelers, other scientists and managers for development of fisheries models and linked models, e.g., ecosystem models and fisheries management models.

- **The Program must address major questions, problems and opportunities.**
- **The Program must model entire systems, when appropriate or needed.**
- **The Program must ensure better communication between modelers and other participants in the Research Program.**
- **The Program must ensure a stable organizational entity to run and maintain models so they will be readily available on a continuing basis.**
- **Models should be an important linkage between research and management.**

## MONITORING

The first question the ES-MP should ask regarding monitoring for each coastal system is what monitoring program would best complement the research program to address the major management issues that have been identified. Once this question has been answered, a rigorous analysis should be made of the existing monitoring programs to determine whether they are adequate for the purposes of the ES-MP. This should be done for each coastal system by a small team of experts. If existing monitoring activities are adequate to meet the specific needs of the ES-MP, the next question is whether or not the data are readily accessible and whether there are assurances that the critical observational programs will be continued.

If there is any uncertainty, the ES-MP may wish to create its own monitoring program. This should be done only if existing monitoring efforts cannot meet the needs of the ES-MP. The key will be in getting the appropriate data with proper quality assurance on a timely basis, and developing mechanisms to ensure that the data are transformed into information useful to the managers associated with the ES-MP.

The ES-MP should not attempt to coordinate all of the monitoring activities being carried out by federal, regional, state, county and city agencies in the coastal system. Effective monitoring programs are carried out to address specific questions, or to test specific hypotheses. That should be the trademark of the monitoring activities undertaken or

assimilated by the ES-MP. Monitoring in the ES-MP should be viewed as a form of long-term research -- observational programs to answer specific questions, to test specific hypotheses, to provide data to adjust and verify models, to document the status and trends of important environmental properties -- including living resources, to provide early warnings of incipient problems, and to assess the efficacy of management actions.

The monitoring data that are relevant to the ES-MP should be analyzed, synthesized and interpreted at least every two years, and perhaps every year. Each of the science-management teams should review these synthesized data sets and assess their relevance to the management issue being tackled. The data should be used to test the efficacy of the management strategies adopted.

Adequate support must be provided for synthesis/analysis/interpretation of monitoring data over the long-term. If there are budget problems, monitoring and synthesis efforts should not be among the first activities to be eliminated. There must be patience and a constancy of commitment to the monitoring program just as to the other components of the ES-MP. Environmental monitoring programs are of great potential value, although few even approach that potential (National Research Council, 1990).

In the ES-MP monitoring program, mechanisms should be put in place to be on the alert for new technologies that may permit observing at the coastal system more efficiently and more effectively or in new and different ways. Before incorporating any new technology, special care should be



exercised to ensure consistency of the data to the extent possible. Monitoring problems should receive routine periodic checkups -- perhaps every three years -- to determine whether they are still playing a useful role. Programs or parameters should be added or dropped, as appropriate. In part, this will be done through the annual evaluations by the management-science teams.

Since the ES-MP will be driven by societal values and uses, monitoring of values and uses of direct importance to society should not be overlooked. Some of the more important parameters such as the frequency and intensity of human uses of the system for different kinds of recreation and aesthetic qualities may not be measured by the existing programs of other agencies. Thus, social scientists should be included in these initiatives.

The public can play important roles in a comprehensive environmental monitoring program, particularly in the monitoring of floatables, wildlife, aquatic vegetation, recreational boating, number of bathers and the frequency of other uses of the coastal system by the public. Special educational training programs for participants in public monitoring programs are essential if the programs are to be effective. Public observers can produce data and information that might otherwise not be available. If the public is involved, mechanisms must be developed from the outset to coordinate the activities of public observers so that the data are reliable and so that the public groups can be kept involved over the long haul. This requires that they see how their data are being used and that the data are reported and disseminated.

One useful mechanism could be the equivalent of the Chesapeake Bay monitoring program's "Bay Barometer." The "Bay Barometer" appears on a regular basis in Chesapeake Bay regional newspapers to provide a chronicle of changing conditions of interest to the public.

## A RECAP OF KEY POINTS

### MONITORING

#### Some Characteristics of the ES-MP Monitoring Program

- The Program should establish at the outset what monitoring is needed for success of the ES-MP. Most monitoring should reflect management goals.
- In determining what to monitor and at what frequencies in time and space, the Program should consider measurement of progress toward meeting management goals, modelling needs and regulatory needs.
- The Program should assess if the monitoring needed for the ES-MP is available. This assessment should be based on a rigorous analysis of existing monitoring programs by a small team of experts.
- The Program should exploit monitoring activities already being done and add only what's missing and needed. The Program should try to influence existing programs, including compliance monitoring programs, to make them more responsive to the goals of the ES-MP without compromising their original goals.
- The ES-MP should ensure that its monitoring program meets the criteria outlined by the National Research Council (1990).
- The Program should view monitoring as long-term research: it should ask questions, test hypotheses, develop conceptual models.
- The Program should ensure effective data management.

- The Program should analyze, synthesize and interpret monitoring data relevant to ES-MP every one or two years. The Program should provide adequate support for these activities and protect them.
- The Program should allocate approximately the same level of support for management and synthesis of data as for data collection.
- The Program should be on the alert for new technologies that allow greater efficiency and effectiveness, and new ways of looking at the environment while ensuring consistency of data.
- The Program should incorporate appropriate new methodologies while ensuring consistency of data.
- The Program must convert monitoring data into informational products useful to different constituencies, including the public. The Program should not overlook geographical information systems.
- The monitoring program should have a thorough periodic check-up, about every three years.
- The Program should include monitoring of environmental values and uses.
- The Program should incorporate an appropriate public monitoring component that is coordinated in partnership with the over-all monitoring program and with the educational program.
- The Program should work toward establishing a network of standard, or at least a coordinated network of, sampling locations among all monitoring programs.

- The Program should develop a coherent plan for storing, managing and retrieving data over the long term. Data should be stored in at least two sites.
- The ES-MP's monitoring program should take full advantage of monitoring initiation in estuaries in the National Estuary Program (NEP).
- The Program should place the regional monitoring program in the context of national programs, particularly NOAA's "Status and Trends" and EPA's "Environmental Monitoring and Assessment Program -- Near Coastal."
- The Program should establish and maintain links among the monitoring-research-management-education components.
- The Program should ensure that the entire system is monitored -- watershed, estuary and contiguous shelf waters -- for diagnostic parameters and at appropriate time-space scales.
- The Program should establish the criteria for assessing the success of the Program and measure success every two to three years.

## EDUCATION

In the Estuarine Science-Management Paradigm, education plays a vital role along with research and monitoring. Education is the mechanism for keeping the public informed and supportive. It is also the mechanism for training the next generation of scientists, managers and informed and concerned citizens -- citizens who elect our decision makers.

Concurrent with these research and monitoring activities, scientists, managers, professional educators and leaders of public interest groups should form continuing partnerships to produce a variety of educational materials. The materials must be suitable for different age groups, for individuals of different educational levels and backgrounds and for delivery through different media. But all must share several features in common. They must be accurate, balanced, informative and interesting. They must pose the environmental issues accurately and richly. They must identify the full range of management alternatives and assess the advantages and disadvantages of the alternatives individually and in different combinations. They must make the factual basis of each issue clear so that important environmental problems -- problems that deserve attention -- can be differentiated from those that may be perceived to be important, but for which scientific evidence indicates otherwise. The goal is to move the technical diagnoses of environmental problems and the prescriptions for their treatment out of the arena of opinion and into the arena of specialized knowledge with proper educational vehicles.

In their new book "Trashing the Planet," Dixie Lee Ray and Lou Guzzo (Ray and Guzzo 1990) explore the apparent mismatch between the benefits and the detriments of technology to society and trends in environmental quality. They ask,

"What has brought this condition about? What has made us lament rather than rejoice? What has made us so quick to believe the worst about ourselves and so reluctant to recognize the good?"

"Among many possible explanations is this one. We have simply done a rotten job of teaching science. Oh, not to those students who will become scientists -- we're quite good at that -- but at the equally important job of teaching science to all those others, to the overwhelming 80 percent or more of the student population who will not enter science or engineering as a profession. There we fail miserably."

Ray and Guzzo go on to point out that most people get most of their information about science and technology from the media, particularly from television and that it is not scientists, but reporters, news directors and editors who control the content of the information delivered by TV.

The authors go on to point out that scientists will have to learn to work more effectively with the media ". . . because there is simply no other mechanism in a free society that can provide the necessary scientific information to voters and politicians." They are probably right about the

general public, but there are several other audiences that scientists and engineers must not give up on. It is worth a serious and concerted effort to work more effectively with teachers at all levels, particularly non-science teachers and with environmental groups. If we do our work well with these groups, perhaps the media will be inclined to report more responsibly on environmental matters.



## A RECAP OF KEY POINTS

### EDUCATION

#### Some Components of the ES-MP Educational Program

- The Program should integrate education into the ES-MP; connect it with other components. The ES-MP should develop an educational Program with a Capital "P".
- The Program should formulate clear goals and objectives at the outset; they should be targeted at the over-all goals and objectives of the ES-MP.
- The Program should stress development of educational materials important to the success of the ES-MP and the incorporation of these materials into existing delivery systems. All proposals should be subjected to rigorous peer review.
- The ES-MP Educational Program should work with existing educational programs and systems to enhance and enrich the uses of appropriate educational materials, including those developed through the ES-MP.
- The Educational Program should provide opportunities for teachers to participate in field programs, seminars, conferences and other forums dealing with important ES-MP issues.
- Educational leaders should be involved in the development of the Educational Program.
- The same levels of excellence should be insisted upon for the educational component as for all other components of the ES-MP.

- The Educational Program should not overlook the importance of education of ES-MP participants across all components; it can be important in forging partnerships, in developing an ES-MP culture which will be critical to the sustained success of ES-MP.
- There should be a periodic review (perhaps every three years) of the Educational Program to assess its impact and its effectiveness. Criteria should be established early in the development of the Program which will be used to assess effectiveness.
- The Educational Program should ensure that there is an environmental-nature interpretive center for each estuary. Special effort should be made to link existing programs, to enhance them; to develop an interactive network. Special effort should be made to link its existing programs, to enhance them, to help promote them, to develop an interactive network, such that existing efforts are not duplicated.
- One important educational activity of the program will be to keep the public informed about all ES-MP activities -- new findings, management successes, monitoring results.
- The Educational Program should develop a variety of customer services to answer questions from the public and to assist in problem solving: an environmental hot line, consultation service, and teams of experts.
- The Educational Program should fund research on assessing the effectiveness of educational products and services and on evaluating how well they perform.
- The Educational Program should give a priority to those educational activities that focus on individuals and groups most important to the success of the ES-MP.

## **ANALYSIS/SYNTHESIS/INTERPRETATION OF DATA AND TRANSFORMATION INTO INFORMATION**

Among the reasons for the tension between the managers and scientists on the importance of research are the mismatch of the expectations of managers and scientists regarding the direct applicability of the results of research to the solution of practical problems and the mismatch in time scales of applicability. Managers need information tailored to a specific problem or issue, and they need it now. Too often academic scientists give them the information neither in a form that is tailored to their particular needs, nor on the time scale in which they need it.

Managers need information, not data. Peter Drucker (1988) described the difference between data and information in the following way: "Information is data endowed with relevance and purpose." The Nobel Laureate P.B. Medawar (1984) added that in a professional vocabulary, "Information connotes structure or orderliness that makes possible the transmission of a meaningful message, or in the form of a communication that prescribes and confers specificity upon any structure or performance."

Scientific and technical information comes from research and monitoring, but if scientific advances are to be useful to management in a timely way, special efforts are needed to tailor the information to the special needs of the manager. The ES-MP is designed to promote this activity.

The leaders of the ES-MP must be committed to a sustained program of fundamental research on issues or themes important to major management problems. They also must be committed to the development of mechanisms to improve the timeliness and effectiveness with which advances in knowledge can be applied to the management and resolution of those problems.

A key component of the ES-MP for each coastal system will be a unit formed by a small permanent staff (one to three people) dedicated to the analysis, synthesis and interpretation of data and to the transformation of environmental data into information. The unit's primary function will be coordination and facilitation. It will rely on principal investigators, on science-management teams and on other experts using a variety of mechanisms described in other sections of this report to develop most of the desired informational products.

## A RECAP OF KEY POINTS

### ANALYSIS/SYNTHESIS/INTERPRETATION OF DATA AND TRANSFORMATION INTO INFORMATION

#### Some Characteristics of These Activities in ES-MP

- The ES-MP should build into each proposal an obligation of the principal investigators to be part of a Science-Management Synthesis Team; educators and communications experts also should be involved.
- The ES-MP should ensure that Science-Management Teams are a continuing activity.
- There should be a spectrum of meeting functions that will ensure frequent interactions of team members on important issues, while minimizing the time required.
- The ES-MP should ensure financial support for participation in these activities by governmental representatives.
- The ES-MP should ensure a timely transformation of data into a rich variety of informational products.
- One ES-MP product should be annual white papers on the evolving science-management issues. These should be incorporated into a series of dynamic documents providing a chronicle of the ES-MP.
- The ES-MP should have a small unit (one to three people) to provide and coordinate staff support to the experts for the full range of analysis/synthesis/integration.

- The ES-MP should make sure meetings are important and run effectively and efficiently.
- The ES-MP should provide opportunities for young investigators interested in careers dedicated to science in service to society.
- Strong, effective teams are critical to the success of the ES-MP. The administrative responsibility of these teams should be given to more senior people; to team leaders.
- The ES-MP should recognize and promote, particularly in academia, the value of the creative aspects of high caliber synthetic activities.
- The ES-MP should establish fellowships and internships for scientists and managers to work together in synthesis teams.

## FUNDING FOR THE ES-MP

Discussion of this topic began with a brainstorming session to answer the question: “In how many ways can we generate and sustain the funds necessary to implement the ES-MP?” The guidelines for a brainstorming session are that (1) quantity of ideas is what counts, (2) no criticism is allowed during the idea-generating stage, (3) wild ideas are encouraged and (4) formation of linkages among ideas is encouraged. The complete list of ideas generated is presented in Table 1. Once the flow of ideas had been exhausted, the evaluation began. These ideas and others will be discussed in greater detail in a future report.

There was unanimity among workshop participants that if the ES-MP is to succeed, it must have an adequate and stable funding source. It was also agreed that the chances of the ES-MP succeeding are enhanced as flexibility in use of funds is increased, particularly during the initial stage of the project. For this reason, the workshop participants recommended an initial demonstration phase to test, refine and demonstrate the power of the ES-MP concept. They recommended that private funds should be sought to support this phase to ensure maximum flexibility and, in that way, maximize the probability of success.

## TABLE 1

**Listing of All Ideas Generated During Brainstorming Session of The Question: In How Many Ways Can We Generate and Sustain the Funding Necessary to Implement the ES-MP? (Listed in the order presented).**

- **Sell 50 Million Hats**
- **Pass a Bond Act**
- **Get Large Contributions From Individuals, Corporations, Foundations, Agencies . . .**
- **Develop a Dedicated Revenue Stream From, For Example, a Cigarette Tax, a Gas Tax, a Sales Tax . . .**
- **Dedicate Fines, Court Settlements To a Special Fund**
- **Implement User Fees**
- **Enact a Temporary Increase in the Sales Tax**
- **Enact a Salt Water Fishing License**
- **Add a New Check-Off to Income Tax Returns**
- **Secure Support From Groups That Would Ultimately Benefit From the ES-MP**
- **Redirect Existing Monies**
- **Set Aside 1% of Appropriate Capital Projects**



## ORGANIZATIONAL STRUCTURE

The Workshop focused its discussion on identifying the desirable characteristics of an organizational structure for the ES-MP. These characteristics will be particularly important during the initial demonstration phase of the ES-MP. They are summarized in Table 2.

The organizational structure and funding mechanisms will be discussed in greater detail in a future report.

**TABLE 2**

**DESIRABLE CHARACTERISTICS OF THE ES-MP  
ORGANIZATIONAL MODEL**

- **Simplicity**
- **Independence**
- **Flexibility**
- **Commitment of Key Resource Management Agencies at All Levels**
- **Commitment of Resources From All Key Agencies to Ensure Their Active Participation**
- **Accountability to Resource Management**
- **Accountability to the Scientific Community**
- **Involvement of Key Individuals and Groups Representing All Constituencies Critical to the Success of ES-MP**

## WHAT'S NEXT?

The ES-MP should be tested. Funding should be sought, possibly from private sources, to apply it to one of New York's major estuaries for a period of five years. This demonstration should be initiated only after securing adequate support and commitments from big organizations and individuals.

## SUMMARY

### STEPS IN APPLYING THE ES-MP

The steps in applying the Estuarine Science-Management Paradigm are outlined in this section. Repetition of material presented earlier is intentional.

**Step 1. Identify through public consultation the assets/values/uses which society wants to protect or enhance.**

This initial step should involve broad consultation to assess the public's desires. It should be achieved through workshops, conferences and other public forums. The results should be distributed widely for comment. A consensus should be achieved.

**Step 2. Identify specific management issues targeted at the assets/values/uses identified by society. Each issue should be stated richly.**

This step should be carried out by key managers, a few carefully selected scientists and a few representatives of the public.

**Step 3. Determine whether or not each management issue identified in step 2 can be addressed adequately**

**with existing data and information; determine how well it can be addressed -- to what levels of accuracy and depth.**

For each major management issue there should be one or more carefully orchestrated vertical integration efforts targeted at specific themes. Each of these synthesis efforts should be done by a group of experts no larger than is needed to cover the essential elements of that issue. These teams should be put together by the leadership of the ES-MP through a negotiation process and not through a broadside request for proposals. Each team should involve the best minds possible in all required areas of expertise. Each synthesis team also should make a first cut at defining the research needs, short-term and long-term, to provide the missing information needed to address the management issues.

**Step 4. Formulation of a Research Program responsive to management issues.**

The management issues will change with time, but in all cases the scientific program should be responsive to them. One of the primary objectives of the ES-MP is to achieve and sustain a good match between management issues and the Research Program, and to retain enough flexibility and autonomy so that the Research Program takes a relatively long view.

The Research Program of the ES-MP must be protected against the whims of society which characterize the normal agency-supported research

programs, programs that often are buffeted by political winds driven by the "pollutant of the week" syndrome.

The preliminary statement of research needs developed in step 3 is the starting point for development of a research program responsive to management needs. The difference between the Research Program of the ES-MP and the more conventional research initiative is that, indeed, it is a Program, a Program with a capital "P". The elements of the Program should be identified by a group of outstanding scientists and a small number of key managers. Several of the scientists responsible for development of the Program should be from outside the region.

The Research Program will be made up of projects, most solicited through Requests for Proposals (RFPs), but mechanisms should be put in place to ensure that the projects are integrated into the Program. The RFPs should state clearly what the management issues are and what information the managers believe they need, but they should be less prescriptive than the typical RFPs for estuarine programs. The choice of specific questions to be asked, or hypotheses to be tested, and the approaches to be used should be left to the scientists. The proposals developed in response to the RFPs should become a major mechanism for selection of projects to be funded. In the selection process, flexibility and openness to creative ideas must be ensured.

Efforts should be made in the development phase of the proposal process to encourage multidisciplinary research by teams of experts; teams which include modelers and experimentalists. It also would be appropriate for

each proposal to indicate how it would utilize monitoring data that exist and monitoring data that are being collected, and to stipulate what additional monitoring data would be available. The importance of socio-economic research should not be overlooked.

The resulting proposals should be subjected to rigorous peer review before any funding commitments are made. It is implicit, however, that once funded the commitment of support for these teams would extend beyond the normal one-year cycle, perhaps three to five years.

All principal investigators supported by the Research Program must have an obligation to be part of a science-management team with managers who are actively involved with responsibility for the specific management issue. The team should meet periodically -- at least quarterly -- to review progress on the research and to explore how the results relate to the management issue.

Each of these teams of scientists and managers also should meet in a more formal setting on an annual basis to prepare a "white paper" on the research and management issue. These will be evolving, dynamic reports that chronicle the ways in which the scientific program has been responsive to management needs and how research results have actually been incorporated into management strategies -- management policies and practices. The interactions between managers and scientists will lead to new research initiatives as the program evolves.

**Step 5. Formulate Management Strategies to Achieve Societal Goals; Utilize the Best Scientific Information**

Management of the system to ensure the assets, values and uses desired by society (step 1) is the raison d'être of the ES-MP. The goals and objectives of the program should be stated explicitly and in terms of assets/values/uses important to society now and in the future. Ecosystem integrity should not be overlooked as an important value.

**Step 6. Implement the Management Strategies**

Without action nothing of importance will happen.

**Step 7. Design and Implement an Environmental Monitoring Program to Assess the Efficacy of the Management Strategies Adopted**

A monitoring program should be carefully crafted to meet the goals and objectives of the ES-MP. It should exploit the best of existing monitoring programs and should add observation only if needed. It should focus on generating important data of high quality and on transforming those data into information needed for the ES-MP. The importance of monitoring uses and values, and of involving the public should not be overlooked. The program should be given a rigorous check-up on a periodic basis.



**Step 8. Create a Science/Management/Education/Environmental Roundtable**

A permanent roundtable should be created which brings together, on a periodic basis, leaders from all the different constituencies critical to the success of the ES-MP. The number of permanent seats at the roundtable should be limited to a maximum of 25. The roundtable should provide a forum to develop and articulate a vision, to clarify goals and objectives and to undertake important projects that cut across ES-MP program elements.

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