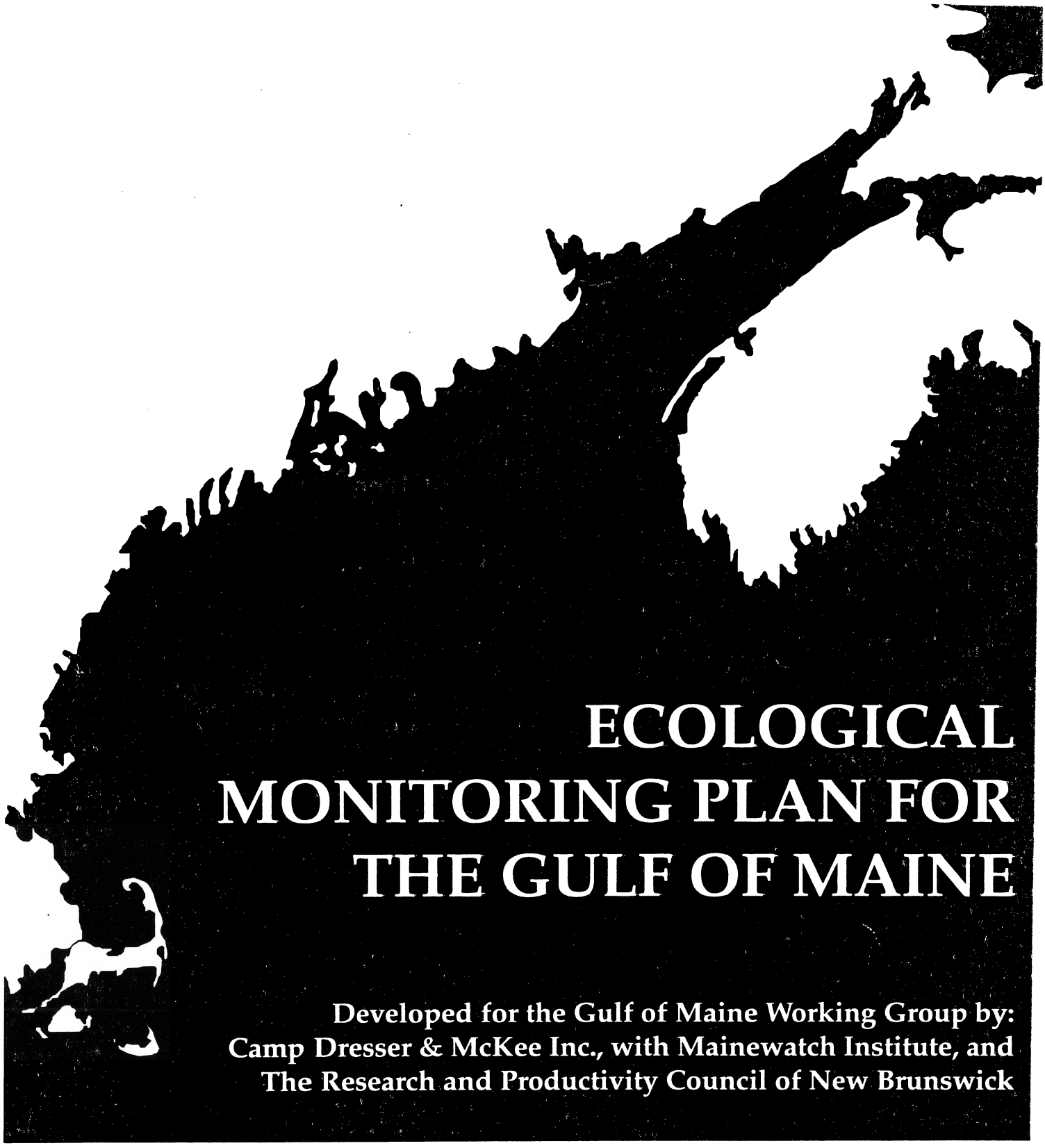


ECOLOGICAL MONITORING PLAN FOR THE GULF OF MAINE

Developed for the Gulf of Maine Working Group by:
Camp Dresser & McKee Inc., with Mainewatch Institute, and
The Research and Productivity Council of New Brunswick

GULF OF MAINE MONITORING PLAN

FINAL REPORT

JUNE 30, 1990

Camp Dresser & McKee Inc.
Research and Productivity Council
of New Brunswick
Mainewatch Institute

EXECUTIVE SUMMARY

This report presents an environmental monitoring plan for the Gulf of Maine. The monitoring plan is one of the tasks in the Action Plan being developed by the Gulf of Maine Council, which was established by an agreement signed in December 1989 by the Governors of Maine, Massachusetts and New Hampshire, and the Premiers of Nova Scotia and New Brunswick.

The monitoring plan is based on management goals and objectives, and monitoring goals and objectives, developed in conjunction with the Gulf of Maine Working Group, the predecessor to the Gulf of Maine Council. Three monitoring goals were established by the Working Group and 11 monitoring objectives developed to meet those goals. The three goals for a monitoring program in the Gulf of Maine are:

- To provide information on status, trends, and sources of marine-based human health risks in the Gulf of Maine including environmental media and products contaminated with pathogens, biotoxins, and metallic contaminants at or near action levels.

- To provide information on the status, trends, and sources of risks to the marine environment in the Gulf of Maine.

- To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action.

A survey was mailed to over 150 scientists, environmental managers, policy makers, and others in the Gulf to identify the important issues and rank the importance of the monitoring goals and objectives. A working conference was then held in Halifax NS on May 31-June 1, 1990 to discuss the priorities and achieve a consensus. The three objectives with the highest priority were:

1. To assess the the status and trends in the marine environment by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality.

2. To assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact.

3. In cases where environmental degradation is suspected, to identify the probable causes, especially as they reflect anthropogenic impacts and cumulative effects.

The participants of the working conference identified an ancillary priority that is not related specifically to monitoring, but should be an important part of any environmental management strategy for the Gulf: all existing environmental data on the Gulf needs to be organized, assessed for quality, and made accessible to a wide range of users.

The monitoring plan described in this report outlines the monitoring methods needed to meet all the 11 monitoring objectives, and identifies ongoing monitoring programs in the Gulf that are addressing these objectives. The plan provides the first stage in what is anticipated to be an ongoing process of review and revision. The further implementation of a monitoring program will require developing detailed sampling designs which specify the number of samples to be collected, the exact locations, and the laboratory procedures to be used for analyzing the samples. This information can usually only be established after pilot studies are done to assess statistical variability in the data.

The monitoring methods presented in this report are developed from a review of methods currently used in other programs and from a list of monitoring questions that were developed to address each objective. The methods are categorized in terms of six monitoring parameters which include:

1) The variable to be monitored,
2) The sampling medium in which the variable is measured (i.e. soft bottom, hard bottom, tissue etc.),
3) The geographical scale/location where sampling should take place,
4) The frequency with which the variable should be monitored,
5) The field methods to be used to monitor the variable, and
6) The type of data analyses needed to provide the information to answer the question.

A more detailed monitoring plan is presented for the three objectives with the highest priority. This includes the proposed locations where sampling should take place and the estimated cost of monitoring the appropriate variables. Overall, it is estimated that the monitoring a broad range of indicators to meet the first objective (assessing the marine environment) will cost in excess of $3,000,000 US annually in the Gulf. This assumes that existing monitoring programs can be modified as needed to collect the appropriate data in their current locations. The estimated cost for collecting the information needed meet the objective with the second highest priority (assessing human health risks from toxics) is estimated to be $560,000 annually. This cost estimate, however, is based on only monitoring the risks of mercury and PCBs, the two toxic compounds for which standards in foods have been developed. There is a major need to fund additional research to understand the human health risks from other toxic compounds. The costs for meeting the objective with the third highest priority, that of identifying causes, cannot be estimated at present because the area and scale of environmental changes have not yet been identified.

The monitoring plan presented in this report also outlines three additional aspects of a monitoring program:

- The procedures to facilitate the transfer of information between the scientists analyzing the monitoring data and the environmental managers who will be using the information to develop management actions,

- A possible organizational structure for the monitoring program, and
- Guidelines for developing a database for storing the information collected by the monitoring program.

PREFACE

Effective management of the Gulf of Maine requires accurate understanding of the nature, scale, and impact of environmental perturbations in the Gulf. The Gulf of Maine Working group, comprised of representatives of the Gulf States and Provinces, early on identified assessments of the health of the Gulf as of pressing importance. The Working Group initiated development of a monitoring plan as a first step toward improving environmental management of the Gulf, envisioning a program that will allow evaluation of environmental quality of the Gulf and improved effectiveness of prevention and remediation efforts.

In 1989, the Working Group established a Monitoring Subcommittee which has worked hard to identify the environmental quality issues of greatest importance to the Gulf States and Provinces and establish a framework for the monitoring plan.

A consortium of Canadian and U.S. firms was hired in late 1989 to develop an initial plan. Camp Dresser & McKee, of Cambridge; Mainewatch Institute, of Hallowell, Maine; and The Research and Productivity Council of New Brunswick, of Fredericton have worked together with the Monitoring Subcommittee to draft goals for the program, review monitoring methodologies, estimate costs, and outline a plan for implementation.

Much time and thought was put into the development of the goals and objectives in particular. Several drafts and redrafts were reviewed by the subcommittee before the final wording was chosen. This effort was made to ensure that the monitoring program, once designed and implemented, will serve the interests and requirements of the Gulf States and Provinces.

As part of this process, a workshop was held in Halifax in early June, 1990 to review a draft report on the proposed monitoring program. Scientists, environmental managers and policy-makers from throughout the Gulf region worked together to develop consensus on goals and objectives and to begin the process of identifying priorities and selecting appropriate monitoring methodologies. The current document reflects the results of the workshop.

The monitoring subcommittee of the Working Group intends this document to be the first step in the development of a marine environmental quality monitoring program for the Gulf of Maine. The development of such a plan for an area as large and complex as the Gulf of Maine is not a simple task but must be accomplished in stages. This report represents the first stage in what is anticipated to be an ongoing process of review and revision. This document is not necessarily intended to be a manual suitable for implementation. Rather, it is meant to establish the broader goals and objectives of a Gulf-wide Monitoring Program upon which a more detailed strategy can be built.

It is anticipated that several ad hoc committees will be formed to identify specific, implementable monitoring methodologies for the high priority

objectives identified in the plan. In addition, the plan will be reviewed at a major scientific conference on the Gulf of Maine planned for late 1990.

As a strategy for implementation, the plan will build on monitoring activities currently underway in the Gulf. For example, it is anticipated that the Status and Trends Program of the U.S. National Oceanic and Atmospheric Administration will be expanded to answer questions about the health of the larger Gulf ecosystem. Gaps in existing programs will be identified and new programs designed. In addition, the plan will focus on local problems, such as shellfish closures, that occur throughout the Gulf region. Data collected from coastal embayments on toxic contamination, nutrient enrichment, and shellfish and beach closures will be augmented by similar data collected in other industrialized embayments along the Gulf shore. It is our hope that this collective approach will yield better solutions to problems encountered or anticipated in such areas.

The success of this exciting endeavor will depend on:

- o the cooperation of States and Provinces in adapting existing monitoring programs to serve the objectives of the Gulf program as well as their own objectives;
- o funding for new monitoring to fill gaps identified in existing monitoring activities;
- o regional coordination to provide guidance for the development and implementation of the program;
- o a database management system that will allow information generated by the monitoring program to be readily available to environmental managers throughout the region; and
- o link to a geographic information system such as Environmental Canada's FMG project.

The Monitoring Subcommittee invites your comments on this monitoring plan. The further development of this plan requires the informed participation of monitoring professionals, other scientists, environmental managers, and policy-makers. Please forward your comments to the Monitoring Subcommittee, c/o Maine State Planning Office, Station 38, Augusta, ME, 04333, so that they may be incorporated in further iterations of the plan.

Anne Johnson Hayden
Chair, Monitoring Subcommittee
Gulf of Maine Working Group

ACKNOWLEDGMENTS

This report was written by Dr. Thomas Hruby of Camp Dresser & McKee Inc. and Dr. John Fitch of Mainewatch Institute. We gratefully acknowledge the guidance and constructive criticism of the Working Group Subcommittee on Monitoring with special thanks to Anne Johnson Hayden, Jack Pearce, and Wayne Barchard. We also wish to thank the many people that responded to the survey, that attended the workshop, and that gave us valuable feedback on the interim draft of the monitoring plan.

We thank Mr. Foster Burningham for his assistance in designing the survey, analyzing the results and in assembling the report on the survey in Appendix C. We thank Dr. Mutual O'Connor for this assistance in facilitating the Gulf of Maine Environmental Monitoring Workshop and for assembling the report on the workshop in Appendix D.

The assistance of Mainewatch Institute administrative assistant Kathi Fortin and research intern Susan Farady in processing the survey results and in assisting in workshop planning and implementation was important and much appreciated.

We also appreciate the assistance of St. Mary's University and especially Dr. Peter Ricketts in co-sponsoring the workshop and helping with the many logistical details.

TABLE OF CONTENTS

TABLE OF CONTENTS
(cont.)

LIST OF FIGURES

LIST OF TABLES

GULF OF MAINE ECOLOGICAL MONITORING PLAN

FINAL REPORT

1.0 INTRODUCTION

The Gulf of Maine is a unique marine ecosystem defined by its physical, chemical, and biological conditions. It is a semi-enclosed sea, separate from the North Atlantic by underwater banks. With its rich bays and estuaries, extensive watersheds, and diverse ecological communities, the Gulf is one of the most productive marine ecosystems on earth. Many of its species migrate through the Gulf region paying little heed to political boundaries separating states, provinces, and nations. Thus, environmental problems and stresses in one area may affect ecological productivity and stability in other parts of the Gulf.

But, the Gulf of Maine is more than a productive natural ecosystem. Both Native American and colonial European cultures settling in the Gulf have been shaped by its environmental and natural resources. The resulting rich and diverse cultural heritage contributes to the region's quality of life. At present, it is home to a large and thriving human population that is dependent on the Gulf's environmental quality and natural resources. The Gulf's economic, aesthetic, and recreational values are directly tied to its natural ecosystem.

The Gulf's natural ecosystem is under increasing and cumulative stress as human populations increase, and as related development expands in the Gulf of Maine bioregion. Pollution, habitat destruction, and overharvesting threaten the Gulf's human and environmental "health". Human health is threatened in some coastal areas by raw or partially treated sewage and industrial discharges. Toxic contaminants are found in the Gulf's deepest basins. Sediments in several of its harbors contain exceptionally high levels of toxic substances. Increased fishing effort has contributed to all time lows in some fish stocks, and coastal development has destroyed environmentally important wetlands. Native species such as the piping plover have because endangered because of steady and cumulative habitat loss. These problems threaten the Gulf's ecosystem and the livelihood of health of its people.

1.1 Gulf of Maine Council on the Marine Environmental and Action Plan

Recognizing that the Gulf of Maine is a common resource of inestimable value to their residents, the provinces of Nova Scotia and New Brunswick, the states of Maine and New Hampshire, and the Commonwealth of Massachusetts have agreed to a cooperative effort to protect the Gulf of Maine environment. An agreement signed by five jurisdictions in December 1989 establishes a Gulf of Maine Council on the Marine Environment, recognizing that the ecological integrity of the Gulf of Maine supercedes all other interests. As a link between the many state, provincial, and federal agencies involved in the Gulf of Maine, the Council will facilitate ongoing and future efforts by the five jurisdictions to maintain and enhance the Gulf's marine ecosystem, its natural resources, and environmental quality. Specifically, the Council will provide assistance

and coordination for research, monitoring, and management; dissemination of scientific data; improved state, provincial, and federal communications; and heightened public awareness. The Council's first task is to develop an Action Plan that can serve as a blueprint "to maintain and enhance marine environmental quality in the Gulf of Maine and to allow for sustainable resource use by existing and future generations." A Working Group was established in 1989 to develop the Action Plan.

The Action Plan is designed to accomplish two tasks: to protect and improve the environmental health of the Gulf of Maine ecosystem, and to minimize risk to public health from polluted Gulf waters. The Action Plan addresses three major issues: environmental quality, coastal resources, and marine resources. There are four areas of concentration under each issue: coordinated management, monitoring, research, and public education and participation.

1.2 The Roles of Environmental Management and Monitoring

Early human cultures attempted to manage the natural environment and to use its resources on a more predictable basis. Over time, as humans became more effective in manipulating natural environments and in harvesting their resources, unforeseen or detrimental impacts became apparent. Management then became necessary to reduce these impacts. Native Americans, for example, adopted hunting and fishing strategies to sustain game species as well as to harvest them. Early European settlers to New England sometimes managed fisheries by establishing seasonal and numerical limits. As human populations increased, their impacts on the natural environment have become more diverse and pervasive so that even underlying environmental quality and ecological integrity are now threatened on local, regional, national, and even global levels.

Modern environmental managers must, thus, address human and environmental health issues as well resource needs. Management efforts have become increasingly focused on maintaining ecological integrity as a means of protecting environmental quality and natural resources. Environmental management goals for the Gulf of Maine Action Plan listed below reflect this approach:

1. To develop harmonious management approaches for the maintenance and enhancement of the environmental quality of the Gulf.

2. To develop interjurisdictional management approaches for the maintenance and enhancement of resources.

3. To develop interjurisdictional strategies for the continued sustainable use of marine land and water resources.

Effective management, however, cannot be accomplished without environmental monitoring. At a time when single species resource harvesting was the major management concern, monitoring tasks were much more simple--to estimate species populations, reproductive rates, and, perhaps, habitat requirements. Today, however, environmental monitoring has expanded in complexity and scope to address diverse management needs.

Information about ecologically important aspects of a resource is needed in order to develop a sound management plan. Information is needed on the sources, ecological resources, the threats to ecological integrity, how the threats impact the ecosystem and human environment, and how the threats and impacts change with time. It is the purpose of a monitoring program to provide this necessary information to the managers and policy makers.

Monitoring involves two kinds of tasks; the first is collecting data on ecological and socio-economic parameters, and the second is analyzing the data so the results are meaningful to managers. Monitoring is an integral part of environmental management because it identifies the problems that need managing, assesses the significance of impacts on the ecosystem, and then assesses whether management actions taken are effective. The data collected are needed for several different management functions. These include:

- To inventory ecological resources,
- To document chemical, physical, and biological changes,
- To identify threats to resources and ecological integrity,
- To assess the significance of the threats,
- To establish the sources of the threats,
- To follow trends in both the resources and the threats, and
- To assess the effectiveness of management actions taken to reduce the threats.

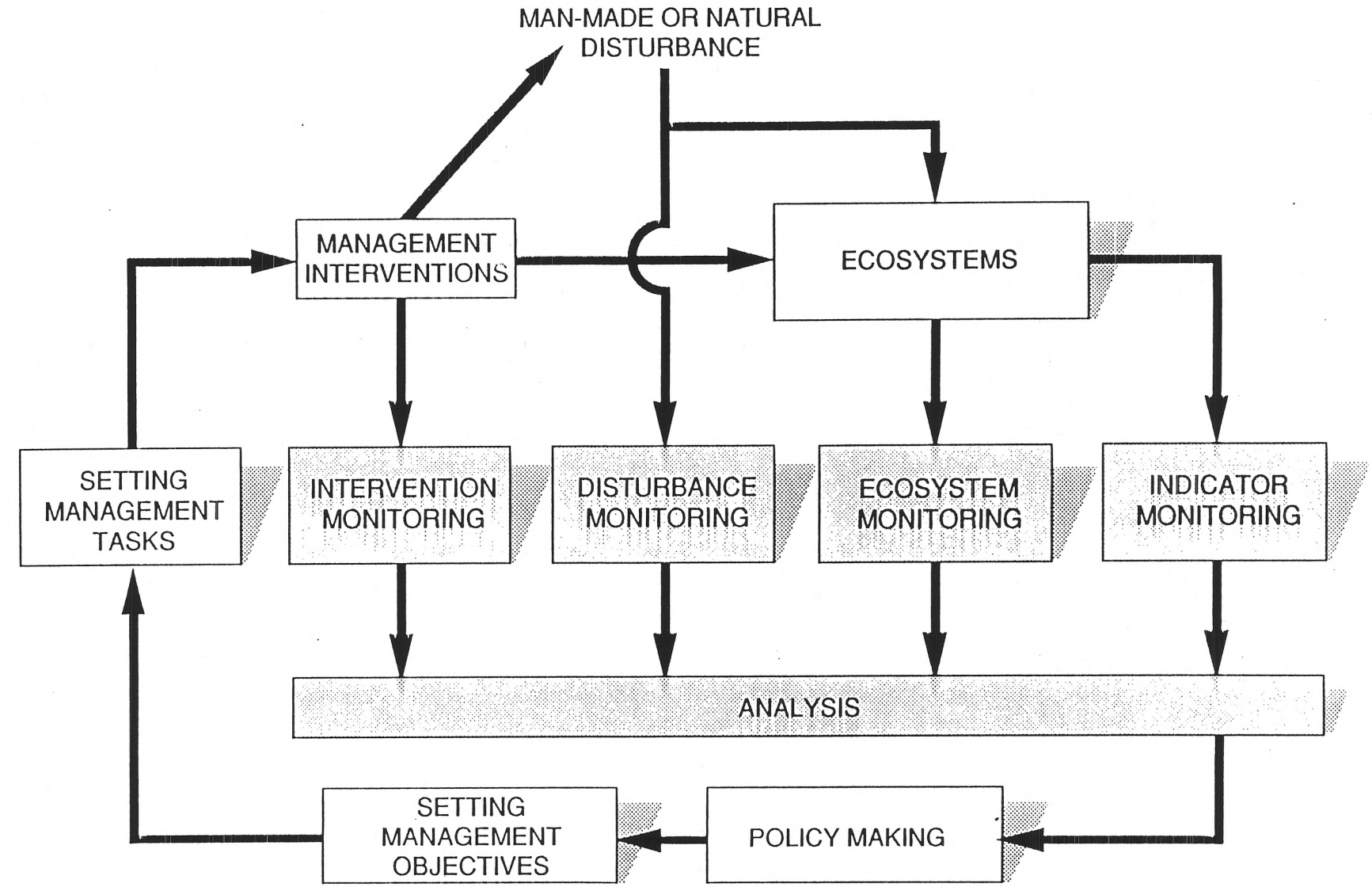
Environmental monitoring is closely linked to environmental management. The two activities are interactive and form a feedback loop. A diagram of how monitoring is integrated with management is shown in Figure 1. As shown in the figure, monitoring involves collecting data for several different purposes.

The first is monitoring the chemical, biological, and physical aspects of ecosystems to assess ecosystem integrity and how it changes in time. Because monitoring an ecosystem is extremely difficult, efforts are often focused on specific biological, chemical or physical indicators that are used as an analogy for the entire system. Managers use this information to identify environmental problems.

If monitoring is to be a useful management tool, however, it has to fulfill other purposes as well. These include collecting information on the disturbances that can cause changes in ecosystem integrity. Identifying remedial actions that can be taken is also an important part of management. Finally, monitoring is needed to assess if specific management interventions are effective at reducing, or eliminating, the disturbances that are affecting ecosystem integrity.

1.3 Gulf of Maine Marine Environmental Quality Monitoring Plan

Recognizing that an overall monitoring plan is a necessary first step in improving environmental management in the Gulf, the Gulf of Maine Working Group established a monitoring subcommittee charged with developing a Gulf of Maine Marine Environmental Quality Monitoring Program. Their mission statement is as follows:



Adapted from Ter Kers and Meelis, 1986

FIGURE 1
INTEGRATION OF MONITORING IN ENVIRONMENTAL MANAGEMENT

In support of the Agreement on Conservation of the Marine Environment of the Gulf of Maine, it is the mission of the Gulf of Maine Marine Environmental Quality Monitoring Program to provide environmental and resource managers with information to support sustainable use of the Gulf, and allow assessment and management of risk to public and environmental health from current and potential threats.

The subcommittee, after a review of existing programs and much discussion, defined three goals for the monitoring program:

1. To provide information on status, trends, and sources of marine-based human health risks in the Gulf of Maine including environmental media and products contaminated with pathogens, biotoxins, and metallic contaminants at or near action levels.

2. To provide information on the status, trends, and sources of risks to the marine environment in the Gulf of Maine.

3. To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action.

As the first step in developing a Gulf of Maine Marine Environmental Quality Monitoring Program, the subcommittee on monitoring contracted with Camp, Dresser & McKee, Inc. of Cambridge, Massachusetts; Mainewatch Institute of Hallowell, Maine; and the Research and Productivity Council of New Brunswick; through the Maine State Planning Office to develop an initial monitoring plan.

This monitoring plan is based on goals and objectives developed in conjunction with the Gulf of Maine Working Group and modified during the Gulf of Maine Environmental Monitoring Working Conference held at St. Mary's University in Halifax on May 31 and June 1, 1990. The plan has been designed to address the following needs:

1. Transboundary: To should provide a blueprint and conceptual framework for "generic implementation" throughout the Gulf of Maine region across political boundaries. It should also provide a structure for standardizing monitoring methodology and data bases throughout the region.

2. Preventative: To provide for early warning of changes affecting human health, natural resources, and environmental quality so that preventative rather than crisis-oriented management actions may be taken.

3. Ecosystems-oriented: To address both tangible features of ecosystems such as species density and diversity, chemical and physical variables, and less tangible features such as energy flow and nutrient cycling.

4. Cooperative and consensus-building: To develop a plan with input from scientists, managers, and policy-makers who will be its ultimate users, and to foster improved communication and cooperation.

5. Management emphasis: To emphasize the timely development of useful information for management decision-making, and for the evaluation and fine-tuning of management actions. Monitoring information must be "accessible" to managers and policy-makers while being scientifically sound and reliable.

6. Use of past and present monitoring efforts and information: To build upon existing efforts and data bases. It should also identify monitoring gaps and areas requiring additional research.

Operational definitions of environmental management and monitoring are needed in order to develop a common approach and conceptual framework. For the purposes of this plan, environmental management is defined as:

> The process of protecting, maintaining, restoring, and/or optimizing long term environmental quality, biodiversity, and natural resources by maintaining the integrity of the Gulf of Maine ecosystem.

The following definition of environmental monitoring was adapted from Environment Canada's definition of environmental effects monitoring (Anon. 1986).

> A program of observations for the purpose of determining whether the presence, or change in the incidence, of a factor(s), has adversely affected human health, or critical biological processes, or the physical and/or chemical nature of the Gulf of Maine ecosystem.

1.4 Gulf of Maine Marine Environmental Quality Monitoring Plan Report

This report presents the Gulf of Maine Marine Environmental Quality Monitoring Plan. Ongoing monitoring efforts were identified through literature reviews; surveys of scientists, managers, and policy-makers in the Gulf of Maine; through a report produced by the Maine State Planning Office; and through discussions at the Gulf of Maine Environmental Monitoring Workshop, held on May 31 and June 1, 1990 at St. Mary's University in Halifax, Nova Scotia. Ongoing monitoring projects are summarized in Appendix A and present monitoring methods used in the Gulf of Maine are discussed in Section 2 of the report and listed in Appendix B.

To be effective, information from the Gulf of Maine Monitoring Program must be readily available to scientists, managers, and policy-makers throughout the region. Suggestions for data management are outlined in Section 5 and suggestions for improving communication and information transfer are outlined in Section 6. These suggestions are based in part on survey results and discussions at the workshop.

Finally, this report contains suggestions for an organizational structure to support the monitoring program in Section 7 and suggestions for an implementation process in Section 8. A glossary of terms is included in Appendix E.

This plan is designed to provide an initial, general framework or blueprint for the Gulf of Maine Monitoring Program based on direction from the Working Group monitoring subcommittee and initial input from 64 scientists, managers, and policy-makers. It will be circulated to scientists, managers, and policy-makers for their comments and then modified accordingly.

The plan, however, does not specify sampling design. This requires statistical and logistic considerations which cannot be specific at this stage in the planing process. Many locations have never been sampled for specific variability and that found in the laboratories doing the analyses (LGL, Ltd. et al.). The second step, developing a statistically based sampling design is highly recommended if hypotheses are to be tested. Many monitoring efforts in the past have not proved the information for which they are established because the data were not statistically defendable (Rosenberg, et al., 1981; Hurlburt, 1984).

1.5 Monitoring Objectives for the Gulf of Maine

Specific monitoring objectives have been developed by the Working Group to meet their overall monitoring goals. These objectives reflect the specific environmental management needs of the GOM as identified by the Working Group. Eleven objectives have been identified. These are listed below, and form the basis of the monitoring plan described in the following sections.

An important part of the new monitoring plan is to identify ongoing monitoring efforts and integrate them into a overall plan structure. Thus, current monitoring efforts that are addressing aspects of the objectives are also listed by the acronym of the sponsoring organization. The detailed description on ongoing program and key to the acronyms, and locations where monitoring is occurring, is given in Appendix A. A summary is shown in Table 1.

1.5.1 Monitoring Objectives for Goal #1: Information on Human Health Risks

1.5.1.1 Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment.

Ongoing programs addressing this objective include: USGS, CDEP-S, MeDMR-S, NHDHW, MA-DEQE, Cape Cod, Bowdoin.

1.5.1.2 Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact.

Table 1: Matrix showing which ongoing monitoring programs meet proposed Gulf of Maine monitoring objectives. Programs are identified by an acronym which is described in Appendix A.

PROGRAM

OBJECTIVE	ODCA	NS&T-B	NS&T-MW	F&O-PSP	MeDMS-PSP	F&O-L'Etang	BHMP	CSW-T	USFWS	USMMS	USGS	NAQUADAT	NCPDI	RIPS	MARMAP	CDEP-S	MeDMR-S	NHDHW	MaDMR-S	MaDMR-PSP	MA	Cape Cod	Bowdoin	NPS-Acadia
Assess risks to human health from pathogens		●									●					●	●	●	●			●	●	
Assess risks to human health from toxics	●	●	●					●	●		●	●	●	●										
Assess risks to human health from phytotoxins				●	●															●				
Assess fish stocks															●									
Assess environment using indicators	●	●	●			●	●	●		●	●	●	●	●	●						●	●	●	●
Identify causes of degradation																							●	
Assess impacts of catatrophes																								
Provide information to managers		●	●																					
Provide timely analysis and interpretation																								
Evaluate and update monitoring																								
Assess impacts of management actions																								

Ongoing programs addressing this objective include: ODCA, NS&T-MW, CWS-T, USFWS, USGS, NAQUADAT, NCPI.

1.5.1.3 Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from biotoxins transmitted through marine foods.

Ongoing programs addressing this objective include: F&O-PSP, McDMS-PSP, Ma-DMR-PSP.

1.5.2 Monitoring Objectives for Goal #2 Information on the Marine Environment.

1.5.2.1 Assess the status and trends in the ecological viability of fish stocks, and identify the causes of change, especially those that can be related to harvesting.

The ongoing program addressing this objective is MARMAP which samples fish populations along transects extending across the GOM.

1.5.2.2 Assess the status and trends in the environment by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality.

Ongoing programs addressing this objective include: ODCA, NS&T-B, NS&T-MW, F&O-E'tang, BHMP, CWS-T, USMMS, USGS, NAQUADAT, NCPDI, MARMAP, MA, Cape Cod, and Bowdoin.

1.5.2.3 In cases where environmental degradation is suspected, identify the probable causes, especially as they reflect anthropogenic impacts and cumulative effects.

No ongoing programs are addressing this objective.

1.5.2.4 The impacts of environmental catastrophes in relation to existing information.

No ongoing programs are addressing this objective.

1.5.3 Monitoring Objectives for Goal #3: Information Exchange.

1.5.3.1 Provide information generated by monitoring activities to resource and environmental managers in a format that will allow risk assessment, assessment of catastrophes, and the design of appropriate rehabilitation, mitigation, damage avoidance, and other management actions.

No ongoing programs are addressing this objective.

1.5.3.2 Provide timely analysis, interpretation and presentation of monitoring results; including analysis of point and nonpoint source contamination on appropriate geographical scales and evaluations of the monitoring program itself relative to developing management needs.

No ongoing programs are addressing this objective.

1.5.3.3 Assess the impact and effectiveness of environmental management actions on risks to public health, the viability of harvestable resources, ecosystem integrity, and local economies as measured by the indicators and models used in the monitoring program.

No ongoing programs are addressing this objective.

2.0 MONITORING METHODS

Monitoring of the marine environment has been ongoing for over three decades, and numerous methods have been developed to collect and interpret ecological data. A literature survey of monitoring programs was done to compile information on the questions asked and the methods used. The compilation of methods provides the basic information used in making choices of monitoring methods for the GOM.

The methods for collecting and analyzing data can be grouped into several "method parameters", which reflect the different aspects of a monitoring program that need to be accomplished. The method parameters that we have identified from a review of other monitoring programs are the environmental or socio-economic VARIABLES to be monitored, the physical environment or MEDIUM from which data on the variables are collected, the actual FIELD METHODS needed to collect samples, the LABORATORY METHODS needed to quantify or analyze samples, and the methods of data ANALYSIS for generating the information needed by environmental managers. Depending on the management objectives, three other parameters that need to be specified are the geographical SCALE, LOCATION, and FREQUENCY of sampling and data analysis. Each one of these method parameters need to be defined for every monitoring question being asked.

The method parameters are to some degree independent of each other, and are not hierarchically linked. Thus, the information compiled on existing methods that have been used in other monitoring programs cannot easily be represented in a tree diagram or a two-dimensional matrix. As a result, the information is presented in a series of tables to be found in Appendix B. The literature search identified over 115 variables that have been monitored, using one or more of 35 field methods in 6 different sampling media. Variables have been quantified in the laboratory using one or more of 27 different methods, and the results interpreted using over 24 different analytical tools and modeling techniques. All of these aspects of monitoring methods are listed in Appendix B.

Scale and frequency are continuous "method parameters", and thus not easily tabulated. They are omitted from the Appendix, but are discussed in the proposed plan. In other monitoring programs the scale has ranged from a very small scale (i.e., a small bay) to global; while frequency of sampling usually ranged from hourly in some cases to annual, or less, in others. Location is a method parameter for which there is no uniformity across monitoring programs so it also cannot be summarized.

3.0 MONITORING METHODS FOR MEETING MONITORING OBJECTIVES IN THE GULF OF MAINE

The monitoring objectives developed for the Gulf of Maine Action Plan are broad in scope and do not in themselves contain enough information from which to develop a monitoring plan. The plan needs to be based on very specific questions phrased in such a way as to permit developing testable hypotheses.

The following outline lists monitoring questions that have been developed to meet the objectives described in Section 1.5. Following each question is the list of monitoring parameters needed to address that question in the GOM. If there was no funding limits, the outline would represent a monitoring plan that addresses all the objectives. However, this ideal situation does not yet exist, and the following outline is refined in subsequent sections to reflect priorities developed by the Working Group, a written survey, and a Working Conference held in Halifax, N.S. on May 1, 1990.

The monitoring methods listed for each question are based on the review of existing methods summarized in Appendix B. The monitoring parameters best suited to each question, relative to needs in the GOM, are listed as a guide for setting up a sampling design. Six monitoring parameters are identified for each question. Four are described in Appendix B, and the other two, which are specific to the Gulf are described below.

The first method parameter that is specific to the GOM is SCALE. This parameter identifies the geographical scale at which the monitoring should be focused. The different options for this parameter used are as follows:

Coast-local: sampling program is coastal and focused on individual bays, estuaries, beaches or harbors.

Coast-regional: sampling program is coastal and integrated over a regional or large bay system such as Casco Bay

Coast-GOM: sampling program is integrated and coordinated along the entire GOM coast.

Open-regional: sampling is in open ocean, and integrated and coordinated over a regional or basin area such as Stellwagen Bank.

Open-GOM: sampling program is integrated and coordinated over all the open waters in the GOM.

The second previously undefined parameter is FREQUENCY. The options are:

- weekly sampling
- during or immediately after a storm
- monthly
- continuously for one year
- once a year
- seasonally, 4 times a year

3.1 Monitoring Questions and Methods to Meet Goal #1 - Human Health Risks

3.1.1 OBJECTIVE: Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment.

Questions related to pathogens cannot be answered fully because methods do not exist for routine monitoring of disease organisms in water. The standard procedures using coliform bacteria do not indicate pathogens, they indicate only the presence of wastes from warm blooded animals, and the possible presence of pathogens. Until better methods are developed the monitoring plan will assume that coliform bacteria will be used as analogs for pathogens.

3.1.1.1 In what areas of the GOM are pathogens analogs near, or above, action levels?

ONGOING PROGRAMS:	CDEP-S MeDMR-S, NHDHW, MaDEQE, Cape Cod, Bowdoin, USGS
VARIABLES:	Fecal coliform, Enterococcus
SAMPLING MEDIUM:	Water, tissues
SCALE:	Coast-local (near population centers, point discharges, shellfish beds)
FREQUENCY:	Weekly
FIELD METHODS:	Bottle, surface grab, dig (for shellfish tissue)
DATA ANALYSIS:	Parametric and nonparametric statistics

3.1.1.2 What are the risks to public health from these levels?

RESEARCH QUESTION. Research is needed on how to monitor and quantify the actual pathogens that cause human illnesses.

3.1.1.3 Are there any trends in pathogen analogs in the areas where concentrations are near, or above, action levels?

ONGOING PROGRAMS:	CDEP-S, MeDMR-S, NHDHW, MaDEQE, Cape Cod, Bowdoin, USGS
VARIABLES:	Fecal coliform, Enterococcus
SAMPLING MEDIUM:	Water, tissues
SCALE:	Coast-local (near population centers, point discharges, shellfish beds)
FREQUENCY:	Weekly during the summer
FIELD METHODS:	Bottle, surface grab, dig
DATA ANALYSIS:	Regression analysis

3.1.1.4 In what areas of the GOM might pathogen analogs reach action levels in the near future, and will they reach these levels?

ONGOING PROGRAMS:	CDEP-S, MeDMR-S, NHDHW, MaDEQE Cape Cod, Bowdoin, USGS
VARIABLES:	Fecal coliform, Enterococcus, Currents, Winds
SAMPLING MEDIUM:	Water, tissues
SCALE:	Coast-local (near population centers, point discharges, shellfish beds)
FREQUENCY:	After major storm during the summer
FIELD METHODS:	Bottle, surface grab, dig, current meters, wind meters.
DATA ANALYSIS:	Statistics, physical circulation models

3.1.1.5 What is the increase, or decrease, in risk to human health from changes in the levels of pathogens?

RESEARCH QUESTION. Research is needed on the pathogens that can cause illness, and the risks they represent.

3.1.1.6 What is the economic impact of human illness resulting from changes in the concentration of pathogens?

RESEARCH QUESTION. Same need as 3.1.1.5

3.1.1.7 What are the sources of acute and chronic health risks from pathogens?

ONGOING PROGRAMS:	None
VARIABLES:	Fecal coliform, Enteroccocus
SAMPLING MEDIUM:	Water
SCALE:	Coast-local (near population centers, point sources, rivers)
FREQUENCY:	After storms
FIELD METHODS:	Bottle, surface grab
DATA ANALYSIS:	Statistics

3.1.2 OBJECTIVE: Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from biotoxins in marine foods.

3.1.2.1 In what areas of the GOM are phytotoxins near, or above, action levels?

ONGOING PROGRAMS:	MaDEP-PSP, F&O-PSP, MeDMS-PSP
VARIABLES:	PSP, Domoic Acid
SCALE:	Coast-local (shellfish beds)
SAMPLING MEDIUM:	Tissues
FREQUENCY:	Weekly during summer
FIELD METHODS:	Dig (for shellfish)
DATA ANALYSIS:	Statistics

3.1.2.2 What are the risks to public health from these levels of phytotoxins?

RESEARCH QUESTION. Research is needed on the relationships between concentrations of toxins and rates of illness, especially for domoic acid.

3.1.2.3 What is the existing economic impact of human illness resulting from phytotoxins?

RESEARCH QUESTION. Same as 3.1.2.2

3.1.2.4 Are there any trends in phytotoxins in the areas where concentrations are near, or above, action levels?

ONGOING PROGRAMS:	Ma-PSP, F&O-PSP, MeDMS-PSP
VARIABLES:	PSP, Domoic acid
SCALE:	Coast-local, shellfish beds
SAMPLING MEDIUM:	Tissues
FREQUENCY:	Weekly during summer
FIELD METHODS:	Dig/dredge (for shellfish)
DATA ANALYSIS:	Regression analysis

3.1.2.5 In what areas of the GOM might phytotoxins reach action in the near future, and when will they reach these levels?

ONGOING PROGRAMS:	Ma-PSP, F&O-PSP, MeDMS-PSP
VARIABLES:	Phytoplankton species, currents
SCALE:	Coast-local
SAMPLING MEDIUM:	Water
FREQUENCY:	Monthly during summer, currents-continuous for a year
FIELD METHODS:	Bottle, pump, current meters
DATA ANALYSIS:	Circulation and transport models, community structure

3.1.2.6 What is the increase, or decrease, in risk to human health from changes in the levels of phytotoxins?

RESEARCH QUESTION. Same as 3.1.2.2

3.1.2.7 What is the economic impact of human illness resulting from changes in the concentration of phytotoxins?

RESEARCH QUESTION. Same as 3.1.2.2

3.1.2.8 What are the sources of phytotoxins?

RESEARCH QUESTION. Research is needed to identify what phytoplankton species, in addition to the Gonyaulux spp. and Nitzschia sp., produce PSP, domoic acid or other phytotoxins. Research is also needed to identify the causes of the blooms of these species.

3.1.3 OBJECTIVE: Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds in marine foods and through water contact sports.

3.1.3.1 What toxic compounds are a human health risk through swimming in polluted waters?

ONGOING PROGRAMS:	None
VARIABLES:	Priority pollutants (all)
SCALE:	Coast-local (beaches, point sources, river mouths)
SAMPLING MEDIUM:	Water
FREQUENCY:	Bi-annual
FIELD METHODS:	Bottles
DATA ANALYSIS:	Risk analyses

3.1.3.2 Are foods contaminated with toxic compounds a human health risk?

ONGOING PROGRAMS:	NS&T-B, NS&T-MW, USMMS
VARIABLES:	Priority pollutants (all), PAH metabolites, PCB metabolites, pesticide metabolites, methyl mercury
SCALE:	Coast-local
SAMPLING MEDIUM:	Tissues
FIELD METHODS:	Nets, traps, digging for catching organisms
FREQUENCY:	Once
DATA ANALYSIS:	Risk analyses, regression analyses, statistics

3.1.3.3 In what areas of the GOM are these toxic compounds near, or above action levels?

RESEARCH QUESTION. Since very few action levels exist, research is needed to develop action levels for most toxics.

3.1.3.4 Are there any trends in the areas where concentrations are near, or above, action levels?

ONGOING PROGRAMS:	None
VARIABLES:	Priority pollutants (all), PAH metabolites, PCB metabolites, pesticide metabolites, methyl mercury
SCALE:	Coast-local
SAMPLING MEDIUM:	Tissues
FIELD METHODS:	Nets, traps, digging for catching organisms
FREQUENCY:	Annual
DATA ANALYSIS:	Risk analyses, regression analyses, statistics

3.1.3.5 In what areas of the GOM might toxics reach action levels in the near future, and are will they reach these levels?

ONGOING PROGRAMS:	None
VARIABLES:	Priority pollutants (all), PAH metabolites, PCB metabolites, pesticide metabolites, methyl mercury, currents
SCALE:	Coast-local
SAMPLING MEDIUM:	Tissues, sediments
FIELD METHODS:	Nets, traps, digging, corers current meters
FREQUENCY:	Annual, continuous for 1 year for current meters
DATA ANALYSIS:	Risk analyses, regression analyses, statistics

3.1.3.6 What is the existing economic impact of human illness resulting from toxic compounds in the marine environment?

RESEARCH QUESTION. Research needed on the health impacts of many toxic compounds. Existing risk analyses on toxics in marine foods are extremely imprecise.

3.1.3.7 What is the increase, or decrease, in risk to human health from changes in the levels of toxics?

RESEARCH QUESTION. Same as 3.1.3.6

3.1.3.8 What is the economic impact of human illness resulting from changes in the concentration of toxics?

RESEARCH QUESTION. Same as 3.1.3.6

3.1.3.9 If water contact or marine foods are causing health risks, what are the sources of the contamination?

ONGOING PROGRAMS:	None
VARIABLES:	Priority pollutants, currents
SCALE:	Coast-local (near population centers, mouths of streams, point discharges)
SAMPLING MEDIUM:	Water, sediments
FIELD METHODS:	Water bottles, corers
FREQUENCY:	Monthly and after storms
DATA ANALYSIS:	Statistics, regression analyses, circulation models

3.2 Monitoring Methods for Goal #2 - Information on the Marine Environment

3.2.1 OBJECTIVE: Assess the status and trends in the ecological viability of fish and shellfish stocks, and identify the causes of change, especially those that can be related to harvesting.

3.2.1.1 What are the economically important fish stocks, and what is their existing impact on local economies?

VARIABLES:	Wholesale prices, marine related job income
SAMPLING MEDIUM:	Socio-economic records
SCALE:	Coast-local
FREQUENCY:	Annual averages
FIELD METHODS:	N/A
DATA ANALYSIS:	Statistics

NOTE: The next series of questions can all be asked for each species that has been identified as economically important. Thus, the total number of monitoring questions will depend on the number of important species identified. In advance of any actual survey, the species that should be included in a preliminary list include: lobster, soft-shell clam, cod, haddock, blue-fin tuna, Atlantic salmon, local species of shrimp, ocean scallops, winter flounder, and Atlantic herring.

3.2.1.2 What is the existing role of economically important (..species) in the structure and functioning of the GOM ecosystem?

RESEARCH QUESTION. Need research on the structure and functioning of the GOM ecosystem.

3.2.1.3 What are the trends in the populations of (species)?

ONGOING PROGRAMS:	MARMAP
VARIABLES:	Species abundance, size/age class distribution reproductive condition
SCALE:	(depends on distribution of species, but should include breeding sites and feeding areas)
SAMPLING MEDIUM:	(depends on species)
FREQUENCY:	Annual
FIELD METHODS:	Depends on species (nets,dredge, trawls etc.)
DATA ANALYSES:	Regression analyses,recruitment exploitation models, year class analyses

3.2.1.4 What are the causes of population changes in (species)?

RESEARCH QUESTION. Research is needed to understand the ecology of each species, and the environmental, as well as harvesting, factors that affect its population.

3.2.1.5 What are the reasons for market acceptance or the economic viability of (species)?

RESEARCH QUESTION. Research is needed on product acceptance and marketing of fish and shellfish.

3.2.2 OBJECTIVE: Assess the existing status and follow trends in the environment by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality.

3.2.3 OBJECTIVE: In cases where environmental degradation is suspected, identify the probable causes.

Specific monitoring questions needed to address Objective 3.2.3 are directly linked to the results obtained under objectives 3.2.2, thus, the monitoring methods for both are linked. Before these two monitoring objectives can be achieved, however, a consensus needs to be reached among scientists, environmental managers and policy-makers with regards to the levels of environmental degradation and ecological stress that is considered significant.

There are two kinds of indicators of the environment. The first is monitoring of a single indicator species in the ecosystem that is known to be sensitive to environmental changes or economically important, and the second is monitoring a specific aspect of the structure or function in the ecosystem (e.g. number of trophic levels). The following list of indicators is based on a survey of those used in other monitoring programs. Additional indicators need to be developed as our understanding of the Gulf ecosystem increases. No consensus, however, was achieved at the workshop regarding what additional indicators should be used at this time.

Often used species indicators are:

a. Winter Flounder
b. Oysters
c. Lobster
d. Mussels

Often used ecosystem indicators include:

e. Benthic community structure
f. Primary Productivity
g. Nutrient enrichment
h. Dissolved oxygen

A research need for this objective is to identify other indicators that may provide better information on the environment.

In addition to species that are known to rapidly accumulate pollutants such as mussels and to the economically important species, possible indicators are those species that play an important role in structuring the ecosystem--the so called "keystone" species. Potentially significant ecosystem indicators are such factors as the number of trophic levels, the relative proportion of biomass as different trophic levels, or the amount

of energy transferred to the different trophic levels. No consensus was achieved among the the scientists and managers at the workshop on what additional indicators should be included in the GOM monitoring program. Not enough information is currently available on other indicators to include them, at this stage, in the program.

Ongoing programs that are currently monitoring species indicators are as follows:

Toxics in mussels (NS&T-MW)
Toxics and histopathology in Winter Flounder (NS&T-B)
Hydrocarbons in marine mammals (USMMS)
Toxics in marine birds (CWS-T)

Ecosystem indicators currently being monitored are:

Phytoplankton populations in l"Etang Inlet (F&O-L'Etang)
Nutrients (BHMP, USGS, NAQUADAT, Bowdoin)
Benthic communities (NPS-Acadia)

The following monitoring questions can be asked for all the species indicators. Some of the method parameters are, therefore, indeterminate, and will depend on the final choice of species.

3.2.2.1 In what areas of the GOM does the (species) show stress that might be attributable to toxic pollutants? ..and..

3.2.2.2 What are the trends in measures of stress in (species)?

The two questions can be answered using the same monitoring methods.

ONGOING PROGRAMS:	NS&T-B
VARIABLES:	histology, mixed-function oxidizes, gonadal index cytochrome P-450 activity
SCALE:	Coast-local (areas of suspected high disturbances)
SAMPLING MEDIUM:	Tissue, organism
FREQUENCY:	annual
FIELD METHODS:	(depends on species)
DATA ANALYSIS:	Parametric and non-parametric statistics

3.2.2.3 What toxic compounds can be correlated with this stress?

ONGOING PROGRAMS:	NS&T-B
VARIABLES:	Priority pollutants, currents
SCALE:	Coast-local (areas of suspected or actual high disturbance)
SAMPLING MEDIUM:	Soft sediments, tissues of prey
FREQUENCY:	Once
FIELD METHODS:	Corers, grabs
DATA ANALYSIS:	Regression, material flow models, circulation models

The following question are applicable to monitoring ecosystem indicators.

3.2.2.4 In what areas of the GOM does the benthic infaunal community show signs of stress? ..and..

3.2.2.5 What are the trends in indicators of stress, where found?

Both questions can be answered using the following methods.

ONGOING PROGRAMS:	(NSP-Acadia)
VARIABLES:	Species abundances
SCALE:	Coast-local
SAMPLING MEDIUM:	Soft sediments
FREQUENCY:	Quarterly - Seasonal
FIELD METHODS:	Corers
DATA ANALYSIS:	Similarities, classification, faunal pollution indices

3.2.2.6 What contaminants can be correlated with this stress?

ONGOING PROGRAMS:	None
VARIABLES:	Priority pollutants, total organic carbon, dissolved oxygen
SCALE:	Coast-local
SAMPLING MEDIUM:	Sediments, bottom waters
FREQUENCY:	Annual except for DO (weekly during summer)
FIELD METHODS:	Corers,DO meters
DATA ANALYSIS:	Regressions, statistics

3.2.2.7 What areas of the GOM are nutrient enriched? ...and..

3.2.2.8 What are the trends in nutrient levels?

These two questions can be answered using the same methods.

ONGOING PROGRAMS:	BHMD, USGS, NAQUADAT, Bowdoin
VARIABLES:	Ammonia, nitrate,inorganic phosphate, silicate
SCALE:	Coast-local
SAMPLING MEDIUM:	Water
FREQUENCY:	Monthly
FIELD METHODS:	Bottles
DATA ANALYSIS:	Statistics, regressions

3.2.2.9 What are the existing impacts of nutrient enrichment, especially in terms of low dissolved oxygen levels and algal blooms, on ecosystem structure and function?

ONGOING PROGRAMS:	None
VARIABLES:	Dissolved oxygen, species abundance
SCALE:	Coast-local
SAMPLING MEDIUM:	Water

FREQUENCY:	Monthly
FIELD METHODS:	Bottles, nets
DATA ANALYSIS:	Similarities, classification, food web models, energy flow models, keystone species models, niche overlap models

3.2.2.10 At what levels of nutrient enrichment are these impacts significant?

RESEARCH QUESTION. Research is needed on the relationships between nutrients and other factors and algal blooms, and on the relationships between algal biomass, productivity and impacts on the ecosystem.

3.2.2.11 What is the existing status and trends in ecosystem energy fixation and flow?

ONGOING PROGRAMS:	None
VARIABLES:	Community gross primary production and community respiration
SCALE:	Coast-GOM
FREQUENCY:	Seasonal
FIELD METHODS:	Field respiration and primary production
DATA ANALYSIS:	Statistical analyses

3.2.2.12 What is the existing status and trends in nutrient assimilation and release?

ONGOING PROGRAMS:	None
VARIABLES:	Nutrient uptake, availability, and release
SCALE:	Coast-GOM
FREQUENCY:	Seasonal
FIELD METHODS:	Nutrient collection and sampling analyses
DATA ANALYSIS:	Statistical analyses

3.2.2.13 What is the existing status and trends in species equitability, species richness, and species composition of key trophic levels?

ONGOING PROGRAMS:	None
VARIABLES:	Species presence and abundance
SCALE:	Coast-GOM
FREQUENCY:	Seasonal
FIELD METHODS:	Observation counts, nets, traps, bottles
DATA ANALYSIS:	Parametric and nonparametric statistics

3.2.2.14 What is the existing status and trends in keystone species?

ONGOING PROGRAMS:	None
VARIABLES:	Species presence, abundance, and feeding habits
SCALE:	Coast-GOM
FREQUENCY:	Seasonal
FIELD METHODS:	Observation counts, nets, traps, bottles
DATA ANALYSIS:	Parametric and nonparametric statistics

3.2.2.15 What is the existing status and trends in rare, threatened, and endangered species?

ONGOING PROGRAMS:	None
VARIABLES:	Species presence, abundance, and habits
SCALE:	Coast-GOM
FREQUENCY:	Seasonal
FIELD METHODS:	Observation counts, nets, traps, bottles
DATA ANALYSIS:	Parametric and nonparametric statistics

3.3 Goal #3-providing information to managers

The third goal of the monitoring program is one of process, not one of data collection. Thus, developing a matrix of monitoring questions and methods is not applicable. The third goal is addressed in Section 6.0.

4.0 MONITORING PLAN

4.1 Priority ranking of monitoring objectives

Establishing a monitoring program that addresses all the questions for meeting the objectives outlined in Section 3 is not a reasonable goal that can be achieved in the near future. Organizational, jurisdictional, and financial constraints limit the actual monitoring that can be reasonably accomplished. As a result, one of the tasks in developing a monitoring plan is to establish priorities for implementing the different monitoring questions. To achieve a broad concensus of what the monitoring priorities should be in the Gulf, an informational survey was sent to over 150 regulators, environmental managers, and scientists. The respondents were asked to rank the three goals and the different objectives in terms of their importance. The survey used and a detailed analysis of the results is given in Appendix C. The priority rankings developed from the survey were then discussed at the Working Conference in Halifax (see Appendix D).

The results from both the survey and Working Conference can be synthesised to yield the following priorities for the monitoring program.

- The second goal, that of monitoring the environment, has the highest priority, and three of its four objectives are ranked 1, 2, and 4 out of the 11 objectives defined. These objectives are:

    1) Monitoring indicators
    2) Monitoring viability of fish stocks
    4) Assessing causes of environmental degradation

- Although there was a general agreement at the Working Conference that monitoring to achieve these three objectives are important, and would easily use all the financial resources available, the other goals should not be put aside until the first goal is achieved.

- The goal of assessing human health risks was considered to have the second highest priority among survey respondents, and of the objectives under this goal the health risks from toxic compounds were considered to be the most important. The health risks from pathogens were also considered to be important by survey respondents but the ranking of this objective was not clear (see Appendix C). This question was clarified at the conference, where a consesus was reached that pathogen monitoring is important, but should not be a focus for the GOM monitoring program because ongoing programs are collecting data over a large area of the Gulf on this question.

- Although the goal of information transfer and its objectives were ranked lowest by survey respondents, participants of the Working Conference strongly believed that one aspect of information transfer not previously considered should have the highest priority. The consensus at the conference was that the first task of a monitoring program is to compile and make available a comprehensive database of all the existing scientific information on the Gulf. Maintaining the database should then continue to be a high priority for funding.

These results indicate that, given limited resources, monitoring activities in the Gulf of Maine should initially be focused on assessing the environment by monitoring indicators and assessing human health risks from toxic compounds. This conclusion is based on an estimate of what can be reasonably accomplished in the next five years, and of an assement of the estimated costs of the monitoring needed to address these two objectives (discussed below).

The following sections present a plan for meeting the two priority objectives by complementing existing monitoring efforts, by developing new monitoring tasks, and by developing a research program to address monitoring questions for which methods do not exist.

4.2 Monitoring Plan for Priority Objectives

The monitoring questions that need to be answered to address the two priority objectives were identified in Section 3, along with the monitoring methods needed to answer the questions. The monitoring plan proposed for the Gulf of Maine is based on collecting the data necessary to answer these questions, using the methods outlined.

Table 2 summarizes the monitoring questions for the first priority objective and the monitoring methods needed. In this initial phase of the monitoring program the recommendation is to focus on two species indicators (Winter Flounder, and Mussels) and three ecosystem function indicators (Benthic Community Structure, Nutrient levels, and Dissolved Oxygen). These indicators were chosen to allow the integration of the new monitoring program with ongoing ones which are monitoring for these indicators in some locations of the Gulf already. The field and laboratory methods for measuring these parameters are also well established and will be easy to implement. It is recommended, however, that a special conference/workshop be convened by the Council to develop new indicators, since no consensus was achieved at the working conference on this issue.

In Table 2 the method variables are more specifically defined to reflect current knowledge of how ecological stress is measured using the individual indicators. The monitoring plan for the first priority objective, therefore, is to collect data on the parameters listed using the methods described. The monitoring plan for this objective, however, requires that levels of "significant environmental degradation" be established so testable hypotheses can be defined. Because there is currently no consensus on what constitutes a significant degradation or what is a significant indication of stress in the Gulf of Maine it is recommended that these also be defined as soon as possible in some consensus building format such as a multi-disciplinary workshop.

Identifying the causes of environmental degradation was also an objective that was identified by the Working Group. Although it was ranked fourth overall, it is directly linked to the first one, and needs to be addressed as more information becomes available. The following is an outline for a general approach to address this objective for the 5 indicators (all except

TABLE 2: MONTORING METHODS FOR ADDRESSING THE FIRST PRIORITY OBJECTIVE: ECOSYSTEM INDICATORS.

MONITORING QUESTION	VARIABLE	SCALE/LOCATIONS	MEDIUM	FIELD METHODS	FREQUENCY	DATA ANALYSES
1. In what areas of the Golf do winter flounder show signs of stress?	mixed function oxidases histology	All parameters should be be monitorred in the following locations: • Boston Harbor • Mouth of Merrimack River • Mouth of Piscataqua River • Casco Bay • Penobscot Bay • Booth Bay Harbor • Cobscook Bay • Machias Bay • Frenchman Bay • St. Croix River • St. John's Harbor • Chignecto Bay • Minas Basin • Avon River • Annapolis Basin • St. Mary's Bay • Yarmouth Harbor • Stellwagen Bank • Jeffries Ledge • Georges Bank	liver	trawls	annual	statistics
2. What are the trends in measures of stress?	mixed function oxidases		liver	trawls	annual	statistics
3. What disturbances can be correlated with stress?	priority pollutants		sediments	cones	annual	statistics
4. In what areas of the Gulf do mussels indicate there are significant levels of environmental stress?	gonadal index priority pollutant		tissue	collect on rocks	annual	statistics
5. What are the trends in measures of stress?	gonodal index priority pollutants		tissue	mark/recapture	bi-annual	statistics
6. What disturbances can be correlated with this stress?	priority pollutants phytoplankton species		water sediments	water bottles cores	monthly	statistics
7. What areas of the GOM are nutrient enriched?	ammonium, nitrate phosphate		water	water bottles	monthly for 1 year	statistics
8. What are the trends in nutrient levels?	ammonium, nitrate, phosphate		water	water bottles	quarterly	statistics
9. In what areas of the GOM does the benthic infaunal community show signs of stress?	benthic invertebrates		sediments	grabs (0.05 m^2)	quarterly	Food Web Models Keystone Species Models
10. What are the trends in indicators of benthic stress?	benthic invertebrates		sediments	grabs	quarterly	Food Web Models Keystone Species Models
11. What disturbances can be correlated with benthic stress?	organic content dissolved oxygen		sediments water	grabs DO meter	annual weekly	
12. In what areas of the GOM are the levels of dissolved oxygen depressed?	dissolved oxygen		water	DO meter	weekly	statistics
13. What are the trends in DO levels?	dissolved oxygen		water	DO meter	weekly	statistics
14. What disturbances can be correlated with depressed DO levels?	BOD organic carbon		water sediments	water bottles cores	weekly annual	statistics

nutrients) that are not direct measurements of a disturbance. The sources of high nutrient levels can be identified by collecting and analyzing water samples at increasing distances from the original point where elevated levels were measured.

1. Based on local knowledge develop hypothesis with regard to the causes. The survey of possible causes should include, but not be limited to waste discharge, nonpoint discharges, harvesting methods, filling or dredging, land use activities in watershed, recreational activities and shipping activities.

2. Define the monitoring parameters best suited for testing hypotheses.

3. Develop criteria for either rejecting or accepting hypotheses.

4. Specify the sampling design needed.

5. Test hypotheses by collecting and analyzing data.

The second priority objective relates to the health risks of toxic compounds. At present only some aspects of this objective can be met through monitoring because few toxic compounds have been adequately studied to understand at what concentrations the compounds pose a health risk. This is especially true for exposure through contact activities such as swimming. A major research need is to identify the health risks associated with contact and ingestion of different concentrations of the many toxic compounds present in the marine ecosystem. Existing risk analyses are extremely imprecise. Another major research need is to develop methods for assessing the economic impacts of marine related human illness from toxics.

The monitoring plan summarized in Table 3 is therefore limited to collecting data on the two priority pollutants for which the U.S. Environmental Protection Agency has developed action levels in marine foods, mercury and PCB's.

4.3 Additional Monitoring Needed for Priority Objectives

4.3.1 Monitoring Environmental Indicators

Table 1 shows that there are 15 ongoing programs that are monitoring the environment using certain variables. Although many of the existing programs are addressing some of the questions in some areas of the Gulf, the coverage is not complete especially as it relates to geographical locations. Table 4 lists the major geographical regions in the Gulf where environmental indicator monitoring should be taking place and the variables needed. Locations and variables that are currently being monitored in ongoing programs are identified with the initials of the organization doing the monitoring, as referenced in Appendix A.

The blanks in Table 4 indicate the variables that are currently not being monitored at specific locations, and indicate what is needed for a

TABLE 3: MONTORING METHODS FOR ADDRESSING THE SECOND PRIORITY OBJECTIVE: HEALTH RISKS FROM TOXICS.

MONITORING QUESTION	VARIABLE	SCALE/LOCATIONS	MEDIUM	FIELD METHODS	FREQUENCY	DATA ANALYSES
1. In what areas of the GOM is mercury in marine foodds at or near 2 ppm?	mercury	Boston Harbor Portsmouth, NH Portland, ME Rockland, ME St. John's NB Moncton NB	tissue of commercially and recreationally harvested fish and shellfish	Trawling Digging Hook and Line	Annual	Statistics
2. In what areas of the GOM are PCBs in marine foods at or near 1 ppm?	PCBs	Minas Basin Yarmouth NS		Trawling, digging, hook and line	Annual	Statistics
3. Are there any trends in mercury levels?	mercury			Trawling, digging, hook and line	Annual	Statistics
4. Are there any trends in PCB levels?	PCBs			Trawling, digging, hook and line	Annual	Statistics
5. In what areas of the GOM might mercury reach 2 ppm in foods in the near future?	mercury		water sediments	bottles cores	Annual Annual	Statistics Statistics
6. In what areas of the GOM might PCBs reach 1 ppm in foods in the near future?	PCBs		water sediments	bottles cores	Annual Annual	Statistics Statistics
7. What are the sources of PCB contamination?	PCBs		water air deposition	Bottles collected in discharge/point and non-point	When action levels are exceeded	Statistics
8. What are the sources of mercury contamination?	mercury		water air depsotion	Bottles collected in discharge/point and non-point	When action levels are exceeded	Statistics

TABLE 4: Locations and variables for the primary objective of the GOM monitoring program. Ongoing programs that are contributing are identified by the acronym of the sponsoring organization. Blanks indicate where the parameters are not being monitored.

	Histology	Mixed Function Oxidase	Priority Pollutants	Gonadal Indices	Phytoplankton	Nutrients	Benthics	Organic Carbon	Dissolved Oxygen	BOD
Boston Harbor	NST/BHMP		NST/BHMP		BHMP	BHMP			BHMP	NCPDI
Merrimack River	NST		NST/USGS			USGS				NCPDI
Piscataqua River			USGS			US?GS				NCPDI
Casco Bay	NST		NST			NCPDI				NCPDI
Penobscot Bay	NST		NST			NCPDI				NCPDI
Boothbay Harbor			NCPDI							NCPDI
Machias Bay	NST		NST/CWS							
Cobscook Bay										
Frenchman Bay	NST		NST							
St. Croix River estuary			CWS			NAQUADAT			F&O-L'Etang	
St. John Harbor			NAQUADAT			NAQUADAT				
Chignecto Bay										
Minas Bay			CWS							
Avon River			DOE			NAQUADAT				
Annapolis Basin										
St. Mary's Bay										
Yarmouth Harbor			ODCA							
Stellwagen Bank					MARMAP				MARMAP	
Jeffries Ledge					MARMAP				MARMAP	
Georges Bank					MARMAP				MARMAP	

Gulf-wide coverage of monitoring to meet the objective. The monitoring program to be developed for the Gulf of Maine Council should include collecting the data to eliminate these voids.

In addition to collecting data on environmental indicators on a local basis the GOM monitoring program should collect synoptic data on general variables such as temperature and salinity on a Gulf-wide basis. Although the current monitoring plan does not propose that the Council initiate any synoptic data collection from ships or by remote sensing because of the costs involved, it is important that opportunities for collecting this data be exploited. With new sattelites that can monitor general environmental indicators on a large-scale (i.e. temperature, chlorophyll) the Council should be prepared to fund the analysis of such data as it is collected. The Gulf-wide indicators will be extremely useful in assessing long-term trends in the environment. Furthermore, every attempt should be made to coordinate data collection with ongoing research programs. All researchers in the Gulf should be informed with regards to the data needs of the monitoring program, and should be requested to collect as much data, both synoptic and localized, as possible.

4.3.2 Monitoring for Human Health Risks

Nine locations were identified as sites where there is an ongoing, or potential risk, from toxics in marine foods or water contact because they are near large population centers or industries with a significant potential for pollution from toxics. These locations include:

Boston Harbor	St. John NB
Portsmouth NH	Moncton NB
Portland ME	Minas Basin
Bath ME	Yarmouth NS
Rockland ME	

Of the ongoing programs, the National Status and Trends program is collecting relevant data in Boston Harbor and the Ocean Dumping Control Act Monitoring in Canada may have some data for sites in the Bay of Fundy (exact locations of sampling were unavailable at this time). Data collected in the other seven programs listed in Table 1 are not specific to permit health risk assessments.

The GOM monitoring plan for addressing this objective is to establish permanent monitoring of shellfish, bottom fish, and the sediments in the 8 locations currently not being monitored. The analyses should at least include PCBs and Hg in tissue since these are the only two contaminants for which action levels have been developed. If funds permit, however, the laboratory analyses of the edible tissues should include the full range of contaminants (EPA priority pollutants, PAHs, metabolites of organic compounds). A program very similar to this has already been proposed by the Maine Department of Environmental Protection ("Maine's Marine Environment: A Plan for Protection") and funded for Casco Bay. This should be used as the basis for expanding into other regions in the Gulf.

To improve the human health risk assessments the sampling should be focused on the areas from which fish and shellfish are currently being taken for consumption and from areas where water contact sports are taking place. The monitoring parameters are those described for question 3.1.3.1-3.1.3.9.

4.5 Estimated Cost of Monitoring for Priority Objectives

4.5.1 Cost for Monitoring Ecosystem Indicators

The frequency of sampling for all the variables listed in Table 2 is annual or more frequent. The costs are, therefore, estimated on an annual basis. Table 5 shows the cost estimate for sampling each variable at each location. The totals for each row and column represent the estimated cost for monitoring each variable at all locations and all variables at one location. The totals for the rows are not the sum of the costs for sampling and analyzing all parameters, but reflect the cost savings that might be accrued by sampling for several different variables using the same methods.

The cost estimates presented are to be used only to provide a very rough approximation of the annual costs of a monitoring program to address the first priority issue. The one factor that has a significant effect on costs, that cannot be estimated at present, is the number of samples that need to be collected for each variable at a location to provide statistical significant information. Sample numbers need to be developed at the sampling design stage. The initial estimate of the annual costs for monitoring the region to meet the first priority objective is in excess of $3,000,000 US (1990). However, given the uncertainty in the number of samples required the actual costs may range from 75% to 150 % of the tabulated values.

Another assumption made in the cost estimate is the existing programs are collecting all of the data needed in the locations identified in Table 4. This may not be the case if the pilot sampling studies indicate more intense sampling is needed to provide the necessary data to test hypotheses. If additional data, or modifications in method, are needed that cannot be incorporated in the ongoing programs, additional funds will be required.

It is recommended that investigators with ongoing monitoring efforts be asked to participate in, and coordinate with, the group developing the sampling design for monitoring the relevant variables.

4.5.2 Cost for Monitoring Human Health Risks from Toxics

The costs for assessing human health risks from mercury and PBC in marine foods are estimated at $70,000/year at each location listed in above. Again, pilot studies are needed to establish appropriate sampling protocols. For this objective the pilot studies also need to be integrated with the data needs of risk analyses. Assuming the data collected by the

TABLE 5: Estimated costs (in thounsands $) for different variables and ocations to meet the first priority objective.

	Histology	Mixed Function Oxidase	Priority Pollutants	Gonadal Indices	Phytoplankton	Nutrients	Benthics	Organic Carbon	Dissolved Oxygen	BOD	TOTAL**
Boston Harbor	NST/BHMP	25	NST/BHMP	10	BHMP	BHMP	50	25	BHMP	NCPDI	100
Merrimack River	NST	25	NST/USGS	10	50	USGS	50	20	3	NCPDI	120
Piscataqua River	25	25	USGS	10	50	US?GS	50	10	3	NCPDI	140
Casco Bay	NST	25	NST	10	100	NCPDI	100	10	3	NCPDI	225
Penobscot Bay	NST	25	NST	10	50	NCPDI	50	10	3	NCPDI	120
Boothbay Harbor	25	25	NCPDI	10	30	15	50	10	3	NCPDI	140
Machias Bay	NST	25	NST/CWS	10	30	15	50	10	3	15	140
Cobscook Bay	25	25	30	10	50	15	50	10	3	15	200
Frenchman Bay	NST	25	NST	10	30	15	50	10	3	15	130
St. Croix River estuary	25	25	CWS	10	100	NAQUADAT	50	10	F&O	15	200
St. John Harbor	25	25	NAQUADAT	10	50	NAQUADAT	100	10	3	15	200
Chignecto Bay	25	25	30	10	50	15	50	10	3	15	180
Minas Bay	25	25	CWS	10	100	25	100	25	3	15	250
Avon River	25	25	DOE	10	30	NAQUADAT	50	10	3	15	150
Annapolis Basin	25	25	30	10	30	10	50	10	3	15	180
St. Mary's Bay	25	25	30	10	30	15	50	10	3	15	180
Yarmouth Harbor	25	25	ODCA	10	30	10	25	10	3	15	150
Stellwagen Bank	25	25	30	10	MARMAP	40	50	20	MARMAP	30	180
Jeffries Ledge	25	25	30	10	MARMAP	40	50	20	MARMAP	30	180
Georges Bank	25	25	30	10	MARMAP	40	100	20	MARMAP	30	180
TOTAL	350	500	210	200	760	255	1075	270	45	155	3345

*DO costs are estimated assuming monitoring will be done by volunteers.

** Total costs estimated based on savings possible by combining sampling methods.

National Status and Trends in Boston Harbor are statistically adequate for risk analyses, the estimated cost for monitoring to meet the third priority objective is $560,000/year.

The largest funding requirement, however, to meet this objective is for research. Little is known about the human health risks of the many toxic contaminants found in marine foods, and at what concentrations these risks are manifest. This information is critical in developing a monitoring program that addresses contaminants other than mercury of PCBs.

5.0 DATABASE MANAGEMENT

The success of the monitoring program will, to a large degree depend on implementing a workable database system where data and information from all monitoring efforts can be stored and retrieved. Inadequate database management and data accessibility has been identified as a major problem in previous monitoring programs (NRC, 1990).

Establishing and managing a database was one of the major topics discussed at the Gulf of Maine Working Conference. Key issues discussed were the type of information that would be useful to users, potential data structures, quality control, and continuity. Likely users identified at the conference include environmental managers, policy-makers, scientists, planners, educators, developers, libraries, and the environmental community.

A regional database must provide useful and reliable information. It cannot simply be a repository for raw data. Both the quality of the data and the quality of the interpretations are critical. The following levels of information and their likely users were identified at the Working Conference.

- Raw Data: useful to relatively few scientists, but does not provide useful information to other users.
- Processed Data: useful to some scientists and managers, but not to others.
- Report Data: useful to many scientists and managers, to some policy-makers, and to some other users.
- Assessments: useful to almost all users.

It was the consensus of the Working Conference that a database be set up for the Gulf region using a geographic information system, perhaps modeled after the the FMG System established by the Geography Department at St. Mary's University, and including an electronic bulletin board modeled after the one used for the Massachusetts Bay Project. Questions were raised about on-line data and the desirability of on-line data exchange. Because of these questions and the general concern regarding quality control of the data, their interpretation, and possible on-line transformation, it was strongly suggested that information specialists be consulted.

Based on the discussions at the Working Conference, it is recommended that a permanent database group be established under the monitoring committee to oversee this aspect of the program. It is also critical that this operation also be adequately funded, since many efforts in the past have failed for lack of funding of this often neglected aspect of a monitoring program (NRC, 1990).

The first task of the database group should be to identify existing data on the Gulf, compile a reference to it, and to develop procedures to provide access to the data by all interested parties. Although compiling data is

not directly a monitoring task, the participants of the working conference (see Appendix C) all felt very strongly and assessing the existing data should be a primary task in establishing a Gulf-wide monitoring program. One recommendation of the Working Conference was that the GOM Council fund a compilation and review of existing data before funding any new monitoring efforts.

To insure that data collected for the monitoring plan is adequately archived and available to all, the following additional tasks should be a priority for a database group organized by the Council. It is strongly urged that all parties collecting data fro the GOM Monitoring Program be asked to submit data using the formats and protocols developed by the database group.

TASK 1: Develop a database which defines data variables to be collected by monitoring activities. The dictionary should be expandable to accommodate new parameters introduced by future monitoring efforts and be formatted to include socio-economic parameters as well as biological, chemical, and physical ones.

TASK 2: Define database elements to include: 1) provisions for unique sample identification, 2) a bibliographic reference number, 3) the information needs the data addresses, 4) provisions (where practical) for units conversion, and 5) an assessment of "data quality".

TASK 3: Define the structure of an exchange format in terms of record length, field size, and data codes for parameters and data elements developed under Task 1.

It is recommended that the data exchange format developed by NOAA for marine toxic substances and pollutants be used as the basis for the GOM format. The NOAA format, however, needs to be expanded to include formats for socio-economic data and for information on the results of the data analyses.

TASK 4: Ensure that data collected in previous and ongoing programs in the GOM are available in databases that are compatible with the one developed in Task 1. This may require funding to translate existing data into compatible formats.

6.0 INFORMATION TRANSFER

To be effective, environmental monitoring and environmental management must be closely linked by multiple feedback loops. Monitoring provides the means by which management questions are defined, and management actions evaluated. In turn, management needs must provide the focus for monitoring efforts and the hypotheses tested by collecting data. An interactive process is necessary to maintain the flow of information between monitoring and management efforts.

The interactive process is based on good communication between all groups involved, from the managers and policy-makers, to the scientists and concerned citizens. Environmental management issues and questions must be clearly defined by managers and policy-makers in consultation with scientists, concerned citizens, and interested public and private organizations. On the other hand, the monitoring efforts needed to address the management questions must be clearly defined by scientists in consultation with the other groups.

Developing a monitoring effort that meets the management questions requires that scientists and managers define, in advance, the action levels and the sampling design to be used. Defining these factors in advance, however, requires prior information from research, and frequently, even pilot studies on the variables to be monitored. As monitoring proceeds, results that are adequately analyzed and interpreted must be provided to managers and policy-makers in a timely manner. Monitoring is also needed to evaluate and fine-tune management actions. Performance levels should be established in advance, as objectively as possible, and additional sampling programs implemented to evaluate the actions. There must be mutual understanding by scientists, environmental managers, and policy-makers of monitoring results and there must also be agreement regarding their significance.

6.1 Information Transfer as a Monitoring Goal

Unfortunately, many previous monitoring efforts have not been effective because the importance of the communication/cooperation process was not adequately understood or emphasized. In a recent review of monitoring programs a committee of the National Research Council concluded:

> " Many monitoring programs are ineffective because they devote too little attention to the formulation of clear goals and objectives, technical program design, and the translation of data into information that is relevant and accessible to decision makers and the interested public." (NRC, 1990)

To overcome this common problem the Working Group monitoring subcommittee has identified the information transfer/communication issue as the third major goal of the monitoring program. The goal is to "provide appropriate and timely information to environmental and resources managers that will allow both efficient and effective management actions and evaluation of such action."

The information presented in this report relative to this monitoring goal comes from the experiences of the contractors, literature review, the results of the survey (Appendix C), and the results of the Working Conference (Appendix D). Administrators and policy makers consider this goal more important, overall, than do researchers and educators. Also, respondents of the survey who spend the majority of their time on management activities ranked the goal of information transfer of higher importance than did respondents spending more time on research, writing, and educational activities.

6.2 Maintaining and Improving the Transfer of Information

The objectives developed to meet the third goal (see section 1.5) define the important steps in the information transfer process. The first objective of providing information to resource and environmental managers in a format that will allow appropriate management actions, emphasizes the need to plan and implement monitoring activities in ways that provide useful information to managers. This means that action levels and sampling design need to be established that specifically answer management questions. The information coming from a monitoring program should be concise, carefully interpreted in a manner relevant to the management issue, and its statistical reliability should be documented. Whenever possible, the information should be deposited in a database that is accessible to other managers and scientists in the region.

The second objective, that of providing timely analysis and interpretation, reflects the fact that management decisions often have to be made on a schedule that is different than one that best meets scientific needs. Thus, schedules and formats for monitoring results should be agreed upon at the time that a sampling design is developed. This will avoid any future misunderstandings between the scientist doing the monitoring and the managers who will be having to make management decisions of the basis of the results.

If a monitoring program is to continue providing useful information, activities must be extended over long periods of time. As a program develops there is need to refine the process of collecting and analyzing data. The third objective, that of refining and updating the monitoring program, emphasizes the need for ongoing communication between scientist and managers to improve the process based on a continuous evaluation of monitoring results. Although this objective was ranked the lowest in importance by the respondents to the survey, it will become more important as the coordination and cooperation in monitoring efforts in the Gulf of Maine increase.

As management activities become more extensive in the Gulf, it becomes increasingly important to evaluate them; not only in terms of effectiveness, but also in terms of overall environmental impacts (the fourth objective under this goal). Poorly planned or implemented management actions can degrade or destabilize environmental quality, natural resources, and ecological integrity, as easily as other anthropogenic causes. Management actions should be based on reliable

monitoring information, firmly linked to scientific principles and appropriate pilot studies. They should be reviewed objectively by an interdisciplinary group of scientists, managers, and policy-makers in order to obtain the broadest possible perspective. The fourth objective also received a low importance ranking from respondents to the survey, but its importance will also grow as regionally coordinated management actions are taken.

6.3 Facilitating Information Transfer in the Gulf of Maine

Four major communication processes have been identified that are essential for the effective transfer of information in a monitoring program for the Gulf of Maine. These are listed below:

- Monitoring needs and priorities must be mutually understood and agreed to by scientists, policy-makers, and managers.

  Respondents to the survey indicated that this process of communication is not very effective in the Gulf of Maine. They ranked its current effectiveness third out of the four listed.

- Ongoing and new monitoring efforts and techniques must be interrelated and coordinated among the scientists involved.

  Respondents to the survey ranked this process as presently being the most effective in the region.

- Interpretation and understanding of monitoring results must be consistent among those involved.

  At present, this process was ranked as fairly effective in the region, ranking second of the four.

- Historic and ongoing monitoring results must be used as a common information base in planning, implementing and evaluating policies and management strategies.

  At present, this communication process was ranked as the least effective in the Gulf region. The need to improve the use of existing data was strongly supported at the Working Conference. A strong consensus was reached that the synthesis of existing data should be given the highest priority in the monitoring program.

Based on these results and discussion at the Working Conference, mutual communication and understanding between scientists, managers, and policy-makers needs to be increased significantly in the Gulf region if a monitoring program is to be successful. One area of mutual understanding in need of improvement is using monitoring information in policy and management development.

To achieve these improvements different forms of communication were considered (see Appendix D). These included: conferences, annual symposia, person-to-person contacts, interorganizational meetings, professional journals, newsletters, popular press, and training seminars. Respondents

to the survey ranked person-to-person contacts as the most effective form of communication, followed by interorganizational meetings and annual symposia. The popular press was considered the least effective at communicating information. Based on these results, it is recommended that a major emphasis of the Gulf of Maine Monitoring Program should be organizing meetings that bring scientists, managers, and policy-makers together to discuss the information needs of all parties involved, and to resolve any misunderstandings.

Information transfer, however, does not only include effective communication among those directly involved in collecting data and managing the resource, but also involves the general public. Public support is critical in maintaining the necessary political and funding support. It is also critical because public cooperation in reducing human impacts and in volunteer efforts are are a significant factor in the success of environmental management and monitoring programs.

Such public support must be based on understanding and mutual trust. As monitoring programs are planned, scientists, managers, and policy-makers must also plan means of communicating and explaining the results to the public. This was identified as a major goal of the Action Plan, and should not be forgotten in the detailed implementation of a monitoring program.

Suggestions for an organizational structure that will meet these information transfer objectives are presented in the following section.

7.0 STRUCTURE OF MONITORING PROGRAM

To successfully implement a monitoring program many tasks need to be accomplished, as has been described in this plan. The tasks can be categorized as functions that need to be carried out, as described below. It is recommended, therefore, that the Council establish a permanent Monitoring Committee, with several associated functional groups, or subcommittees, as shown in Figure 2. These suggestions for an organizational structure to support a Gulf-wide program are based on a review of other programs as well as the survey and the Working Conference (see Appendices B,C).

A Citizen's Advisory Committee to the Gulf of Maine Council is recommended to comment on general monitoring and management goals, objectives and information needs. The concept is one that has proved successful in the U.S. "Bays" programs.

A standing monitoring committee, such as the Working Group subcommittee currently in operation, is needed to provide guidance to the Council on information needs, monitoring objectives and questions. In addition, the committee should be charged with the following tasks:

- o Prepare proposals for monitoring
- o Establish action levels for review by scientists
- o Assure quality control
- o Review management questions
- o Identify potential funding needs and sources

The monitoring committee should receive information from groups or subcommittees with the following functions:

Scientific

- o Establishes sampling design and laboratory methods for each monitoring task
- o Supervise QA/QC
- o Identify new monitoring methods and integrates them into ongoing monitoring program
- o Established intercalibration procedures between laboratories
- o Determine the precision and accuracy of data needed to answer each monitoring question
- o Review action levels established by monitoring committee

Database

- o Develop format for database
- o Compile existing data into database
- o Develop expert systems of data interpretation for environmental managers
- o Ensure that newly collected monitoring data are incorporated into database
- o Define user groups
- o Specify information levels for database

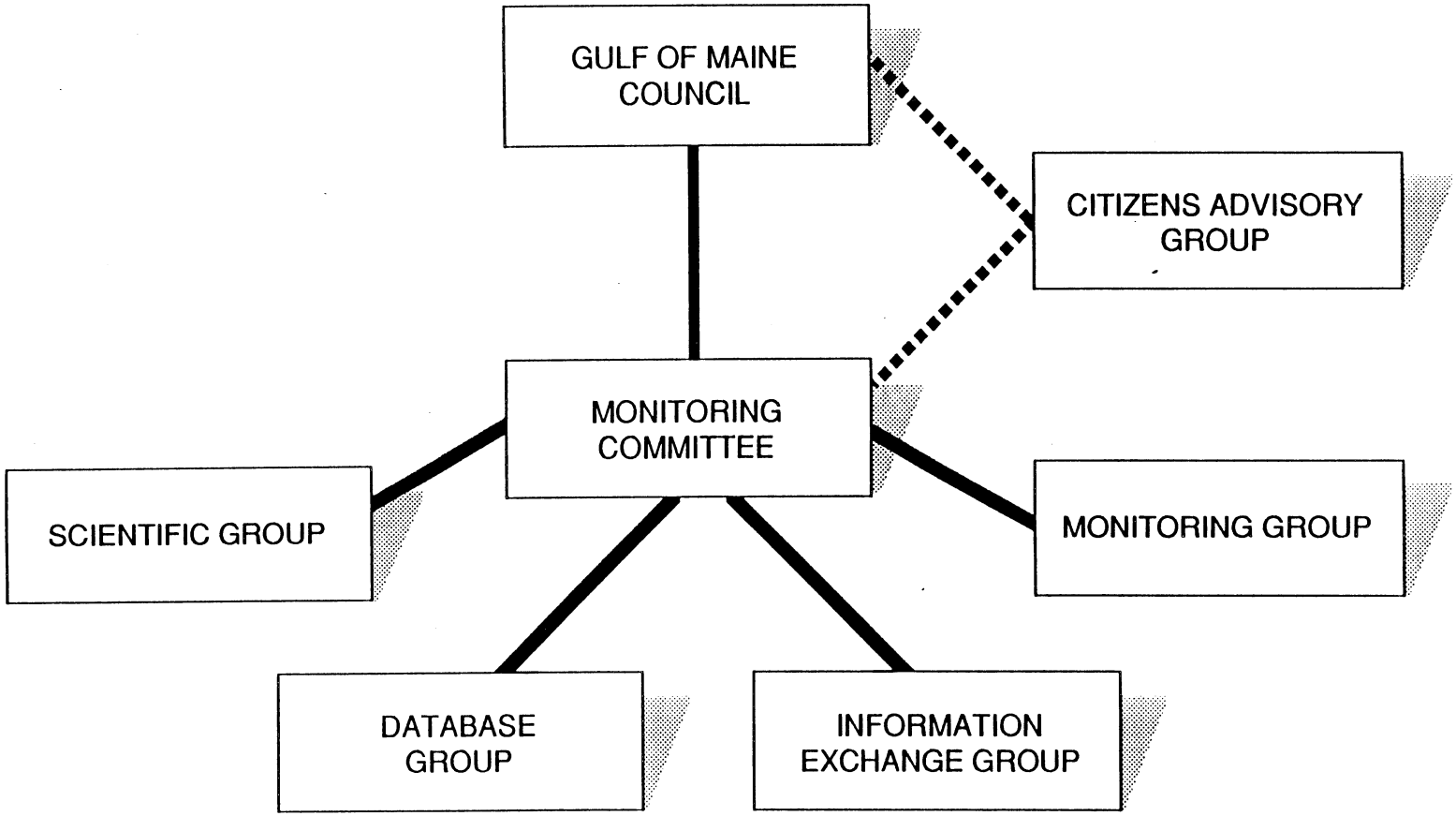


FIGURE 2
ORGANIZATIONAL STRUCTURE FOR GULF OF MAINE MONITORING PROGRAM

Information Exchange

- o Organize symposia, workshops and other activities to facilitate information transfer
- o Publish a newsletter
- o Regularly survey scientists and managers on the effectiveness of information transfer
- o Coordinate GOM monitoring with ongoing programs

8.0 PROCESS FOR IMPLEMENTING MONITORING PLAN

The following suggestions for implementing a Gulf of Maine Monitoring Program have been developed from a review of other monitoring efforts, as well as the survey and Working Conference. The process for implementing the program is outlined as a series of tasks that need to be accomplished. These tasks should be initiated as soon as possible, and can be done concurrently, depending on the resources and time available.

Task 1: Establish the monitoring committee and its associated function groups.

Task 2: Develop a pilot and demonstration monitoring project to address a regional management issue of general interest in the Gulf of Maine. For example, a pilot Gulf-wide mussel watch program would serve to intergrate two major ongoing projects with the monitoring goals developed.

The following list of subtasks is suggested as a process by which the task can be accomplished.

Task 2.1 - Develop a consensus among scientists, managers, and policy-makers on the specific question to be addressed by the monitoring, and the information needed to answer the question.

Task 2.2 - Develop a consensus on a priori action levels.

Task 2.3 - Develop a sampling design considering ongoing and historic data, and the statistical requirements of the hypothesis being tested. The sampling design should include standardized methods, QA/QC procedures, the type of data analyses to be done, and a schedule and format for reporting information to managers and policy-makers. Preliminary information collected through a pilot study or by analyzing results from ongoing programs should be used to integrate data collection with data analysis to optimize the information content of the data and minimize costs.

Task 2.4 - Develop and implement a plan for public information and citizen/volunteer participation in the project.

Task 2.5 - Provide managers with information as specified and use the results to improve the monitoring project.

Task 2.6 - Use monitoring information to develop management actions, and then track the effectiveness of the actions.

Task 3 - Design and implement a database system and information exchange process to provide likely users with reliable and useful information.

Task 4 - Plan and implement a Gulf-wide sampling design to address the first priority objective using appropriate ecosystems indicators.

Task 5 - Monitor the effectiveness of the information transfer process between all parties, and make changes as needed.

Task 6 - Plan and implement a Gulf-wide sampling design to address the second priority objective.

Task 7 - Periodically review the monitoring program and its goals and objectives, and make necessary change.

The process of implementing the monitoring plan described above, like the plan itself, is not meant to be fixed. The entire process should be flexible to accommodate changes in goals and interests of the the Gulf's inhabitants.

9.0 Bibliography

Anon, 1986. Environmental Effects Monitoring Operational Guidelines, Environment Canada, Environmental Protection Service, Atlanta Region.

Beanlands, G.E., P.N. Duinker (1983). An Ecological Framework for Environmental Impact Assessment in Canada. A book for the Institute for Resource and Environmental Studies, Dalhousie University 1983.

Brayton, P., D. Roszak, S.A. Hug, L.M. Palmer, D.J. Grimes and R.R. Colwell (1984). Public Health Significance of Human Pathogens in the Ocean, Oceans '84:263-267.

Dames, Moore, & SEAMOcean Inc. (1984). "Evaluation of Measurement Techniques for Monitoring Marine Pollution," Report for NOAA, December 1984.

Fricker, A., D.L. Forbes (1988). A System for Coastal Description and Classification. Coastal Management 16:111-137, 1988.

Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). Long-Term Consequences of Low-Level Marine Contamination: An Analytical Approach. Reports and Studies No. 40.

Goede, A.A., M. DeBruin (1986). The use of Bird Feathers for Indicating Heavy Metal Pollution. Environmental Monitoring and Assessment 7:249-256.

Hurlbert, S.H. (1984). Pseudoreplication and the Design of Ecological Field Environments. Ecol. Monogr. 54:187-211.

International Council for the Exploration of the Sea (ICES) (1988). "Report on the Working Group on Environmental Assesment and Monitoring Strategies," Noor Koping, Sweden, May 1988.

Jackson, J.K., V.H. Resh (1989). Sequential Decision Plans, Benthic Macroinvertebrates, and Boilogical Monitoring Programs. Environmental Management 13:455-465.

Kingston, P.F. and M.J. Riddle (1989). Cost Effectiveness of Benthic Faunal Monitoring. Marine Pollution Bulletin 20:490-496.

Kramer, C.J.M. (1986). Monitoring of Abiotic Compartments for Trace Metals: Difficulties, Strategies and the use of Surveys. Environmental Monitoring and Assessment 7:169-187.

Larsen, P.F., D.F. Gadbois, A.C. Johnson (1986). Polycyclic Aromatic Hydrocarbons on Gulf of Maine Sediments: Distribution and Mode of Transport. Marine Environmental Research 18:231-244.

LGL Ltd. ESL Environmental Sciences Ltd., Artic Laboratories Ltd. Atlantic Oceanics Company Ltd., G.D. Greene, and C.S. johnson, 1985. Effects Monitoring Strategies and Programs for Canada's East Coast. ESRF Report No. 005:88p.

Magnien, R.E., R.E. Summers, M.S. Haire, W.R. Boynton, D.C. Brownlee, A.F. Holland, F. Jacobs, W.M. Kemp, K.G. sellner, G.D. Foster, D.A. Wright (1987). "The Maryland Office of Environmental Programs Chesapeake Bay Water Quality Monitoring First Bienniel Report, Monitoring for Management Actions", February, 1987.

Maine State Planning Office (1989). "Marine Environmental Quality Monitoring Programs in the Gulf of Maine: An Inventory", Augusta, Maine, May 1989.

(NRC) Marine Board, National Research Council (1990). Managing Troubled Waters: The Role of Marine Environmental Monitoring. National Academy Press, Washington, D.C.

National Oceanic and Atmospheric Administration (NOAA) (1989). "An Evaluation of Candidate Measures of Biological Effects for the National Status and Trends Program," NOAA Technical Memorandum NOS OMA 45, Seattle, Washington, April 1989.

North and Mid Atlantic Region (1980). "Summary of Non-Federally Funded Marine Pollution Research, Development and Monitoring Activities," May 1980.

O'Connor J.S., R.T. Dewling (1986). Indices of Marine Degradation: Their Utility. Environmental Management 10:335-343.

Pearce, J.B., L. Despres-Patanjo (1988). A Review of Monitoring Strategies and Assessments of Estuarine Pollution. Aquatic Toxicology 11:323-343, 1988.

Resh, V.H., and D.G. Price (1984). Sequential Sampling: A Cost-Effective Approach for Monitoring Benthic Macroinvertebrates in Environmental Impact Assessments. Environmental Management 8:75-80.

Rosenberg, D.M., S.S. Balling, M.A. Barnby, J.N. Collins, D.V. Durbin, T.S. Flynn, D.D. Hart, G.A. Lamberti, E.P. McElravy, J.R. Wood, T.E. Blank, D.M. Schultz, D.L. Marrin, D.G. Price (1981). Recent Trends in Environmental Impact Assessment. Can. J. Fish. Aquat. Sci. 38:591-624

Segar, D.A. (1986). Design of Monitoring Studies to Assess Waste Disposal Effects on Regional Site Specific Scales. in: Public Waste Management and the Ocean Choice, Eds. K.D. Stolzenbach, J.T. Kidlow, and E.T. Harding. MIT Sea Grant College Program. 85-36 April 1986.

Segar, D.A., E. Stamman (1986). A Strategy for Design of Marine Pollution Monitoring Studies. Water Science and Technology 18:15-26, 1986.

Shigenaka, G., J.E. Price (1988). Correlation of Coprostanol to Organic Contaminants in Coastal and Estuarine Sediments of the U.S. Water Resources Bulletin 24:989-998.

Sindermann, C.J. (1988). Biological Indicators and Bilogical Effects of Estuarine/Coastal Pollution. Water Resources Bulletin 24:931-939

Strickland, J.D.H. and T.R. Parsons (1965). A Manual of Seawater Analysis, Bulletin No. 125 Fisheries Research Board of Canada.

Ter Keurs, W.J., E. Meelis (1986). Monitoring the Biotic Aspects of our Environment as a Policy Instrument. Environmental Monitoring and Assessment 7:161-168, 1986.

Viktor, S. (1983). Bridging the gap Between Environmental Science and Policy-Making: Why Public Policy Often Fails to Reflect Current Scientific Knowledge. Ambio, 1983.

Weeks, B.A., A.S Keisler, J.E. Warinner, E.S. Mathews (1987). Preliminary Evaluation of Macrophage Pinocytosis as a Technique to Monitor Fish Health. Marine Environmental Research 22:205-213

West, N. (1987). Estuarine Quality Use and Public Perception. Coastal Zone 87:804-810.

Not Available

APPENDIX A

NOT Available

APPENDIX B

APPENDIX C

APPENDIX C

SUMMARY: GULF OF MAINE MONITORING SURVEY

Prepared by the Mainewatch Institute

Appendix C provides a graphical, tabular and textual summary of the 64 useable Gulf of Maine Monitoring Survey questionnaires that were returned to the Mainewatch Institute, in Hallowell, Maine, during the months of April and May, 1990. The survey consisted of question sequences about:

* the professional characteristics of the respondent;

* the respondents' (and those of their organizations) current involvement in work relevant to the project's monitoring goals;

* the respondents' ratings of the importance of the broad monitoring goals identified for the project, and of the importance of the individual monitoring objectives associated with those goals;

* the respondents' assessment of the current effectiveness of various aspects of the communication process between and among relevant constituencies, and of effectiveness of a variety of communications media.

The presentation of survey results is consistent throughout the summary. Each topic begins with a graphical representation of the overall frequency distributions of the variables related to that topic, followed by a more precise tabular representation of the findings, and concludes with a brief narrative. The relationships between the categorical and topical variables mentioned in the narratives are statistically significant at $p<=.10$.

No attempt has been made in this appendix to assess the significance of the survey findings relative to the project. That occurs elsewhere in this report.

PART ONE:

PROFESSIONAL CHARACTERISTICS OF SURVEY RESPONDENTS

FIG. 1: TYPE OF ORGANIZATION FOR WHICH RESPONDENT WORKS

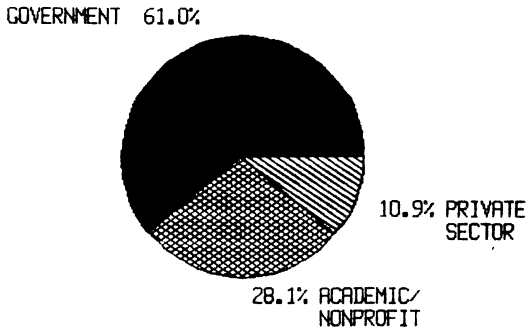


TABLE 1. TYPE OF ORGANIZATION FOR WHICH RESPONDENT WORKS

	N	n	(%)	%
Government	39			60.9%
Nat'l Policy		5	7.8%	
State/Prov Policy		6	9.4	
Nat'l Research		15	23.4	
State/Prov Research		11	17.2	
Other Gov't		2	3.1	
Academic/Nonprofit	18			28.1
State/Prov Univ		5	7.8	
Private University		4	6.3	
Nonprofit		7	10.9	
Other Educational		2	3.1	
Private Sector	7			10.9
Consulting		4	6.3	
Private Business		2	3.1	
Private Research		1	1.6	
TOTAL	64			99.9%

According to categories chosen by the respondents, the majority (61%) of the respondents are employed by government agencies with nearly one-fourth of all representing national (U.S. or Canadian) research agencies, and another 17% coming from state or province research agencies. About one in six respondents are associated with an academic institution, and one of every nine with a nonprofit group. Only 7 of the respondents represent the private sector, and four of them work for consulting firms.

FIG. 2: TYPE OF POSITION HELD BY RESPONDENT

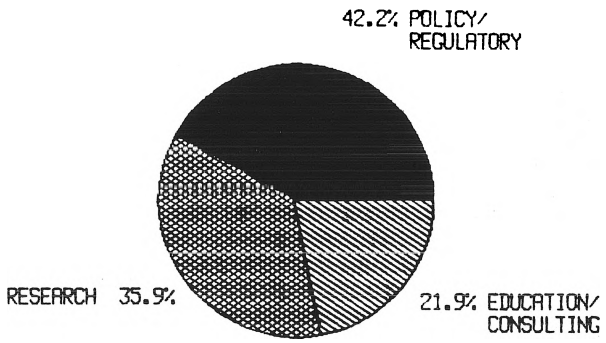


TABLE 2. TYPE OF POSITION HELD BY RESPONDENT

	N	n	(%)	%
Policy/Regulatory	27			42.2%
Admin/Policy		24	37.5%	
Regulatory/Legal		3	4.7	
Research	23			35.9
Basic Research		12	18.8	
Applied Research		11	17.2	
Educational/Consulting	14			21.9
Teaching		6	9.4	
Consulting		6	9.4	
Public Interest		2	3.1	
TOTAL	64			100.0%

Two-thirds of the respondents are employed in either administration-policy formulation (37.5%) or as researchers (35.9%). Teachers and consultants (both 9.4% of the sample) constitute the next largest groups of respondents. Most of the respondents classifying themselves as teachers conduct research as well. Teachers, consultants, and individuals employed in public interest nonprofits are grouped together not because of homogeneity in their opinions but because as individual groups they constitute very small sample sizes. There is, however, a logic to the three-tiered grouping represented in Figure 2 and Table 2 in that: the Policy/Regulatory grouping includes those involved in management activities; the Researchers are those most deeply involved in inquiry; and the Educational and Consulting group are engaged in the dispensing of information to a larger population.

FIG. 3 RESPONDENT LEVEL OF EDUCATION

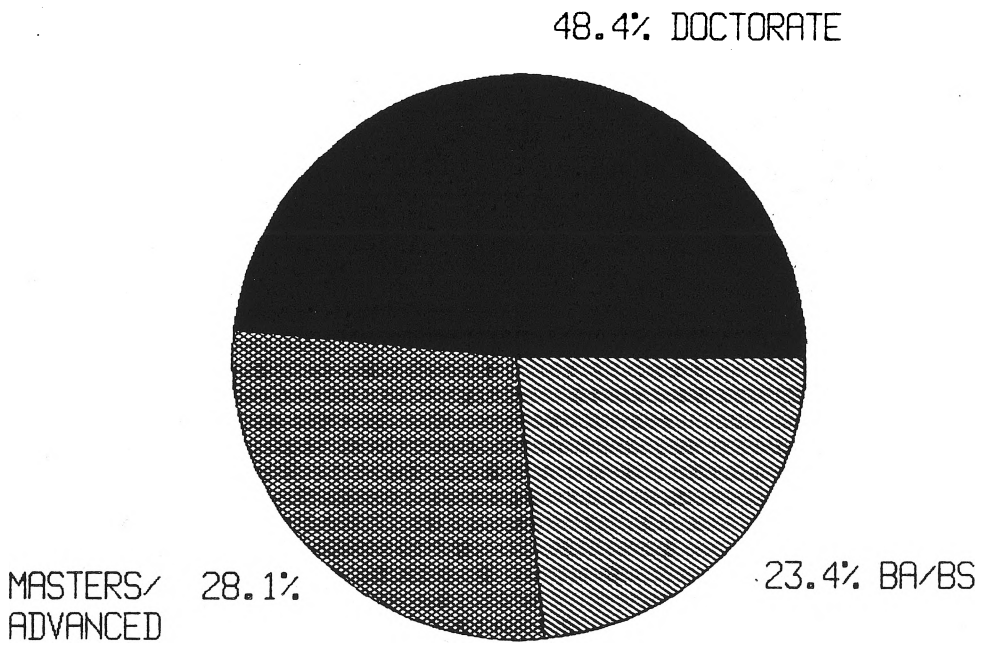


TABLE 3. EDUCATIONAL LEVEL OF RESPONDENT

	N	n	(%)	%
Doctorate	31			48.4%
Masters/Advanced	18			28.1
Masters		17	26.6	
JD/LLB		1	1.6	
Baccaulaureate	15			23.4
TOTAL	64			99.9%

Three-fourths of the respondents have advanced degrees with nearly half (48.4%) holding doctorates. One respondent has a law degree.

FIG. 4: MEAN PROPORTION OF TIME SPENT ON TYPES OF JOB-RELATED ACTIVITIES

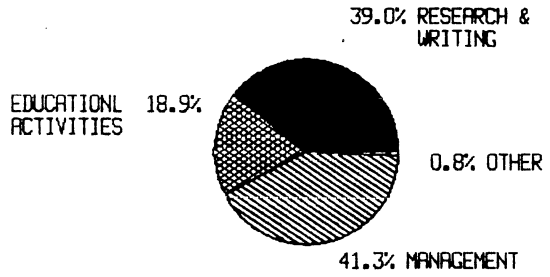


TABLE 4. MEAN PROPORTION OF TIME SPENT ON THE JOB AT SPECIFIC ACTIVITIED BY TYPE OF ORGANIZATION AND TYPE OF POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Research and Writing	39.0	39.3	40.3	33.3	21.0	65.9	29.7
Sampling	4.7	5.8	2.9	3.3	1.4	9.1	3.9
Lab research	4.7	3.5	8.6	0.0	0.7	8.9	5.3
Computer analysis	8.2	8.7	9.3	1.7	2.6	17.6	3.7
Writing	21.4	21.3	19.5	28.3	16.3	30.2	16.8
Educational Activities	18.9	11.2	33.1	23.3	12.2	9.6	47.1
Consulting	6.7	5.0	5.7	20.8	2.2	4.1	19.5
Teaching	5.2	0.5	16.3	0.0	0.7	2.6	17.9
Public education	7.0	5.7	11.1	2.5	9.2	2.8	9.7
Management	41.3	49.4	26.8	35.0	67.0	24.4	19.6
Administration	14.5	12.6	18.2	15.8	22.6	8.3	9.3
Policy formulation	7.8	11.2	2.1	4.2	15.7	1.7	2.5
Project management	15.6	20.9	6.1	10.8	25.2	9.4	7.1
Legal/Regulatory	3.4	4.7	0.5	4.2	3.5	5.0	0.7

Overall, respondents divide their time about equally between research and writing activities and management responsibilities with educational activities taking up only about half as much time as the other types. Writing consumes at least one-eigth, and as much as 30%, of most of the respondents' work days. As would be expected research and writing are a larger part of the day for those who are employed as researchers than it is for others, while management responsibilities are much greater for those employed by government agencies and/or in policy/regulatory positions. Consulting appears to be the province of those in the private sector, and those whose positions are the most academically oriented. Very little teaching and public edcuation is done by those employed outside of the academic realm.

PART TWO:

CURRENT PROJECT-RELEVANT WORK UNDERWAY BY RESPONDENTS AND/OR THEIR ORGANIZATIONS

FIG. 5: CURRENT WORK ON MONITORING OBJECTIVES BY RESPONDENTS AND/OR THEIR ORGANIZATIONS

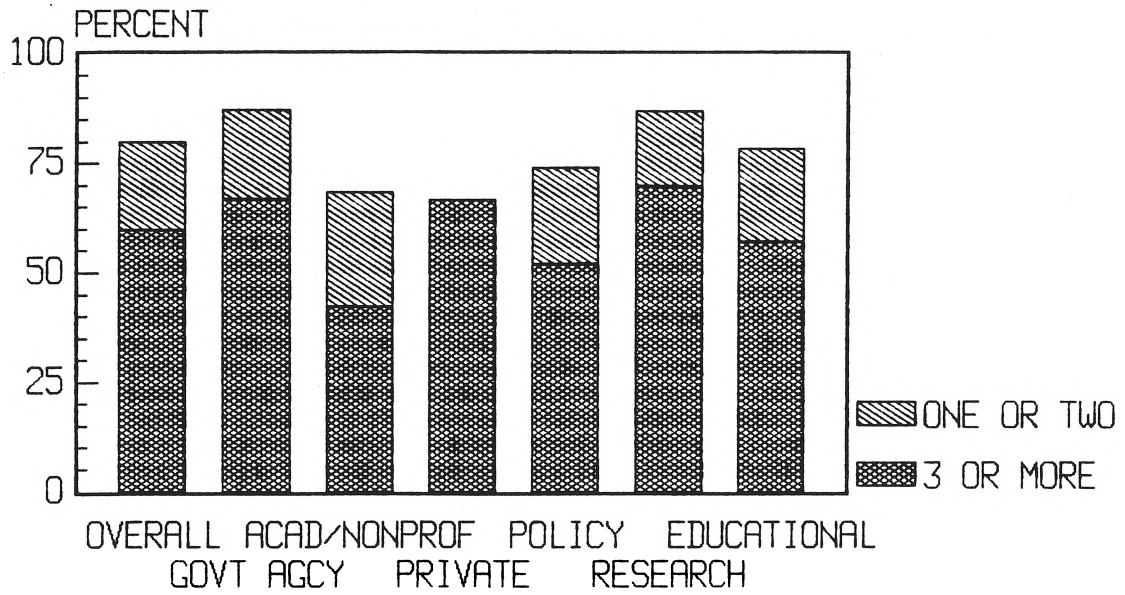


TABLE 5. NUMBER OF MONITORING OBJECTIVES ON WHICH RESPONDENT OR H/HER ORGANIZATION IS CURRENTLY WORKING BY TYPE OF ORGANIZATION AND POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Three or more	59.4%	66.7%	42.1%	66.7%	51.9%	69.6%	57.1%
One or two	20.3	20.5	26.3	0.0	22.2	17.4	21.4
None	20.3	12.8	31.6	33.3	25.9	13.0	21.4
TOTAL	100.0%	100.0	100.0	100.0	100.0	100.0	99.9

Overall, 80% of the respondents reported that they, or their organizations, are currently working on at least one of the management objectives identified by the Gulf of Maine Management Project with six of ten reporting current work on three or more of these objectives. Employees of government agencies are the most likely to be working on some objective(s), while those respondents, and private sector employees, are more likely than those affiliated with academic or nonprofit organizations to be working on three or more of the monitoring objectives. Researchers are more likely than others to be working on these objectives, and they generally are working on several of them at this time.

FIG. 6: CURRENT WORK ON MONITORING OBJECTIVES BY RESPONDENTS AND/OR THEIR ORGANIZATIONS (GOAL #1 OBJECTIVES)

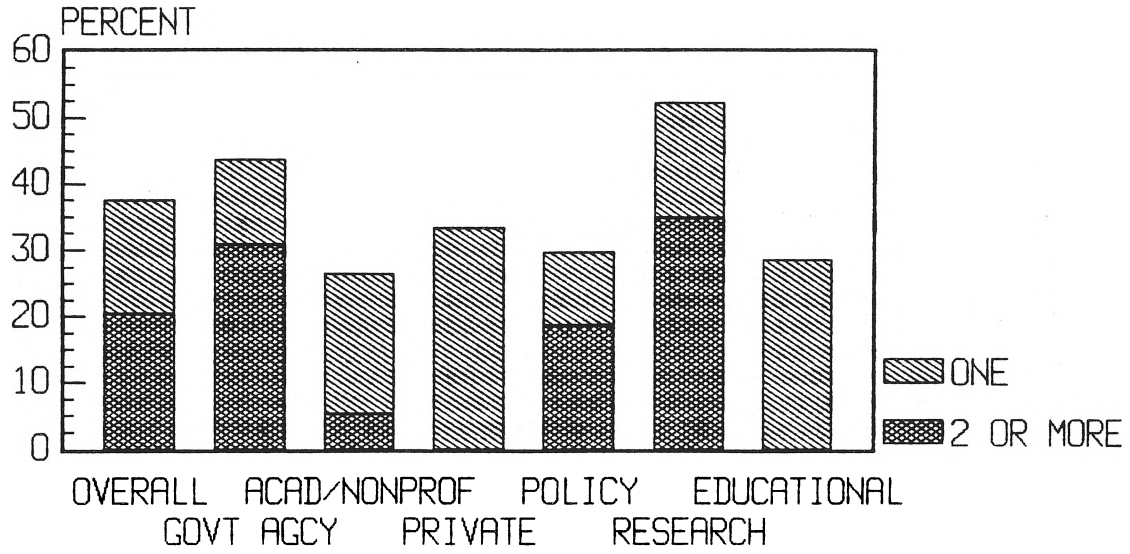


TABLE 6. NUMBER OF MONITORING OBJECTIVES ON WHICH RESPONDENT OR H/HER ORGANIZATION IS CURRENTLY WORKING BY TYPE OF ORGANIZATION AND POSITION (MONITORING GOAL #1 OBJECTIVES ONLY)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Two or more	20.3%	30.8%	5.3%	0.0%	18.5%	34.8%	0.0%
One	17.2	12.8	21.1	33.3	11.1	17.4	28.6
None	62.5	56.4	73.7	66.7	70.4	47.8	71.4
TOTAL	100.0%	100.0	100.1	100.0	100.0	100.0	100.0

Slightly more than one-third (37.5%) of the respondents reported that they and/or their organization are currently working monitoring goal #1 objectives. These objectives include monitoring the health risks of pathogens, phytotoxins and toxic compounds. Most of the work currently be undertaken to these ends appears to be being conducted by government supported researchers.

FIG. 7: CURRENT WORK ON MONITORING OBJECTIVES BY RESPONDENTS AND/OR THEIR ORGANIZATIONS (GOAL #2 OBJECTIVES)

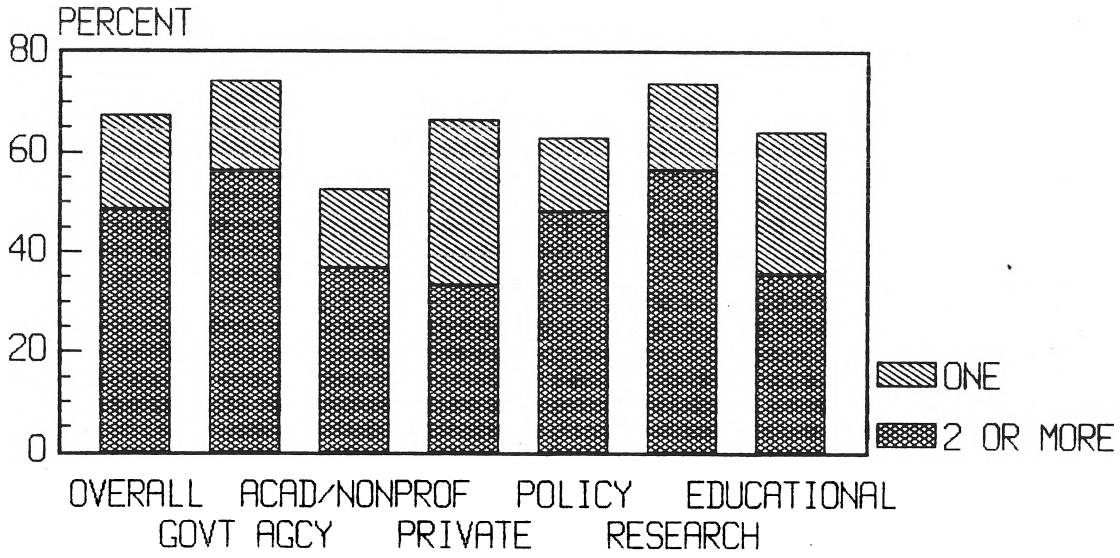


TABLE 7. NUMBER OF MONITORING OBJECTIVES ON WHICH RESPONDENT OR H/HER ORGANIZATION IS CURRENTLY WORKING BY TYPE OF ORGANIZATION AND POSITION (MONITORING GOAL #2 OBJECTIVES ONLY)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Two or more	48.4%	56.4%	36.8%	33.3%	48.1%	56.5%	35.7%
One	18.8	17.9	15.8	33.3	14.8	17.4	28.6
None	32.8	25.6	47.4	33.3	37.0	26.1	35.7
TOTAL	100.0%	99.9	100.1	99.9	99.9	100.0	100.0

Monitoring Goal #2 objectives are concerned with the status, trends and sources of ecosystem health risks. About half (48.4%) of the respondents report that work is currently being carried out by themselves or their organizations on two or more of these objectives, and another 18.8% say that work is on-going on one of these. This work appears to be more heavily concentrated in government agencies given that three-fourths of the employees of such organizations report work being carried out relative to these objectives, as compared to about half of those affiliated with academic-nonprofit and private sector organizations.

FIG. 8: CURRENT WORK ON MONITORING OBJECTIVES BY RESPONDENTS AND/OR THEIR ORGANIZATIONS (GOAL #3 OBJECTIVES)

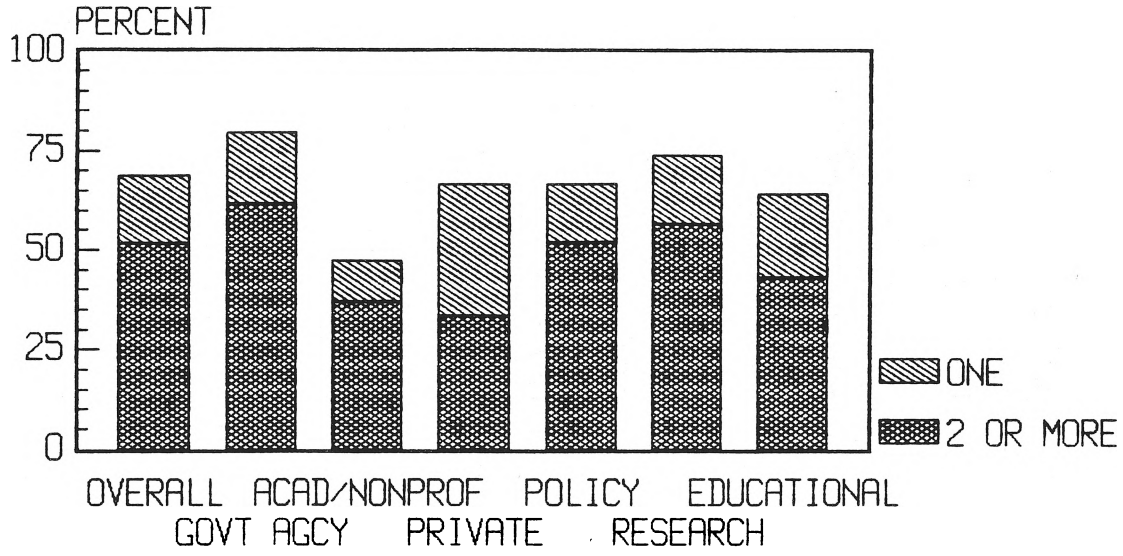
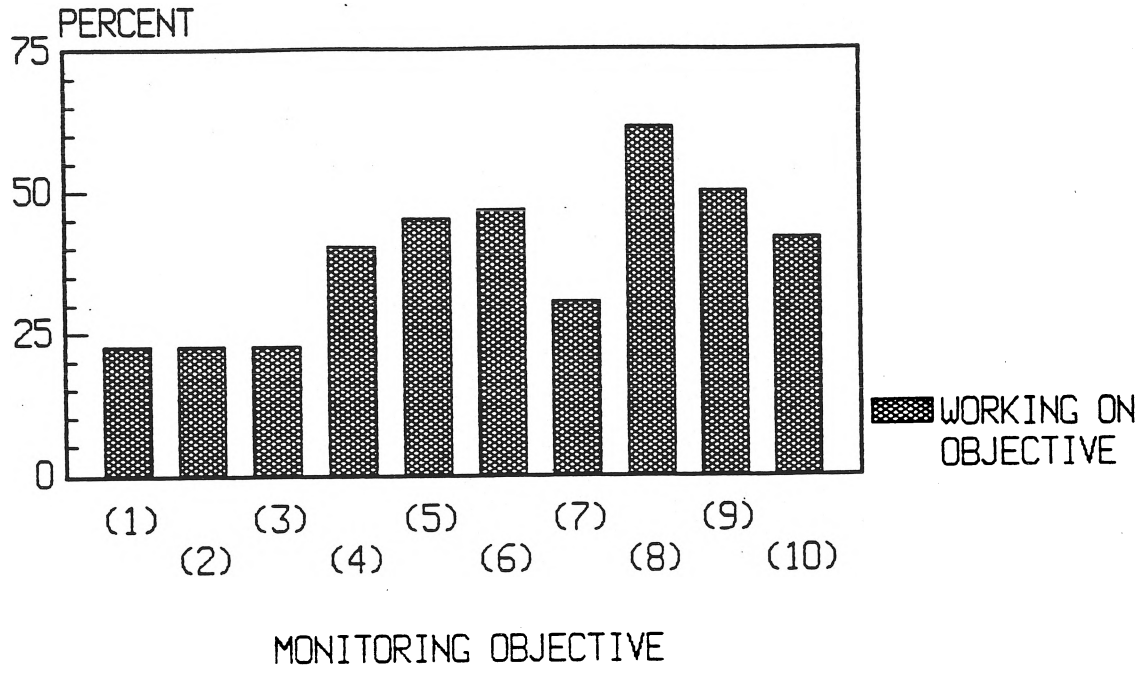


TABLE 8. NUMBER OF MONITORING OBJECTIVES ON WHICH RESPONDENT OR H/HER ORGANIZATION IS CURRENTLY WORKING BY TYPE OF ORGANIZATION AND POSITION (MONITORING GOAL #3 OBJECTIVES ONLY)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Two or more	51.6%	61.5%	36.8%	33.3%	51.9%	56.5%	42.9%
One	17.2	17.9	10.5	33.3	14.8	17.4	21.4
None	31.3	20.5	52.6	33.3	33.3	26.1	35.7
TOTAL	100.1%	99.9	99.9	99.9	100.0	100.0	100.0

About half of the respondents (51.6%) report that work on two or more of the Monitoring Goal #3 objectives is currently being undertaken by themselves or their organization. In all, two-thirds are working on at least one of these objectives which include maximizing the use and transfer of information. This work is much more prevalent among employees of government agencies.

FIG. 9: WORK ON INDIVIDUAL MONITORING OBJECTIVES



HORIZONTAL AXIS KEY:

(1) Monitor human health risks from pathogens.
(2) Monitor human health risks from phytotoxins.
(3) Monitor human health risks from toxic compounds.
(4) Monitor the viability of fish stocks.
(5) Monitor appropriate indicators.
(6) Identify causes of environmental degradation.
(7) Assess impacts of environmental catastrophes.
(8) Provide information to managers.
(9) Provide timely analysis.
(10) Impacts of management actions.

TABLE 9. PROPORTION OF RESPONDENTS WORKING ON SPECIFIC MONITORING OBJECTIVES BY TYPE OF ORGANIZATION AND POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Pathogen health risks	22.6%	31.6%	11.1%	0.0%	19.2%	40.9%	0.0%
Phytotoxin health risks	22.6	31.6	11.1	0.0	19.2	36.4	7.1
Toxic compounds risks	22.6	28.9	11.1	33.3	19.2	31.8	21.4
Viability of fish stocks	40.3	44.7	33.3	33.3	34.6	54.5	28.6
Monitoring indicators	45.2	50.0	33.3	50.0	42.3	54.5	35.7
Ident causes env degrad	46.8	55.3	33.3	33.3	53.8	45.5	35.7
Assess impacts env catast	30.6	44.7	5.6	16.7	34.6	31.8	21.4
Provide info to managers	61.3	71.1	44.4	50.0	57.7	68.2	57.1
Provide timely analysis	50.0	57.9	38.9	33.3	42.3	63.6	42.9
Imapacts of mgt actions	41.9	52.6	22.2	33.3	50.0	36.4	35.7

Assess existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment: Overall, 22.6% of the respondents reported that they, or their organization, are currently addressing this objective. It appears that most of this work is being carried out by researchers associated with governmental agencies.

Assess existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from phytotoxins transmitted through marine foods: Again 22.6% respondents report work being done, and they appear to be essentially the same group of governmental researchers.

Assess existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact: Some work on this objective is being done across the full range of organization and position types; however, only 22.6% report any work being done on it.

Assess the existing status and follow trends in the ecological and economic viability of fish stocks, and identify the causes of change, especially those that can be related to harvesting: Work is being carried out on this objective by 40.3% of the respondents or their organizations. While the work transcends the organizational and position types represented by the respondents, it appears to be somewhat more concentrated in governmental agencies, and among those who describe their positions to be research-oriented.

Assess the existing status and follow trends of ecosystem integrity by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality: This objective is currently being addressed by 45.2% of the respondents and/or organizations represented in the survey. It is being carried out by all types of organizations, but is most frequently mentioned by employees of government agencies.

In cases where environmental degradation is suspected, identify the causes, especially as they reflect anthropogenic impacts and cumulative effects: This objective is being worked on by 46.8% of the respondents or their organizations. It is being addressed most frequently by governmental agencies.

As needed, assess the impacts of environmental catastrophes in relation to existing information: Fewer than one-third (30.6%) of the respondents reported work on this objective. Government agencies appear to be much more involved in addressing this issue than are other organizations.

Provide information generated by monitoring activities to resource and environmental managers in a format that will allow design of appropriate rehabilitation, mitigation, damage-avoidance procedures, and other management actions: This objective is the most frequently addressed of those identified by the project--61.3% said that they, or their organizations, are currently working on it. Again, while work transcends all types of organizations, governmental agencies appear to be the most heavily involved in confronting this objective. Academic institutions and nonprofit organizations and those who are in educational positions are working on this more than any other objective identified by the project.

Provide timely analysis, interpretation and presentation of program results; evaluate and update the monitoring program based on these results as required: Half of the respondents reported on-going work on this objective. That work is most often being done by researchers affiliated with a government agency.

Assess the impact of environmental management actions on risks to public health, the viability of harvestable resources, ecosystem health, and local economies as measured by the indicators developed by the monitoring program: Overall, 41.9% said that they, or their organization, are working on this. The work is often being carried out by those in policy/administrative positions in governmental agencies.

Additional Relevant Activities

Six of the respondents identified one additional activity upon which they or their organization is working. One identified three additional current work foci.

PART THREE:

RESPONDENTS' RATINGS OF THE IMPORTANCE OF THE MONITORING GOALS

FIG. 10: GENERAL IMPORTANCE OF THE THREE MONITORING GOALS

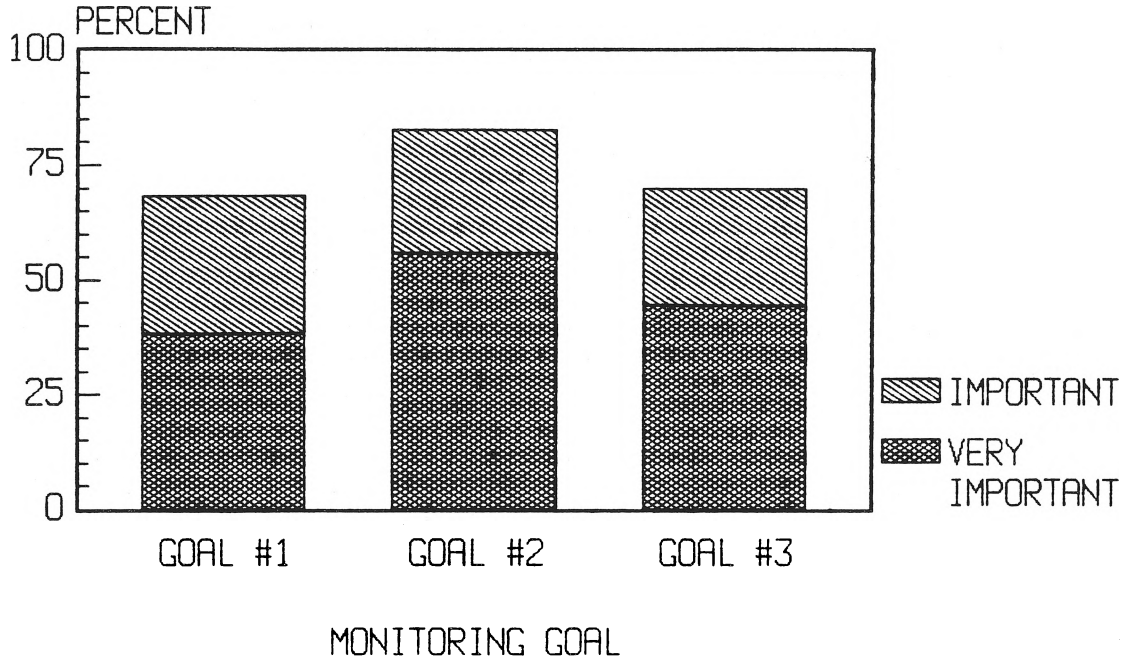


TABLE 10a. IMPORTANCE OF MONITORING GOALS BY TYPE OF ORGANIZATION AND POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Monitoring Goal #1							
Very important	38.1%	43.6%	22.2%	50.0%	33.3%	43.5%	38.5%
Important	30.2	25.6	33.3	50.0	22.2	30.4	46.2
Less important	31.7	30.8	44.4	0.0	44.4	26.1	15.4
Monitoring Goal #2							
Very important	55.6	53.8	66.7	33.3	59.3	52.2	53.8
Important	27.0	28.2	16.7	50.0	29.6	26.1	23.1
Less important	17.5	17.9	16.7	16.7	11.1	21.7	23.1
Monitoring Goal #3							
Very important	44.4	46.2	33.3	66.7	40.7	39.1	61.5
Important	25.4	30.8	11.1	33.3	33.3	21.7	15.4
Less important	30.2	23.1	55.6	0.0	25.9	39.1	23.1

TABLE 10b. IMPORTANCE OF MONITORING GOALS IN RELATION TO OBJECTIVES CHOSEN BY INDIVIDUAL OR ORGANIZATION FOR WORK

	NUMBER OF MONITORING GOAL OBJECTIVES WORKING ON								
	Goal #1			Goal #2			Goal #3		
	Two+	One	None	Two+	One	None	Two+	One	None
Monitoring Goal #1									
Very import	46.2%	18.2%	41.0%	32.3%	36.4%	47.6%	39.4%	30.0%	40.0%
Important	15.4	63.6	25.6	32.3	27.3	28.6	36.4	40.0	15.0
Less import	38.5	18.2	33.3	35.5	36.4	23.8	24.2	30.0	40.0
Monitoring Goal #2									
Very import	53.8	72.7	51.3	58.1	63.6	47.6	72.7	30.0	40.0
Important	30.8	18.2	28.2	29.0	18.2	28.6	18.2	40.0	35.0
Less import	15.3	9.1	20.5	12.9	18.2	23.8	9.1	30.0	25.0
Monitoring Goal #3									
Very import	7.7	54.5	53.8	35.5	72.7	42.9	39.4	80.0	35.0
Important	46.2	9.1	23.1	25.8	27.3	23.8	30.3	10.0	25.0
Less import	46.2	36.4	23.1	38.7	0.0	33.3	30.3	10.0	40.0

General Importance of Individual Monitoring Goals

Goal #1: To provide information on status, trends and sources of marine-based human health risks in the Gulf of Maine including environmental media and products contaminated with human pathogens, biotoxins, and organic and metallic contaminants at or near action levels. Respondents were asked to rate the importance of this, and the other two goals, on a 1-to-5 scale, where 1 meant that the goal was very important, and 5 meant it was not at all important. This goal is considered to be very important by 38.1%, and important ("2"), by another 30.2% of the respondents. Researchers and educators consider this of generally greater importance than do those in administrative or policy formulating positions. As would be expected those respondents who reported that they, or their organizations, are working on one or more of the objectives connected with this monitoring goal attach greater importance to it than do other respondents.

Goal #2: To provide information on status, trends and sources of marine ecosystem health risks in the Gulf of Maine including ecological and economic viability of fish stocks, presence in and impact of toxics on species, changes in ecosystem health due to pollutants, including dissolved oxygen, nutrients, toxics, and habitat destruction. More than half of the respondents (55.6%) consider this monitoring goal to be very important, with another 27% considering it to be important. While those working on objectives connected with this goal appear to be somewhat more likely to attach importance to it, those who are currently working on two or more of the objectives related to Goal #3 (see below) are the most likely of the respondents to rate this goal as being very important.

Goal #3: To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action. This goal is seen to be of importance by a seven in ten of the respondents. Those respondents associated with academic and nonprofit organizations attach less importance to it than do others. Also, those who are currently addressing Goal #1 objectives see it of much less importance than do those not working on those objectives.

FIG. 11 MONITORING GOAL RANKINGS AS MOST IMPORTANT

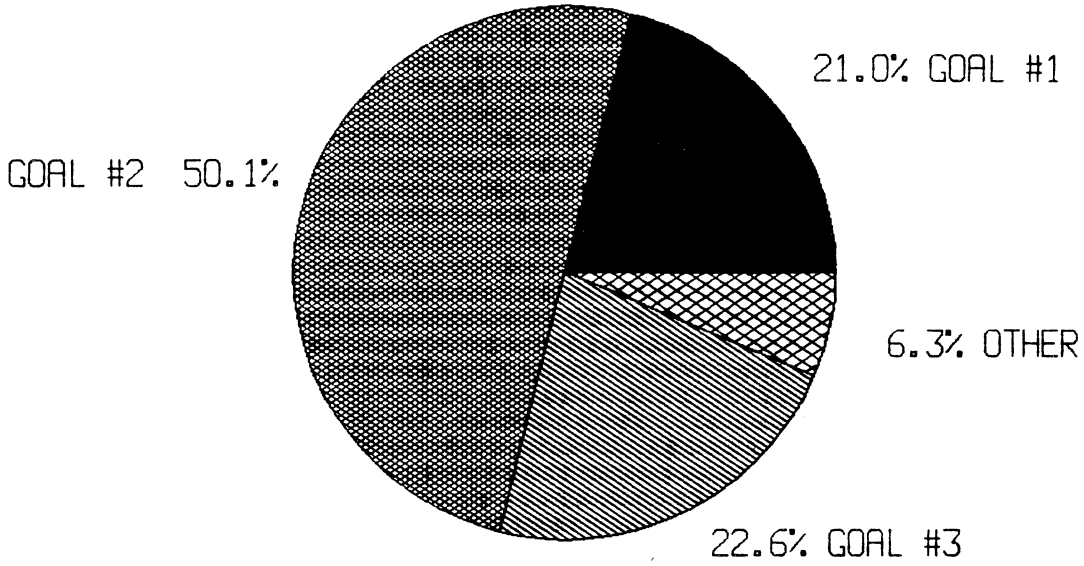


TABLE 11a. RELATIVE IMPORTANCE OF MONITORING GOALS BY TYPE OF ORGANIZATION AND POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Monitoring Goal #1							
Most important	21.0%	24.3%	15.8%	16.7%	18.5%	19.0%	28.6%
Next important	33.9	29.7	31.6	66.7	29.6	38.1	35.7
Less important	45.2	45.9	52.6	16.7	51.9	42.9	35.7
Monitoring Goal #2							
Most important	50.0	45.9	63.2	33.3	59.3	38.1	50.0
Next important	25.8	32.4	15.8	16.7	29.6	23.8	21.4
Less important	24.2	21.6	21.1	50.0	11.1	38.1	28.6
Monitoring Goal #3							
Most important	22.6	24.3	10.5	50.0	22.2	23.8	21.4
Next important	22.6	24.3	21.1	16.7	29.6	14.3	21.4
Less important	54.8	51.4	68.4	33.3	48.1	61.9	57.1

TABLE 11b. RELATIVE IMPORTANCE OF MONITORING GOALS IN RELATION TO OBJECTIVES CHOSEN BY INDIVIDUAL OR ORGANIZATION FOR WORK

	NUMBER OF MONITORING GOAL OBJECTIVES WORKING ON								
	Goal #1			Goal #2			Goal #3		
	Two+	One	None	Two+	One	None	Two+	One	None
Monitoring Goal #1									
Most import	36.4%	0.0%	22.5%	17.2%	25.0%	23.8%	19.4%	18.2%	25.0%
Next import	18.2	45.5	35.0	27.6	33.3	42.9	32.3	45.5	30.0
Less import	45.5	54.5	42.5	55.2	41.7	33.3	48.4	36.4	45.0
Monitoring Goal #2									
Most import	45.5	63.6	47.5	55.2	41.7	47.6	64.5	9.1	50.0
Next import	45.5	9.1	25.0	31.0	25.0	19.0	25.8	36.4	20.0
Less import	9.1	27.3	27.5	13.8	33.3	33.3	9.7	54.5	30.0
Monitoring Goal #3									
Most import	9.1	18.2	27.5	17.2	25.0	28.6	12.9	63.6	15.0
Next import	27.3	36.4	17.5	31.0	16.7	14.3	29.0	0.0	25.0
Less import	63.6	45.5	55.0	51.7	58.3	57.1	58.1	36.4	60.0

Relative Importance of the Three Monitoring Goals

The respondents were asked to rank the importance of the three monitoring goals identified by the project, and any additional goals that were respondent identified.

Goal #1: This goal (marine-related human health risks) is considered to be the most important of the goals by one-fifth of the respondents, and the second most important by one-third. Those actively engaged in addressing Goal #2 objectives attach the least relative importance to this goal.

Goal #2: Monitoring Goal #2 (ecosystem health) is considered to the most important of the identified goals by half of the respondents, and either the most or second most important by three-fourths. Researchers attach less relative importance to this goal than do administrators or educators. As would be expected, those working on objectives related to the goal are most likely to see its relative importance in a favorable light.

Goal #3: This goal (information use and transfer) is seen as the most important by 22.6%, and the second most by another 22.6%. Those working on one of this goals identified objectives are much more likely than those working on more than one or none of its objectives to rank it as the most important of the three monitoring goals.

Additional Respondent Identified Goals

Nearly half (31) respondents identified additional monitoring goals that s/he thought should be considered for inclusion in the project. Eight of these respondents identified two such additional monitoring goals.

PART FOUR:

RESPONDENTS' RATINGS OF THE IMPORTANCE OF THE MONITORING OBJECTIVES

TABLE 12. THE RELATIVE IMPORTANCE OF EACH OF THE MONITORING OBJECTIVES BOTH WITHIN GOALS AND AMONG ALL MONITORING OBJECTIVES

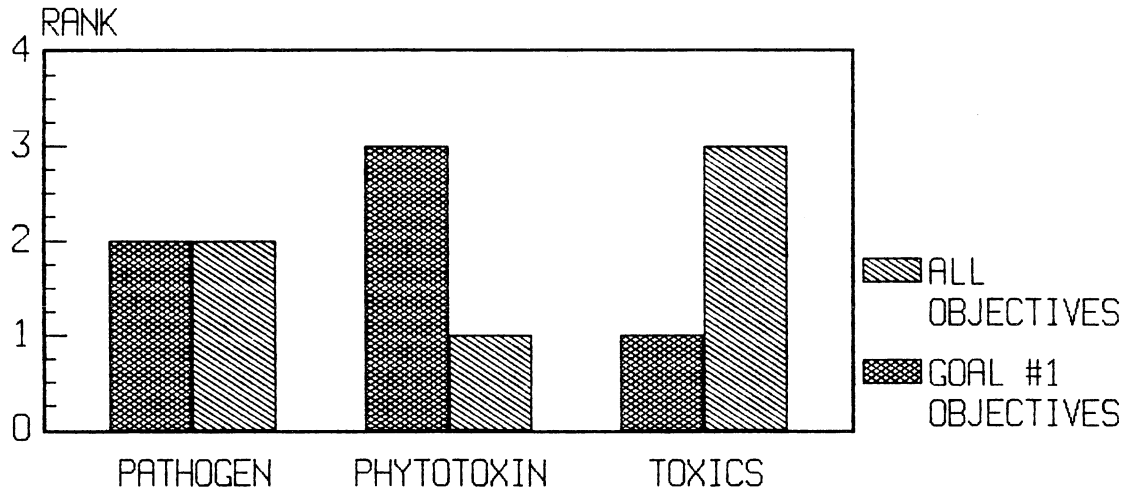
	MEAN RANK WITHIN GOAL	RANK ALL	MEAN REL. TO ALL	RANK WITHIN GOAL REL ALL	RANK OVERALL
Goal #1 Objectives					
Pathogen health risks	2.0	2	5.6	2	5
Phytotoxin health risks	2.1	3	4.6	1	2
Toxic compounds risks	1.7	1	5.9	3	6
Goal #2 Objectives					
Viability of fish stock	2.3	3	4.6	2	2
Monitoring indicators	1.9	1	3.9	1	1
Assess env degradation	2.2	2	4.7	3	4
Assess impacts catastro	3.4	4	9.1	4	11
Goal #3 Objectives					
Provide info to mgrs	2.2	1	5.9	1	6
Provide timely analysis	2.4	2	7.0	2	8
Eval&update monit prog	3.1	4	8.2	4	10
Assess impact env acts	2.8	3	7.7	3	9

The respondents were asked: first, to rate the relative importance of each monitoring objective relative to the other goals specifically associated with the goal to which that objective was associated (Section-B); and secondly, to rate the importance of each objective in relation to all other monitoring objectives (Section-C). Figures 12a through 12c illustrate a degree of inconsistency between the within goal importance of the objectives associated with Goal #1 (human health risks) and Goal #2 (ecosystem health risks). The within goal importance of the Goal #1 objectives is reversed when those objectives are related to all of the objectives. The monitoring of human health risks from marine-related toxic compounds is seen to be the most important within goal objective and human health risks from phytotoxins in the marine environment is rated the least important within goal concern; however, the monitoring of marine-related phytotoxins is the most important of the Goal #1 objectives relative to all of the project-identified ones, and monitoring the risks to human health from toxic compounds is the least important of the Goal #1 ojectives when ranked in relation to all of them.

This inconsistency also occurs to a lesser extent between the within goal and overall rankings of the Goal #2 objectives in that monitoring the viability of fish stocks (third in importance within goal) and identifying the causes of environmental degradation (second within goal) trade places when the Goal #2 monitoring objectives are ranked relative to all of the project-identified goals. There is no changing of order among the Goal #3 within goal and overall ranking of importance of the monitoring objectives associated with that goal.

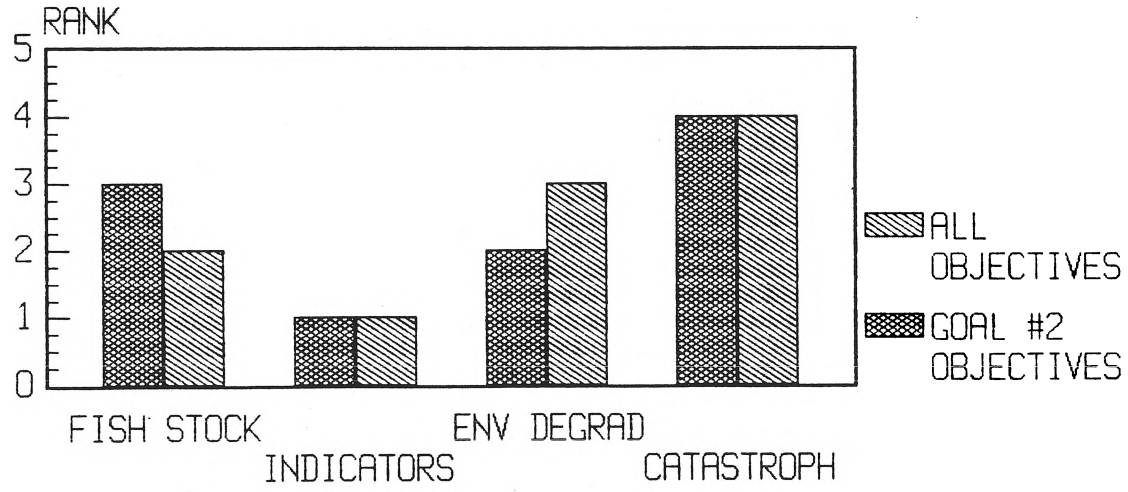
Excluding the assessment of the impacts of environmental catastrophes which is ranked as the least important objective overall, all of the Goal #2 objectives are in the top quartile of the relative importance rankings of the individual objectives. Monitoring the appropriate indicators of environmental integrity is seen to be the most important Goal #2 and overall objective. Monitoring phytotoxins is the only Goal #1 objective in the first quartile of importance overall; however, the monitoring of pathogen human health risks ranks fifth and concern for human health risks from marine-related toxic compounds ranks in a tie for sixth overall. The Goal #3 objectives are seen to be generally less important than those associated with the other two monitoring goals. (See Figure 12d and Table 12.)

FIG 12a: DEGREE OF CONSITENCY/INCONSISTENCY OF THE IMPORTANCE OF GOAL #1 OBJECTIVES WHEN RANKED WITHIN GOAL #1 VERSUS ALL MONITORING OBJECTIVES



GOAL #1 MONITORING OBJECTIVE

FIG 12b: DEGREE OF CONSITENCY/INCONSISTENCY OF THE IMPORTANCE OF GOAL #2 OBJECTIVES WHEN RANKED WITHIN GOAL #1 VERSUS ALL MONITORING OBJECTIVES



GOAL #2 MONITORING OBJECTIVE

FIG 12c: DEGREE OF CONSITENCY/INCONSISTENCY OF THE IMPORTANCE OF GOAL #3 OBJECTIVES WHEN RANKED WITHIN GOAL #1 VERSUS ALL MONITORING OBJECTIVES

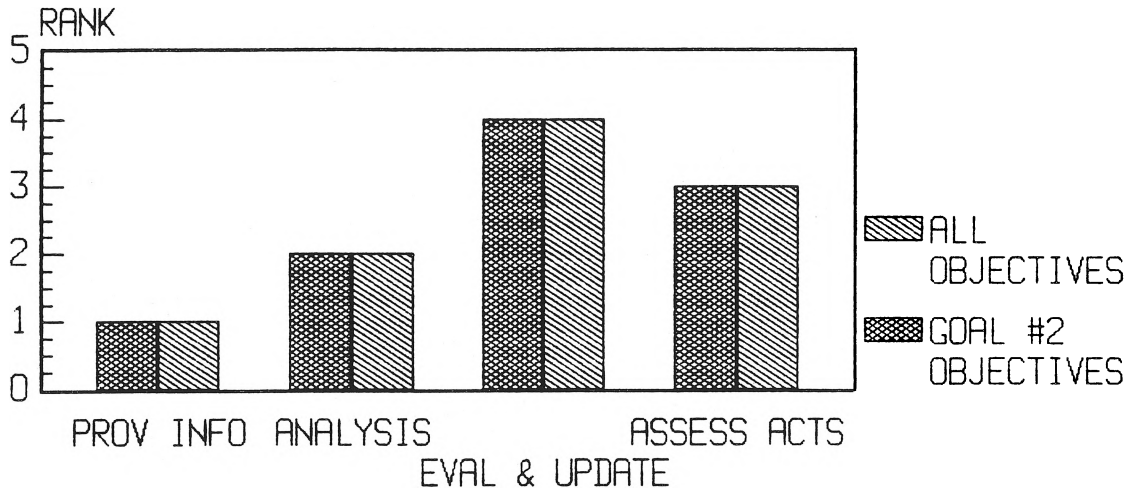


FIG. 12d: OVERALL RANK OF RELATIVE IMPORTANCE OF EACH MONITORING OBJECTIVE IN RELATION TO ALL OF THE OBJECTIVES

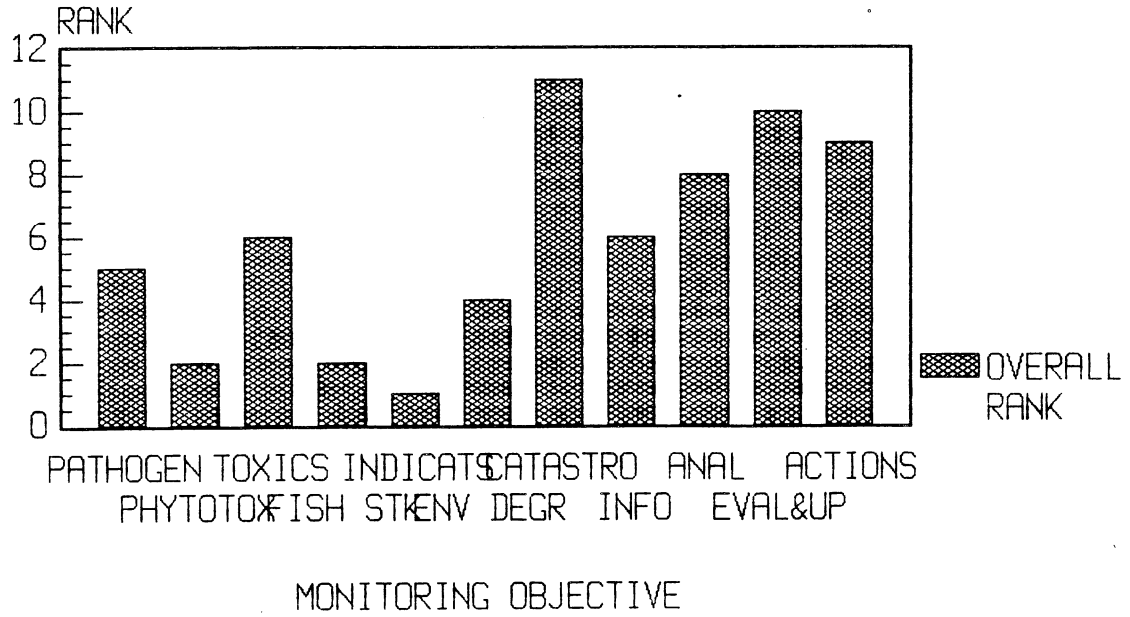


FIG. 13: COMBINED RELATIVE IMPORTANCE OF THE MONITORING OBJECTIVES ASSOCIATED WITH EACH OF THE GOALS GROUPED AS VERY IMPORTANT, IMPORTANT, LESS IMPORTANT

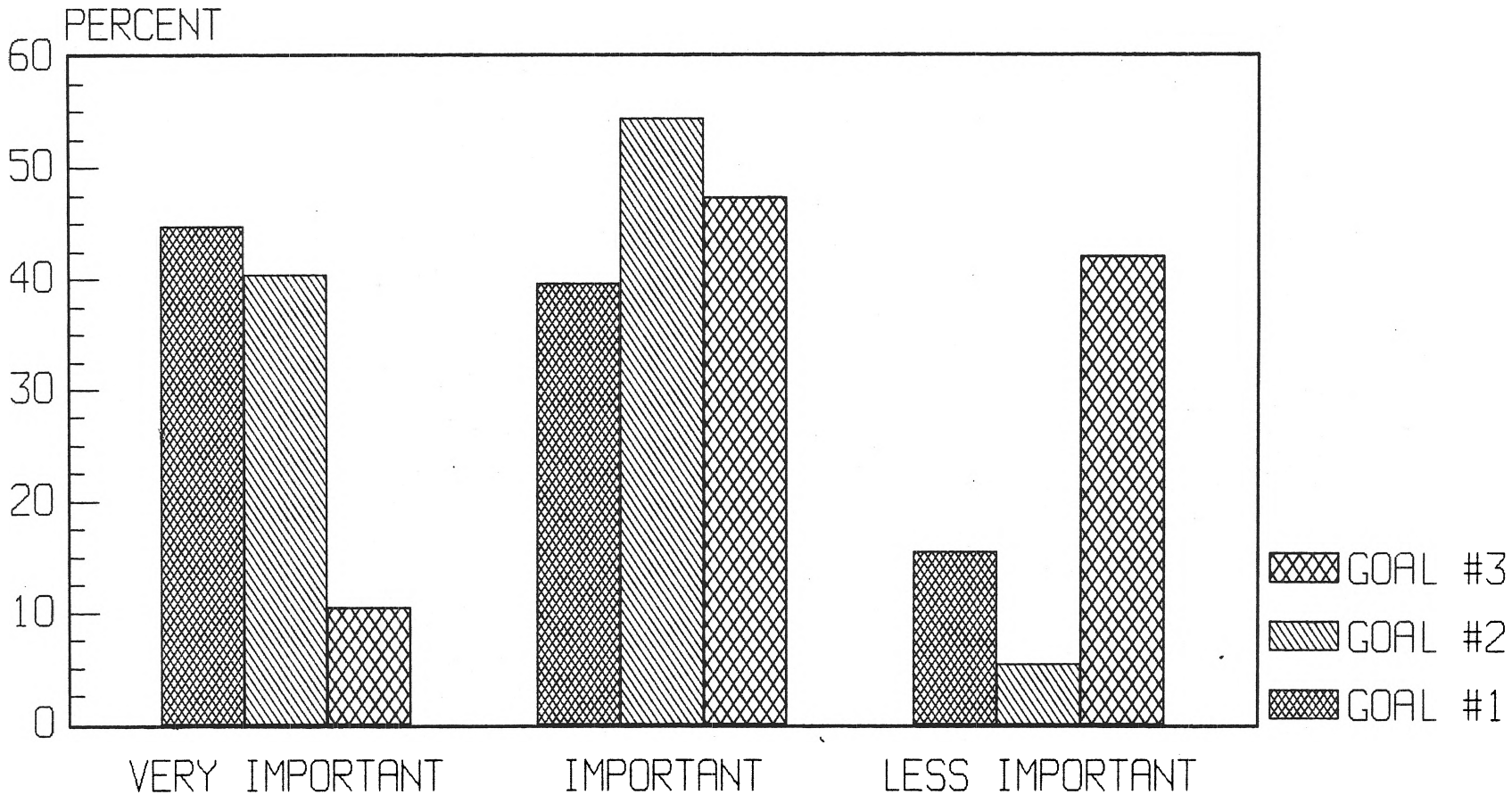


TABLE 13a. COMBINED RELATIVE IMPORTANCE OF THE PROJECT-IDENTIFIED OBJECTIVES[a] FOR EACH OF THE MONITORING GOALS BY TYPE OF ORGANIZATION AND POSITION

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Goal #1 Objectives Combined							
Very important	44.8%	40.5%	55.6%	33.3%	38.5%	45.0%	58.3
Important	39.7	45.9	27.8	33.3	46.2	40.0	25.0
Less important	15.5	13.5	16.7	33.3	15.4	15.0	16.7
Goal #2 Objectives Combined							
Very important	40.4	36.1	50.0	33.3	44.0	35.0	41.7
Important	54.4	58.3	44.4	67.7	52.0	60.0	50.0
Less important	5.3	5.6	5.6	0.0	4.0	5.0	8.3
Goal #3 Objectives Combined							
Very important	10.5	13.9	0.0	33.3	12.0	10.0	8.3
Important	47.4	44.4	55.6	33.3	56.0	45.0	33.3
Less important	42.1	41.7	44.4	33.3	32.0	45.0	58.3

[a] See text for an explanation of the calculation of the Goal 1-3 Combined Importance Indices used in tables 13a through 13d.

TABLE 13b. COMBINED RELATIVE IMPORTANCE OF THE PROJECT-IDENTIFIED OBJECTIVES FOR EACH OF THE MONITORING GOALS BY PROPORTION OF TIME SPENT ON THE JOB DOING CERTAIN TYPES OF ACTIVITIES

	PROPORTION OF TIME SPENT								
	Research&Writing			Educatn&Speaking			Management		
	>50%	1-50%	None	>50%	1-50%	None	>50%	1-50%	None
Combined Import.	<----------			---------->	<----------		---------->	<----------	
Goal #1 Objs.									
Very import.	52.6%	38.7%	50.0%	71.4%	45.9%	28.6%	31.8%	48.3%	71.4%
Important	36.8	38.7	50.0	14.3	37.8	57.1	50.0	37.9	14.3
Less import.	10.5	22.6	0.0	14.3	16.2	14.3	18.2	13.8	14.3
Goal #2 Objs.									
Very import.	42.1	43.3	25.0	42.9	41.7	35.7	47.6	34.5	42.9
Important	57.9	53.3	50.0	42.9	55.6	57.1	42.9	62.1	57.1
Less import.	0.0	3.3	25.0	14.3	2.8	7.1	9.5	3.4	0.0
Goal #3 Objs.									
Very import.	5.3	13.3	12.5	0.0	8.3	21.4	19.0	6.9	0.0
Important	42.1	43.3	75.0	57.1	44.4	50.0	47.6	44.8	57.1
Less import.	52.6	43.3	12.5	42.9	47.2	28.6	33.3	48.3	42.9

TABLE 13c. COMBINED RELATIVE IMPORTANCE OF THE PROJECT-IDENTIFIED OBJECTIVES FOR EACH OF THE MONITORING GOALS BY VOLUME OF WORK IN WHICH RESPONDENT IS ENGAGED RELATIVE TO THE MONITORING OBJECTIVES OF EACH GOAL

	NUMBER OF MONITORING GOAL OBJECTIVES WORKING ON								
	Goal #1			Goal #2			Goal #3		
	Two+	One	None	Two+	One	None	Two+	One	None
Combined Import.									
Goal #1 Objs.									
Very import.	58.3%	37.5%	42.1%	51.9%	27.3%	45.0%	48.4%	44.4%	38.9%
Important	33.3	37.5	42.1	37.0	54.3	35.0	38.7	44.4	38.9
Less import.	8.3	25.0	15.8	11.1	18.2	20.0	12.9	11.1	22.2
Goal #1 Objs.									
Very import.	33.0	87.5	32.4	44.4	36.4	36.8	46.7	11.1	44.4
Important	66.7	12.5	59.5	51.9	63.6	52.6	50.0	77.8	50.0
Less import.	0.0	0.0	8.1	3.7	0.0	10.5	3.3	11.1	5.6
Goal #1 Objs.									
Very import.	16.7	0.0	10.8	14.8	0.0	10.5	10.0	11.1	11.1
Important	25.0	37.5	56.8	29.6	63.6	63.2	40.0	55.6	55.6
Less import.	58.3	62.5	32.4	55.6	36.4	26.3	50.0	33.3	33.3

TABLE 13d. COMBINED RELATIVE IMPORTANCE OF THE PROJECT-IDENTIFIED OBJECTIVES FOR EACH OF THE MONITORING GOALS BY GENERAL LEVEL OF IMPORTANCE ATTACHED TO EACH OF THE MONITORING GOALS

	GENERAL LEVEL OF IMPORTANCE								
	Goal #1			Goal #2			Goal #3		
	Very	Imprt	Less	Very	Imprt	Less	Very	Imprt	Less
Combined Import.									
Goal #1 Objs.									
Very import.	61.9%	47.1%	16.0%	20.0%	52.9%	52.6%	5.0%	11.8%	15.8%
Important	28.6	35.3	47.8	70.0	47.1	42.1	65.0	41.2	36.8
Less import.	9.5	17.6	44.8	10.0	0.0	5.3	30.0	47.1	47.4
Goal #1 Objs.									
Very import.	40.6	42.9	54.5	51.6	28.6	27.3	9.7	14.3	9.1
Important	43.8	35.7	36.4	45.2	64.3	63.6	48.4	57.1	36.4
Less import.	15.6	21.4	9.1	3.2	7.1	9.1	41.9	28.6	54.5
Goal #1 Objs.									
Very import.	34.6	35.7	64.7	36.0	42.9	47.1	16.0	7.1	5.9
Important	42.3	57.1	23.5	56.0	57.1	47.1	56.0	50.0	35.3
Less import.	23.1	7.1	11.8	8.0	0.0	5.9	28.0	42.9	58.8

Figure 13 shows the relative combined importance of the objectives associated with each of the monitoring goals. The combined importance was established by summing the overall rankings of the individual goals and grouping the sums into a three-tiered variable with the values: very important, somewhat important, and less important. Only one in twenty of the respondents rate the combined importance of Goal #2 (ecosystem health risks) objectives as "less" important. Respondents generally identified the Goal #2 and Goal #1 (human health risks) as "very" important in equal proportion; in contrast, Goal #3 (information use and transfer) objectives are seen to have comparatively less combined importance with 42.1% rating them as "less" important and only one in twenty as "very" important.

The relationships between respondent characteristics and their rating of the combined relative importance of the monitoring objectives of the goals is represented in tabular form in Tables 13a through 13d.

Goal #1 (human health risks): The importance attached to the Goal #1 objectives increases as does the proportion of time spent in educational activities, and decreases as the proportion of time spent in management increases. Those who attach less general importance to the other monitoring goals, in that they do note rate those as generally "very" important, are more likely to consider the combined importance of the Goal #1 objectives to be "very" important.

Goal #2 (ecosystem health risks): The combined relative importance of these objectives is seen to be greatest by those who spend most of their time doing research and writing, and much less important by those who spend none of their work day in that way. Those currently working on some of the Goal #1 objectives (especially those working on only one) rate the the combined importance of these objectives more highly than do others.

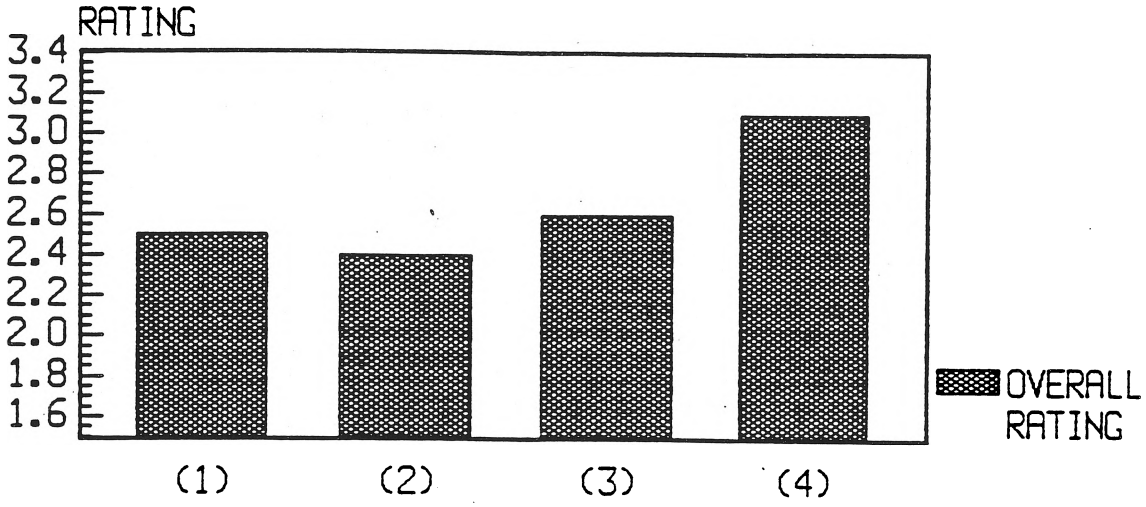
Goal #3 (information use and transfer): Administrators and policy formulators consider these to be more important than do researchers and educators. Those who spend most of their work day in management activities see greater combined importance of the Goal #3 monitoring objectives, while the perceived importance of these declines as the proportion of time spent in both research-writing and educational activities increases. Respondents who are currently working on Goal #2 objectives see little importance attached to these objectives compared to those who are not working on any of those objectives. Those respondents who consider monitoring Goal #1 to be of generally "less" importance attach the greater combined importance to these objectives than do others.

PART FIVE:

RESPONDENTS' RATINGS OF VARIOUS ASPECTS

OF THE COMMUNICATION PROCESS

FIG. 14: MEAN RATINGS OF THE STEPS IN THE COMMUNICATION PROCESS AT PRESENT (1=VERY EFFECTIVE, 2=EFFECTIVE, 3=SOMEWHAT EFFECTIVE, 4=INNEFFECTIVE)



STEP OF THE PROCESS

HORIZONTAL AXIS KEY:

(1) Identify monitoring needs for policy and management purposes.
(2) Develop standard monitoring techniques of information gathering.
(3) Use of monitoring results in policy and management development.
(4) Use of monitoring results in evaluation and fine-tuning policy and management.

TABLE 14. RESPONDENTS' MEAN RATINGS OF THE EFFECTIVENESS OF TH STEPS IN THE PROCESS OF COMMUNICATING MONITORING INFORMATION IN TERMS OF THEIR PRESENT EFFECTIVENESS BY TYPE OF ORGANIZATION AND POSITION (1=Very effective, 2=Effective, 3=Somewhat effective, 4=Very inefective.)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Identify monitoring needs for policy and management purposes	2.5	2.6	2.1	2.7	2.2	2.4	2.4
Develop standard monitoring techniques of info gathering	2.4	2.4	2.2	3.2	2.6	1.9	2.5
Use of monitoring results in policy and mgt development	2.6	2.8	2.3	3.0	2.7	2.5	2.6
Use of monitoring results in eval & fine-tuning pol & mgt	3.1	3.2	2.9	2.7	3.1	3.2	3.0

Respondents were asked to rate the current level of effectiveness of the steps in the process by which communication of monitoring information occurs. These ratings were: 1=very effective, 2=effective, 3=somewhat effective, and 4=very ineffective. Figure 14 and Table 14 present the overall mean ratings of the effectiveness of each of four steps in graphic and tabular form.

Identification of monitoring needs for policy-making and management purposes:

The mean rating of this step, 2.5, suggests that it is seen as being fairly effective. Those associated with academic and nonprofit institutions have a more favorable view of this step then do those employed by government agencies or by private enterprise.

Development of standard monitoring techniques to gather needed information:

This step receives the most favorable rating, 2.4, given to any of the components of the process by which monitoring information is communicated. Those associated with academic or nonprofit institutions (2.2) and government agencies (2.4) consider it to be largely effective, while those in private business (3.2) have much less regard for the effectiveness of this step in the process. Researchers (1.9) are much more likely than others to see this as being "very effective" or "effective."

Use of monitoring results in policy management and management development:

Again, this step appears to be fairly effective in that it obtained a 2.6 mean rating. Government and private business employees have a dimmer view of the effectiveness of this part of the process than do those from academic institutions and nonprofits.

Use of monitoring results in evaluating and fine-tuning policy and management:

This part of the process by which monitoring results are communicated received the lowest mean rating for effectiveness--3.1. Those associated with governemnt agencies (3.2) were the most critical, while private enterprise (2.7) seem to feel the most positive about its effectiveness.

FIG. 15 MEAN RATINGS OF COMMUNICATION BETWEEN AND AMONG RELEVANT GROUPS (1=VERY EFFECTIVE, 2=EFFECTIVE, 3=SOMEWHAT EFFECTIVE, 4=INEFFECTIVE)

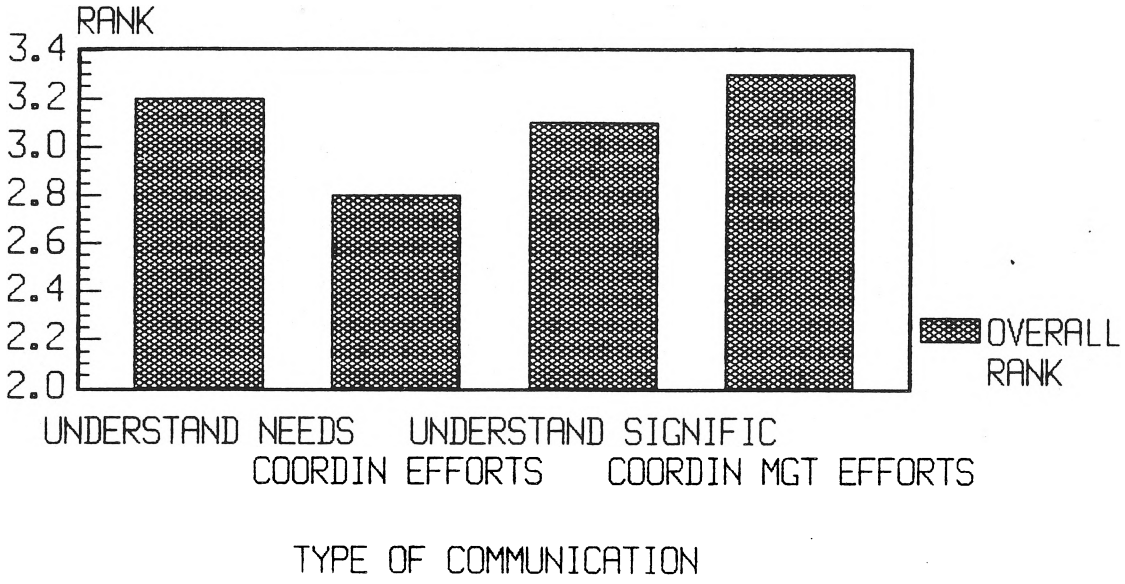


TABLE 15. RESPONDENTS' MEAN RATINGS OF THE CURRENT EFFECTIVENESS OF COMMUNICATION BETWEEN AND AMONG SCIENTISTS, POLICY-MAKERS AND MANAGERS BY TYPE OF ORGANIZATION AND POSITION (1=Very effective, 2=Effective, 3=Somewhat effective, 4=Very inefective.)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Mutual understanding of needs and priorities	3.2	3.3	2.9	3.0	3.5	3.1	2.6
Coordination of monitoring techniques and efforts	2.8	2.8	2.9	2.8	3.0	2.5	2.9
Mutual understanding of monit. results and the significance	3.1	3.1	3.3	3.6	3.2	3.0	2.5
Coordination of policies and management startegies	3.3	3.3	3.2	3.2	3.2	3.4	3.2

The respondents were asked to rate the current level of effectiveness of communication between and among scientists, policy-makers and managers. Again, a four-point rating was employed where a "1" rating meant very effective and "4" meant very ineffective. Figure 15 and Table 15 illustrate that the communication between groups relevant to the monitoring project is considered to be less effective than is the general communication of monitoring information discussed above.

Mutual understanding of monitoring needs and priorities between scientists, policy-makers and managers:

The mutual understanding of monitoring needs and priorities is seen as less than currently effective with an overall mean rating of 3.2. Government employees see this aspect of communication as being less effective than others. While educators (2.5) see this a fairly effective, administrators and policy formulators (3.5) tend to view this as a largely ineffective situation.

Coordination of monitoring techniques and efforts among scientists:

This is the aspect of mutual communication that is seen to be the most effective (2.8) by the respondents. Researchers consider it to be significantly more effective than do others.

Mutual understanding of monitoring results and their significance between scientists, policy-makers and managers:

While educators (2.5) see this aspect of communication between relevant groups to be fairly effective, others see this as largely ineffective giving it an overall mean rating of 3.1.

Coordination of policies and management strategies based on monitoring information:

This is the most lowly rated (3.3) aspect of mutual communication. It is seen as largely ineffective across all respondent subgroups.

FIG. 16: MEAN RATINGS OF EFFECTIVENESS OF METHODS OF INFORMATION TRANSFER AT PRESENT (1=VERY EFFECTIVE, 2=EFFECTIVE 3=SOMEWHAT EFFECTIVE, 4=INEFFECTIVE)

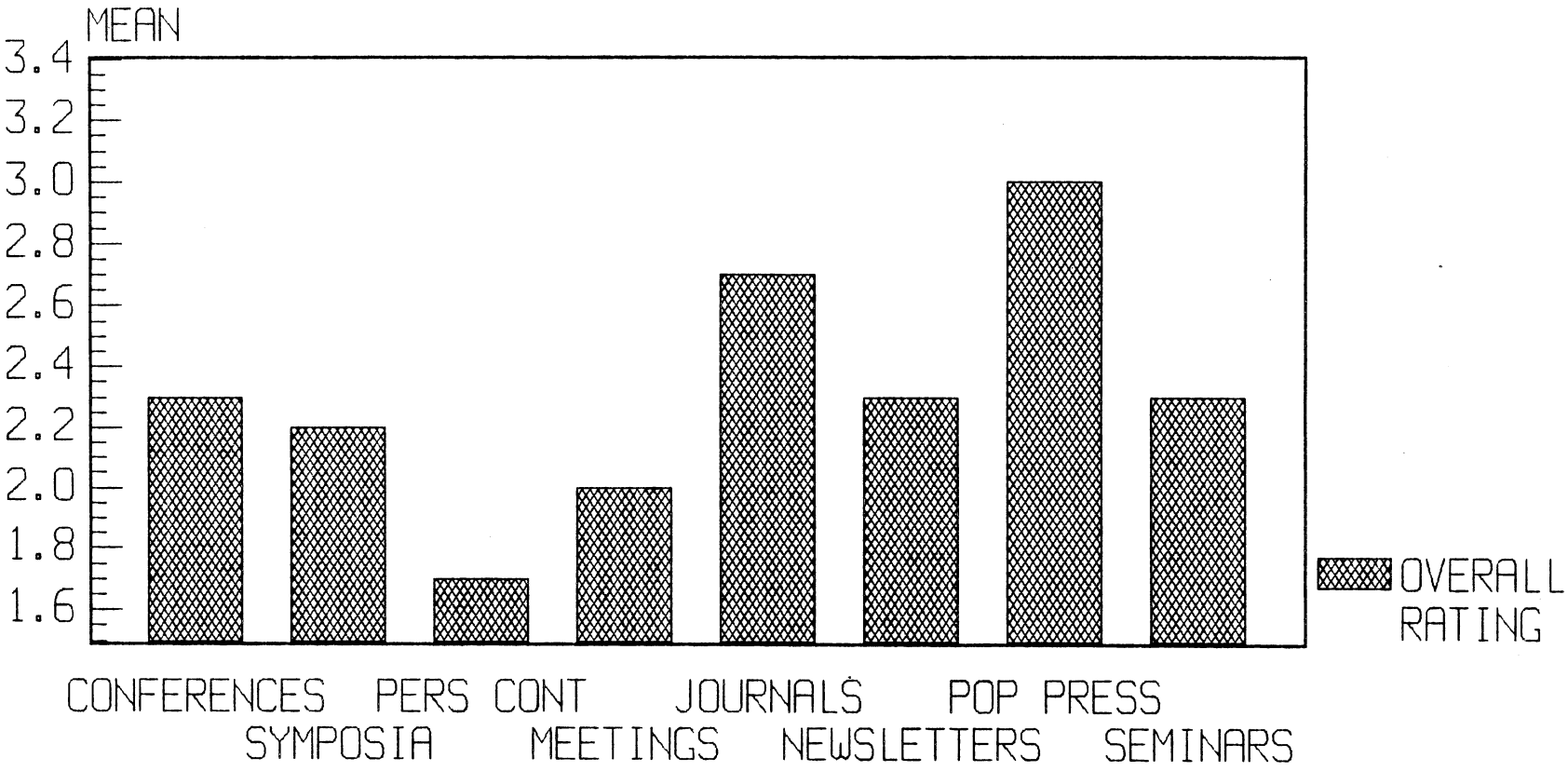


TABLE 16. RESPONDENTS' MEAN RATINGS OF EFFECTIVENESS OF METHODS BY WHICH INFORMATION IS EFFECTIVELY TRANSFERRED BETWEEN SCIENTISTS, POLICY-MAKERS AND MANAGERS BY TYPE OF ORGANIZATION AND POSITION (1=Very effective, 2=Effective, 3=Somewhat effective, 4=Very inefective.)

		TYPE ORGANIZATION			TYPE POSITION		
	Overall	Gov't	Acad	Priv	Policy	Rsearch	Edctn
Conferences	2.3	2.4	2.2	1.8	2.3	2.5	1.9
Annual symposia	2.2	2.3	2.2	1.8	2.4	2.3	1.9
Personal contact	1.7	1.6	1.7	1.8	1.8	1.5	1.6
Interorganiz. meetings	2.0	1.8	2.3	2.2	1.9	2.0	2.0
Professional journals	2.7	2.7	2.4	3.2	2.6	2.6	2.8
Newsletters	2.3	2.4	2.2	2.4	2.4	2.4	2.2
Popular press	3.0	3.0	2.8	2.8	2.9	3.2	2.8
Training seminars	2.3	2.4	2.3	2.0	2.4	2.4	2.1

Finally, the respondents were asked (again on a 1-to-4 scale) the effectiveness of media by which information is transferred between scientists, policy-makers and managers. In general, face-to-face forms of information transfer are seen to be more effective than are printed media. (See Figure 16 and Table 16.)

Conferences: Overall, conferences received a mean effectiveness rating of 2.3. Private sector respondents (1.8) and educators (1.9) have significantly more regard for the effectiveness of this medium, while those associated with government agencies and/or who describe their positions as research-oriented rate conferences as being less effective than do others.

Annual Symposia: This medium receives an overall effectiveness rating of 2.2. Like conferences, symposia are seen to be most effective by the private sector and educators, and less so by governmet and researchers.

Person-to-Person Contact: This media is rated overall as the most effective (1.7). All respondent subgroups considered it to be a largely effective medium of information transfer.

Interorganizational Meetings: Interorganizational meetings are rated by the respondents as being quite effective--2.0 overall. Those associated with government agencies (1.8) have the greatest regard for this medium.

Professional Journals: These were seen to be comparatively less effective than the media discussed above, with an overall rating of 2.7. Those associated with academic institutions or nonprofit organizations have more regard for the effectiveness of professional journals as a medium for information transfer than do others.

Newsletters: Newsletters are considered to be the most effective (2.3, overall) of the printed methods of information transfer. Acamedicans rate this medium to be somewhat more effective than do other respondents.

Popular Press: Respondents from all subgroups consider this medium to be a largely ineffective means of information transfer rating it 3.0 overall.

Training Seminars: The effectiveness of training seminars is seen to be on a par with conferences and seminars. The respondents give this medium a 2.3 overall rating. Educators hold seminars in higher regard as a method of information than do others.

Goals of the Gulf of Maine Working Group on the Marine Environment

1) Coordinate protection of the Gulf's ecosystem
2) Promote sustainable development
3) Promote public awareness
4) Foster marine research

Gulf of Maine Marine Environmental Quality Program
Mission Statement:

It is the mission of the Gulf of Maine Marine Environmental Quality Monitoring Program to provide environmental and resource managers with information to support sustainable use of the Gulf, and allow assessment and management of risk to public and environmental health from current and potential threats.

A0. Currently the Gulf of Maine Marine Environmental Quality Monitoring Program has developed three monitoring goals. Below, we ask that you rate the level of importance of those three goals, and that you take this opportunity to identify other monitoring goals that need to be included into the program.

A1. Using a 1-to-5 scale, where 1 means it is of utmost importance and 5 means that the goal is of little importance,please rate the relative importance of each of the three monitoring goals. (PLEASE ENTER ANSWERS IN SPACES AT RIGHT)

A1a. Monitoring Goal #1: To provide information on status, trends and sources of marine-based human health risks in the Gulf of Maine including environmental media and products contaminated with human pathogens, biotoxins, and organic and metallic contaminants at or near action levels. ___

A1b. Monitoring Goal #2: To provide information on status, trends and sources of marine ecosystem health risks in the Gulf of Maine including ecological and economic viability of fish stocks, presence in and impact of toxics on species, and changes in ecosystem health due to pollutants, including dissolved oxygen, nutrients, toxics, and habitat destruction. ___

A1c. Monitoring Goal #3: To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action. ___

A2. What, if any, monitoring goals do you believe need to be added to the program?

A2a. Additional monitoring goal #1: _____

_____ ___

A2b. Additional monitoring goal #2: _____

_____ ___

A3. Now, please rank order the three established monitoring goals and any that you have added in order of your perception of their importance to the Gulf of Maine. (PLEASE PLACE A "1" IN THE SPACE TO THE RIGHT OF THE MOST IMPORTANT, A "2" NEXT TO THE 2nd MOST IMPORTANT, AND SO ON.) RA

Monitoring Goal #1: human health risks _____ ___
Monitoring Goal #2: ecosystem health risks _____ ___
Monitoring Goal #3: information to managers _____ ___
Additional Monitoring Goal #1 _____ ___
Additional Monitoring Goal #2 _____ ___

Within each of the established monitoring goals, there are a number of monitoring objectives. Below, we ask that you rank order these monitoring objectives according to your perception of the importance of those objectives.

Monitoring Goal #1: **To provide information on status, trends and sources of marine-based human health risks in the Gulf of Maine including environmental media and products contaminated with human pathogens, biotoxins, and organic and metallic contaminants at or near action levels.**

The monitoring objectives under monitoring goal #1 are listed below. Please read through the list, add other monitoring objectives under this goal in the space provided if you believe the list is incomplete and then rank order them by importance. (PLEASE PLACE A "1" IN THE SPACE TO THE RIGHT OF THE MOST IMPORTANT, A "2" NEXT TO THE 2nd MOST IMPORTANT, AND SO ON.)

RANK

(a) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment. _____

(b) Assess the existing levels, the trends, sources and economic impacts of acute and chronic risks to human health from phytotoxins in marine foods. _____

(c) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact. _____

Additional #1: _____

_____ _____

Additional #2: _____

_____ _____

Additional #3: _____

_____ _____

Monitoring Goal #2: **To provide information on status, trends and sources of marine ecosystem health risks in the Gulf of Maine including ecological and economic viability of fish stocks, presence in and impact of toxics on species, and changes in ecosystem health due to pollutants, including dissolved oxygen, nutrients, toxics, and habitat destruction.**

The monitoring objectives under monitoring goal #2 are listed below. Please read through the list, add other monitoring objectives under this goal in the spaces provided if you believe the list is incomplete, and then rank order them by importance. (PLEASE PLACE A "1" IN THE SPACE TO THE RIGHT OF THE MOST IMPORTANT, A "2" NEXT TO THE 2nd MOST IMPORTANT, AND SO ON.)

RANK

(1) Assess the existing status and trends in the ecological and economic viability of fish stocks, and identify the causes of change, especially those that can be related to harvesting. _____

(2) Assess the existing status and follow trends of ecosystem integrity by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality. _____

(3) In cases where environmental degradation is suspected, identify the causes, especially as they reflect anthropogenic impacts and cumulative effects. _____

(4) As needed, assess the impacts of environmental catastrophes in relation to existing information. _____

Additional #1: _____ _____

Additional #2: _____ _____

Additional #3: _____ _____

B3. **Monitoring Goal #3: To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action.**

The monitoring objectives under monitoring goal #3 are listed below. Please read through the list, add other monitoring objectives under this goal in the spaces provided if you believe the list is incomplete and then rank order them by importance. (PLEASE PLACE A "1" IN THE SPACE TO THE RIGHT OF THE MOST IMPORTANT, A "2" NEXT TO THE 2nd MOST IMPORTANT, AND SO ON.)

RA

(1) Provide information generated by monitoring activities to resource and environmental managers in a format that will allow design of appropriate rehabilitation, mitigation, damage-avoidance procedures, and other management actions. ___

(2) Provide timely analysis, interpretation and presentation of program results. ___

(3) Evaluate and update monitoring program based on the anlysis, interpretation and presentation of program results as required. ___

(4) Assess the impact of environmental management actions on risks to public health, the viability of harvestable resources, ecosystem health, and local economies as measured by the indicators developed for the monitoring program. ___

Additional #1: _____

_____ ___

Additional #2: _____

_____

Additional #3: _____

_____

The Monitoring Objectives for all three Monitoring Goals have been grouped together below. Please rank order the monitoring objectives from most to least important towards achieving monitoring goals, assuming that funding constraints are likely and that not all monitoring objectives may be sustained or implemented.

Please write in any additional objectives which you think are necessary to achieve the Monitoring Goals in the spaces provided and include these in your ranking.

(PLEASE PLACE A "01" IN THE SPACE TO THE RIGHT OF THE MOST IMPORTANT, A "02" NEXT TO THE 2nd MOST IMPORTANT, AND SO ON.) RANK

(a) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment. _____

(b) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact. _____

(c) Assess the existing levels, the trends, sources and economic impacts of acute and chronic risks to human health from phytotoxins transmitted through marine foods. _____

(d) Assess the existing status and follow trends in the ecological and economic viability of fish stocks, and identify the causes of change, especially those that can be related to harvesting. _____

(e) Assess the existing status and follow trends of ecosystem integrity by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality. _____

(f) In cases where environmental degradation is suspected, identify the causes, especially as they reflect anthropogenic impacts and cumulative effects. _____

(g) As needed, assess the impacts of environmental catastrophes in relation to existing information. _____

(h) Provide information generated by monitoring activities to resource and environmental managers in a format that will allow design of appropriate rehabilitation, mitigation, damage-avoidance procedures, and other management actions. _____

(i) Provide timely analysis, interpretation and presentation of program results. _____

(j) Evaluate and update monitoring program based on the anlysis, interpretation and presentation of program results as required. _____

(k) Assess the impact of environmental management actions on risks to public health, the viability of harvestable resources, ecosystem health, and local economies as measured by the indicators developed for the monitoring program. _____

(l) Additional #1: _____ _____

(m) Additional #2: _____ _____

(n) Additional #3: _____ _____

). We would like your ideas on how monitoring needs and information can be more effectively communicated among scientists, policy-makers, and managers in the Gulf of Maine.

.. Please rate the following steps in the process of communicating monitoring information in terms their present effectiveness as follows:

1=very effective, 2=effective, 3=somewhat effective, 4=very ineffective.

(PLEASE ENTER ANSWERS IN THE SPACES AT RIGHT) RATE

a. Identification of monitoring needs for policy-making and management purposes _____

b. Development of standard monitoring techniques to gather needed information _____

c. Use of monitoring results in policy and management development _____

d. Use of monitoring results in evaluating and fine-tuning policy and management _____

D2. Please rate the current effectiveness of communication between and among scientists, policy-makers and managers in terms of their present effectiveness as fol lows:
1=very effective, 2=effective, 3=somewhat effective, 4=very ineffective.
(PLEASE ENTER ANSWERS IN THE SPACES AT RIGHT) RA

a. Mutual understanding of monitoring needs and priorities between scientists, policy-makers, and managers ___

b. Coordination of monitoring techniques and efforts among scientists ___

c. Mutual understanding of monitoring results and their significance between scientists, policy-makers, and managers ___

d. Coordination of policies and management strategies based on monitoring information ___

D3. Please rate the following methods by which you believe monitoring information is effectively transferred between scientists, policy-makers, and managers as follows:
1=very effective, 2=effective, 3=somewhat effective, 4=very ineffective.
(PLEASE ENTER ANSWERS IN THE SPACES AT RIGHT) RA

a. Conferences ___

b. Annual symposia ___

c. Person-to-person contacts (meetings, postal mail, phone, Fax, computer) ___

d. Interorganizational meetings ___

e. Professional journals ___

f. Newsletters ___

g. Popular press (newpapers, magazines, TV, and radio) ___

h. Training seminars ___

i. Other # 1: ___

j. Other # 2: ___

D4. What suggestions do you have for improving the communication of Gulf of Maine monitoring information and its use in developing and fine-tuning policy and management options?
Please add your suggestions for improving the communication process, types of communication, and methods of communication below (please continue on additional sheets if you require more space):

Suggestion # 1: _____

_____

Suggestion # 2: _____

_____

Suggestion # 3: _____

_____

D. We would like some information about you, the type of work you do, and the organization you work for in order to develop a profile of people interested in the Gulf of Maine Project.

1. Which of the following best describes the organization for which you work?
(PLEASE ENTER THE NUMBER OF BEST RESPONSE IN THE SPACE AT RIGHT.) _____

(01) National government policy agency
(02) State/Province government policy agency
(03) National government environmental or research agency
(04) Other government agency
(05) State/Province government environmental or research agency
(06) State/Province college or university
(07) Private college or university
(08) Other educational institution
(09) Private nonprofit organization
(10) For profit consulting organization
(11) Private business: research and development
(12) Private business: products/services
(13) Public interest
(14) Charitable organization
(15) Other—describe _____

2. Which of the following best describes your type of position there?
(PLEASE ENTER THE NUMBER OF BEST RESPONSE IN THE SPACE AT RIGHT.) _____

(1) Administrative/policy making
(2) Regulatory/legal
(3) Basic research
(4) Applied research and development
(5) Teaching
(6) Consulting
(7) Public Interest
(8) Other—describe: _____

3. What is the highest level of formal education which you have completed?
(PLEASE ENTER THE NUMBER OF BEST RESPONSE IN THE SPACE AT RIGHT.) _____

(1) Doctorate
(2) Masters
(3) Other advanced degree—specify:
(4) Baccalaureate
(5) Associates/technical degree
(6) Other— describe: _____

4. Approximately what percent of your time is spent:
(PLEASE WRITE ANSWERS IN SPACES PROVIDED AT RIGHT)
NOTE: SHOULD TOTAL 100% _____ %

(a) Sampling _____
(b) Lab research _____
(c) Computer analysis _____
(d) Writing _____
(e) Consulting _____
(f) Teaching _____
(g) Public education/speaking _____
(h) Administration _____
(i) Policy formulation _____
(j) Project/resource management _____
(k) Legal/regulatory implementation _____
(l) Other: _____ _____
(m) Other: _____ _____

100%

F0. We are developing an inventory of monitoring efforts already underway in the Gulf of Maine region and would like information on any monitoring work that you are either involved in or know of.

F1. Please indicate, checking off a "YES" or "NO" answer, any of the monitoring objectives that you and your organization are currently working on.
(PLEASE CHECK OFF ANSWERS IN SPACES AT RIGHT)

	YES	N
(a) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from pathogens in the marine environment.		
(b) Assess the existing levels, the trends, sources, and economic impacts of acute and chronic risks to human health from toxic compounds transmitted through marine foods and water contact.		
(c) Assess the existing levels, the trends, sources and economic impacts of acute and chronic risks to human health from phytotoxins transmitted through marine foods.		
(d) Assess the existing status and follow trends in the ecological and economic viability of fish stocks, and identify the causes of change, especially those that can be related to harvesting.		
(e) Assess the existing status and follow trends of ecosystem integrity by monitoring appropriate indicators, especially those that will allow early identification of change in environmental quality.		
(f) In cases where environmental degradation is suspected, identify the causes, especially as they reflect anthropogenic impacts and cumulative effects.		
(g) As needed, assess the impacts of environmental catastrophes in relation to existing information.		
(h) Provide information generated by monitoring activities to resource and environmental managers in a format that will allow design of appropriate rehabilitation, mitigation, damage-avoidance procedures, and other management actions.		
(i) Provide timely analysis, interpretation and presentation of program results; evaluate and update monitoring program based on these results as required.		
(j) Assess the impact of environmental management actions on risks to public health, the viability of harvestable resources, ecosystem health, and local economies as measured by the indicators developed for the monitoring program.		
(k) Additional #1: _____		
(l) Additional #2: _____		
(m) Additional #3: _____		

F2. In what projects are you currently engaged that are relevant to the Gulf of Maine Project as you understand it? (PLEASE WRITE ANSWERS IN SPACES PROVIDED.)

(a) _____

_____

(b) _____

_____

(c) _____

_____

(d) _____

_____

3. Are you aware of any other projects that are relevant to the Gulf of Maine project? (PLEASE WRITE ANSWERS IN SPACES PROVIDED.)

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(f) _____

(g) _____

THANK YOU FOR YOUR HELP.

Please send to:

MAINEWATCH INSTITUTE
P.O. Box 209
Hallowell, ME 04347
(207) 622-7000

APPENDIX D

A SUMMARY OF THE GULF OF MAINE WORKSHOP

Held May 31 and June 1, 1990 at St. Mary's College
Halifax, Nova Scotia

A WORKSHOP TO DEVELOP AN ENVIRONMENTAL MONITORING PROGRAM FOR THE GULF OF MAINE

INTRODUCTION

The purpose of the GOM workshop was to gain input of ideas and suggestions for improving a draft version of the environmental monitoring plan being developed to help guide management efforts in conserving the natural resources and environmental quality of the Gulf of Maine ecosystem. The Gulf of Maine Monitoring Project is an ambitious undertaking in that it involves extremely complex issues which are international, as well as multidisciplinary, in scope. Consequently, a primary objective of the workshop was to bring together a diverse group of participants, representing both the scientific, planning, political and public sectors, who would be able to offer comprehensive insight and critique on the proposed monitoring plan. Because of this diversity, workshop sessions were lively, intense and productive. Many useful and challenging ideas, suggestions and conclusions were developed. The following summary presents some of the more important issues and results from the workshop sessions. Schematic diagrams illustrating the goals and objectives of the work sessions are presented after the summary.

OPENING REMARKS AND STRUCTURE OF WORKSHOP

The workshop opened with welcoming remarks from Peter Underwood of the Nova Scotia Department of the Environment and Dr. Kenneth Ozmon, President of St. Mary's University. This was followed by an overview of the GOM Action Plan and the events leading up to it, and the proposed Monitoring Plan by John Pearce, National Marine Fisheries Service, NOAA. Next, Anne Johnson Hayden introduced the contractors and moderators—Dr. John Fitch, Mainewatch Institute and Dr. Tom Hruby, Camp, Dresser and McKee—who presented an overview of the goals and structure for the workshop. The structure of the workshop for the two days consisted of morning and afternoon plenary sessions with two concurrent breakout sessions, in which the participants divided into groups to discuss different aspects of the proposed monitoring plan.

* Written by the Mainewatch Institute

Day 1, May 31 **CONCURRENT MORNING SESSIONS TO REVIEW GOALS 1 AND 2 OF THE PROPOSED GOM MONITORING PLAN**

SESSION 1-A: GOAL 1. HUMAN HEALTH RISK MONITORING
Moderator: Brian Marcotte

SESSION 1-B: GOAL 2. MARINE ECOSYSTEMS RISK MONITORING
Moderator: Wayne Barchard

These two concurrent sessions focused on discussing the objectives, monitoring questions and variables proposed for the first two goals of the draft monitoring plan. Important comments and suggestions from these sessions are presented below.

Session 1-A: Human Health Risk Monitoring

Goal 1 of the GOM Monitoring Plan involves Human Health Risk Monitoring. The three objectives of this goal are to:

I. Assess Risk from Pathogens
II. Assess Risk from Biotoxins, and
III. Assess Risk from Marine Foods and Water Sports

General Comments

- Positive contributions to human health should be monitored as well as negative aspects.
- Non-point sources are, perhaps, the biggest challenge of the monitoring plan in that they are the most difficult to monitor, manage and regulate.

Specific Comments and Suggestions

Objective I Assess Risk from Pathogens

- What constitutes an *action level*? What would be an acceptable working definition for the monitoring plan?
- What constitutes a *significant trend*? It is important that trends be used to modify monitoring practises.
- To what degree should the GOM Council be involved in research?
- What are the existing US and Canadian programs regarding pathogen monitoring that the GOM Monitoring Plan could draw from?
- Changing patterns of demographics should be considered an important criteria for monitoring pathogen trends.

Objective II Assess Risk from Biotoxins

- There are a variety of compounds that should be measured in addition to the identified variables of PSP and Domoic Acid. Some other useful variables would be ASP, and DSP.

- Should the somewhat vague term *action level* be replaced with the term *trends*?

- A hierarchy of monitoring questions was proposed which should be useful for consistent treatment of all of the questions in Goal 1. The proposed hierarchy is:
  - What are the existing concentrations, levels or trends?
  - What are the sources?
  - What are the risks?

- The issue of predictability is a key concept, and should be a major objective in the monitoring plan.

Objective III Assess Risk from Marine Foods and Water Sports

- This objective should be changed to read "Assess Risk from Contaminants." The concept of marine foods and water sports should be implicit in all three objectives.

- What are the contaminants that we can successfully measure at this time? Is there anything else we could or should be measuring besides PCBs and heavy elements? Perhaps the Council should utilize a group of experts to identify other critical contaminants that should be measured.

Session 1-B: Marine Ecosystems Risk Monitoring

Goal 2 of the GOM Monitoring Plan involves Marine Ecosystem Monitoring. The four objectives of this goal are to:

I. Assess Fish and Shellfish Stocks and Elements of Change
II. Assess Ecosystem Integrity
III. Identify Causes of Environmental Degradation
IV. Assess Impacts of Environmental Catastrophes

General Comments

- It was recommended that Goal 2 should be changed from "Marine Ecosystems Risk Monitoring" to read "Marine Environment Risk Monitoring".

- Monitoring should also consider trends on *land*, as well as marine.

- The medical profession has a useful monitoring plan in that when coliform levels reach a certain level, management can step in to close that area for

swimming, clamming, etc. A similar degree of simple and clear parameters are needed for environmental planning.

- It is very important that monitoring be done in a scientific, credible and defensible manner.

Specific Comments and Suggestions

Objective I Assess Fish and Shellfish Stocks and Elements of Change

- The term *economic viability of fish stocks* should be replaced by the concept of *ecologic viability and abundance of animal stocks.*

- What are the causes of change in the ecologic viability and how are they related to harvesting?

Objective III Identify Causes of Environmental Degradation

- Are causes beyond the scope of environmental monitoring? Determining cause involves research and the collection and interpretation of data. Where does the necessary research and funding for this objective fit in a monitoring plan?

Objective IV Assess Impacts of Environmental Catastrophes

- Perhaps the effects of catastrophes should be left to others for involvement, for while it is a definite long-term issue, it doesn't seem to have the same immediacy as do the other objectives of this goal.

Day 1, May 31: CONCURRENT AFTERNOON SESSIONS TO DEFINE MONITORING PRIORITIES FOR GOALS 1 AND 2 IN RELATION TO CURRENT EFFORTS AND ANTICIPATED COSTS

SESSION 2-A: GOAL 1. HUMAN HEALTH RISK MONITORING
Moderator: Brian Marcotte

SESSION 2-B: GOAL 2. MARINE ECOSYSTEMS RISK MONITORING
Moderator: Wayne Barchard

These two concurrent sessions focused on developing priorities in relation to current efforts and anticipated costs for the first two goals of the draft monitoring plan. Important comments and suggestions from these sessions are presented below.

Session 2-A: Human Health Risk Monitoring

General Comments

- The Gulf of Maine Council should recommend, not fund, research.

- Wherever possible, the GOM Monitoring Project should tie in to existing data bases and research.

- An important consideration is whether funding should or could be tied to demographics.

Specific Comments and Suggestions

- Ten criteria were identified as being essential priorities for developing a monitoring program to assess health risk. They include:

1. Produces data useful to managers
2. Monitors variables as mandated by governments
3. Monitors morbidity and illness to humans
4. Monitors cleanliness and marketability of seafood
5. Produces information useful in public education
6. Offers cost data and is cost efficient
7. Is practical and can be implemented in near future
8. Is based on statistically valid and reproducible data
9. Provides input as to the degree of real versus perceived risk
10. Identifies need for additional complementary information

- Three classes of contaminants were considered: pathogins, biotoxins and other (a group containing heavy metals, PAHs, PCBs, dioxin, pesticides, and herbicides). It was the consensus of the group that of these three, the other contaminants should be given top priority because pathogens and biotoxins were already being measured by other groups.

- The group attempted to plot the criteria against the various contaminants and their costs to develop priorities, but after considerable discussion elected not to do so because of a consensus that the importance of the criteria would change in relationship to the parameter being measured.

- The GOM Council should retain a panel of experts to advise in the design of the monitoring program and determine the priorities and methods to be used. This panel would involve statisticians as well as environmental scientists.

Session 2-A: Marine Ecosystems Risk Monitoring

General Comments

- The monitoring program should focus on preventive approaches rather than reactive remedial action, i.e., look at what happens within local populations of animals rather than focusing on the results of overfishing, etc.

- The North Sea study—which is already measuring nutrient levels, phytoplankton biomass, oxygen levels, and consideration of benthic organisms—would be a useful model and analogy for developing a

monitoring program for the Gulf of Maine. The two areas are similar in many respects.

Specific Comments and Suggestions

- Six criteria were identified as being essential priorities for developing a monitoring program to assess risk in the environment. They include:

  1. Need
  2. Cost
  3. Present efforts
  4. Timeliness; short-term versus long-term considerations
  5. Effectiveness

- In terms of ranking the importance of three objectives for priority monitoring, the group agreed with the ranking developed in the earlier survey, specifically:

  1. Environmental integrity—most important
  2. Causes of degradation
  3. Resources (such as shellfish)—least important

  It was the consensus of the group that catastrophe should be considered a separate issue.

- Other than reaching consensus as to the criteria and relative importance of objectives, the group could not agree as to what should be monitored, or in what way.

- The group agreed that there was no need to measure everything, everywhere, but suggested that a list of Core Variables be developed which could be used regardless of location. A partial list was generated by the group and includes:

  1. Nutrients
  2. Temperature
  3. Salinity
  4. Oxygen
  5. Light transmission
  6. Species identification—presence and absence
  7. Benthic community structure.

Day 2, June 1 **CONCURRENT MORNING SESSIONS ON USING AND DISSEMINATING MONITORING INFORMATION**

SESSION 3-A: USING MONITORING INFORMATION IN RISK ASSESSMENT: CRITICAL NEEDS AND OPPORTUNITIES
Moderator: Don Gordon

SESSION 3-B: EXCHANGING, DISSEMINATING, AND BUILDING UPON MONITORING INFORMATION BASES
Moderator: Judy Pederson

These two concurrent sessions focused on discussing important elements of the communication and information transfer process between scientists, managers, and policy makers. Important comments and suggestions from these sessions are presented below.

Session 3-A: Using Monitoring Information in Risk Assessment: Critical Needs and Opportunities

Session 3-A addressed three issues: a) What are the processes, criteria and standards that should be used?; b) How should ecosystem-level risks be defined and assessed?; and c) How should action levels be established, especially for preventive rather than reactive, monitoring and management programs? Some of the more important comments and responses to these issues are presented below.

- Monitoring should involve biological, physical and chemical variables.

- Management personnel need three kinds of information:
    1. Specific numbers, levels and definitive standards
    2. Clear understanding of how the numbers and levels were arrived at
    3. Guidance as to when an expert or scientist should be called in to help in their management process

- There should be only one format used in the GOM Monitoring Plan. Presently, there is a diversity of formats and criteria, as well as diversity in limits in numbers and levels for enforcement purposes. This causes extreme problems.

- With respect to ecosystem and human health indicators, presently the public health indicators are few in number, but fairly well known. On the other hand, the ecosystem is very complex, and requires a diversity of species be understood, including harvest impacts. Several criteria were identified for establishing an ecosystem indicator. They include:
    1. The organism should be neither superabundant nor a rare species
    2. The organism should have fairly stable population numbers
    3. The organism should represent an specific or defined ecosystem
    4. A basic knowledge of the organism should be available

- In terms of using information, it should be remembered that scientists do not like to give numbers that are unreliable, whereas managers most often use doubtful data or create numbers in order to make decisions, regardless of what scientists do or don't do.

- In assessing risk, socio-economic analogs might be useful. However, whatever models are used must be appropriate and well thought out.

- In developing acceptable levels, it would be advisable to obtain public input as to what they think is credible and tolerable.

Session 3-B: Exchanging, Disseminating, and Building Upon Monitoring Information Bases

Session 3-B addressed three issues: a) Who would or should be the users of the monitoring information?; b) Should the information bases be integrated or segmented?; and c) How should action levels be established, especially for preventive rather that reactive monitoring and management programs? Some of the more important comments and responses to these issues are presented below.

- Several user groups were identified, including:
    1. Legislators
    2. Environmental community
    3. Managers
    4. Planners
    5. Educators
    6. Developers
    7. Libraries

- It was suggested that the GOM Council use information specialists in developing this area.

- It was stressed that raw data is not information. In this sense, a useful hierarchy of data would be:
    1. Raw data—useful to relatively few people
    2. Process data
    3. Report data
    4. Assessments—useful to many people

- The quality of both data and data interpretation is critical.

- The concept of electronic availability of on-line data and information warrants serious consideration and study. Critical questions would be: Who would use it?; What would be an acceptable degree of error?; How would the integrity of the data be maintained?; Could the data be misused?; How would strengths and weaknesses be explained?, etc.

- A key issue for any monitoring program is that of *continuity*. There are numerous programs already, but how can continuity be assured?

- There has to be consensus on key or sentinel species and variables.

- There is a real need for an integrated regional Core Data Base, which individuals could add to. Also, there should be a workshop for representatives to set protocol. In this context, it was suggested that the housing of the Core Data could be integrated with the FMG System which has been developed within the Geography Department at St. Mary's University.

- Another useful type of information exchange would be to establish some sort or GOM OMNET or other type of electronic bulletin board, such as has been done with the Massachusetts Bay Project.

- In terms of financing the information exchange, it is suggested that the GOM Council should establish a management group to address cost issues.

Day 2, June 1: Concurrent Afternoon Sessions on Developing an Action Plan for a Hypothetical Environmental Problem

In the fourth and final session, the workshop participants divided once more into two groups, A and B, to explore a simulation exercise on a hypothetical environmental problem. The background information given to both groups was the same, and the assignment was to develop an appropriate action plan. To enhance the realism of the exercise, each individual group was asked to further divide itself into teams of Scientists, Managers, and Policy Makers/Politicians to insure comprehensive consideration of the issue. The background information given for the problem included the following:

- THE PROBLEM: Initial monitoring of a XYZ Bay in the Gulf of Maine has indicated elevated levels of copper above previous background levels in 5 out of 24 lobsters collected.

- DATA: The previous mean background copper concentration level in the bay was 3 ppm and the copper concentrations in the 5 lobsters (collected at random in the bay) were 20, 25, 19, 33, and 20 ppm, respectively.

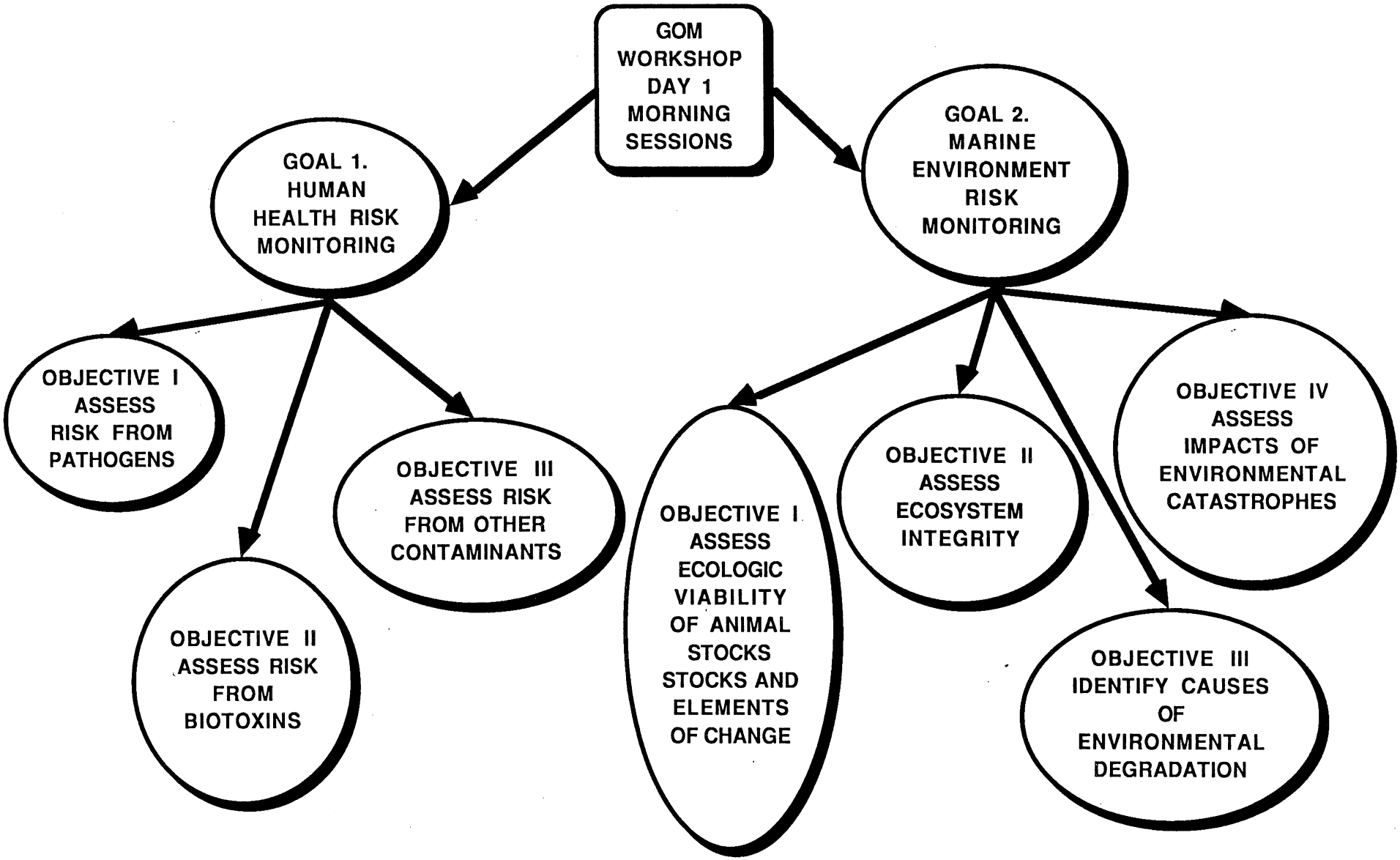
- OTHER INFORMATION: XYZ Bay has one harbor, two direct municipal discharges, and one river entering the bay. It is renowned for its beauty and is a popular tourist spot. It is also an important least tern feeding area and a small colony breeds on one of the islands in the bay.

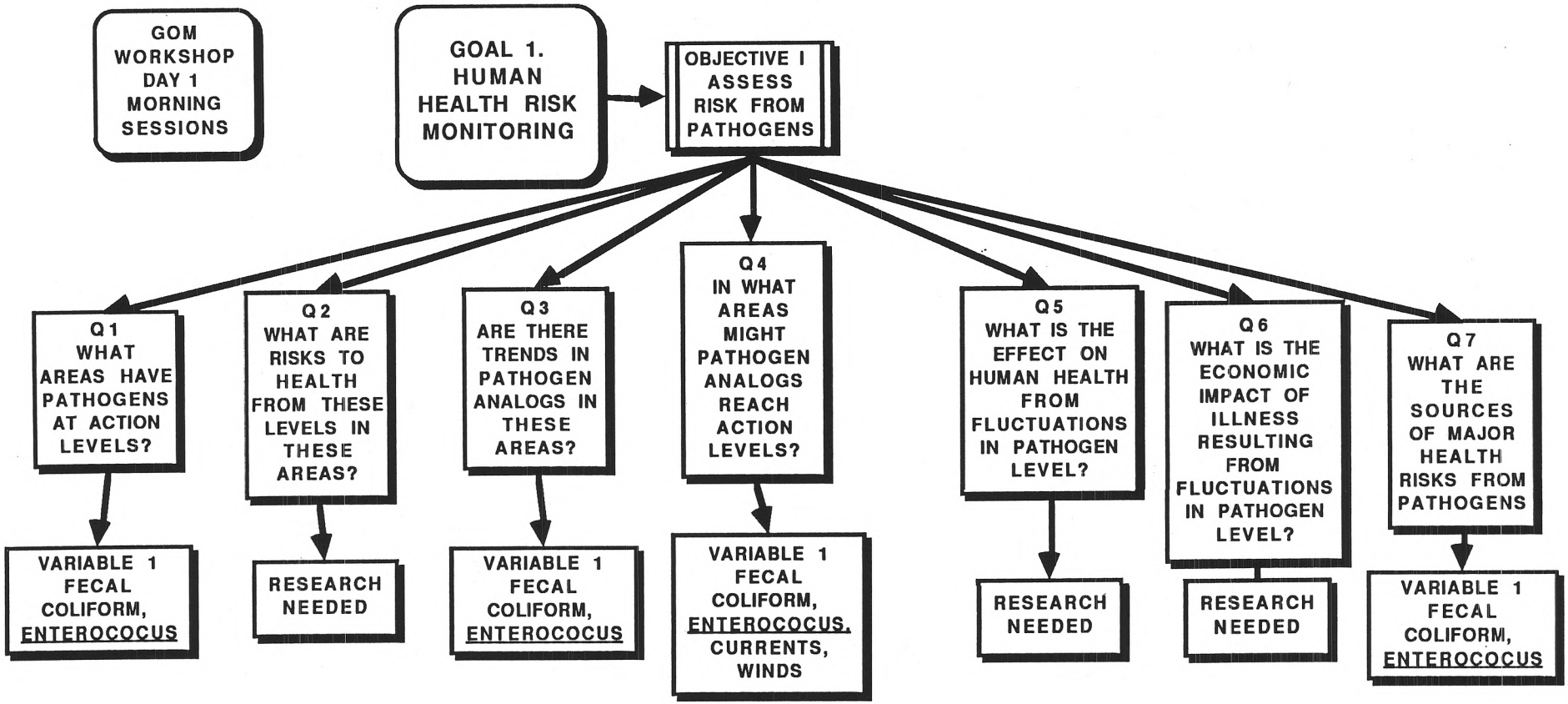
- QUESTIONS TO BE ADDRESSED BY THE GROUP CONSENSUS ACTION PLAN:
    1. What is the sources(s) of copper pollution?
    2. What are the potential ecosystem effects?
    3. What are the potential human health risks?

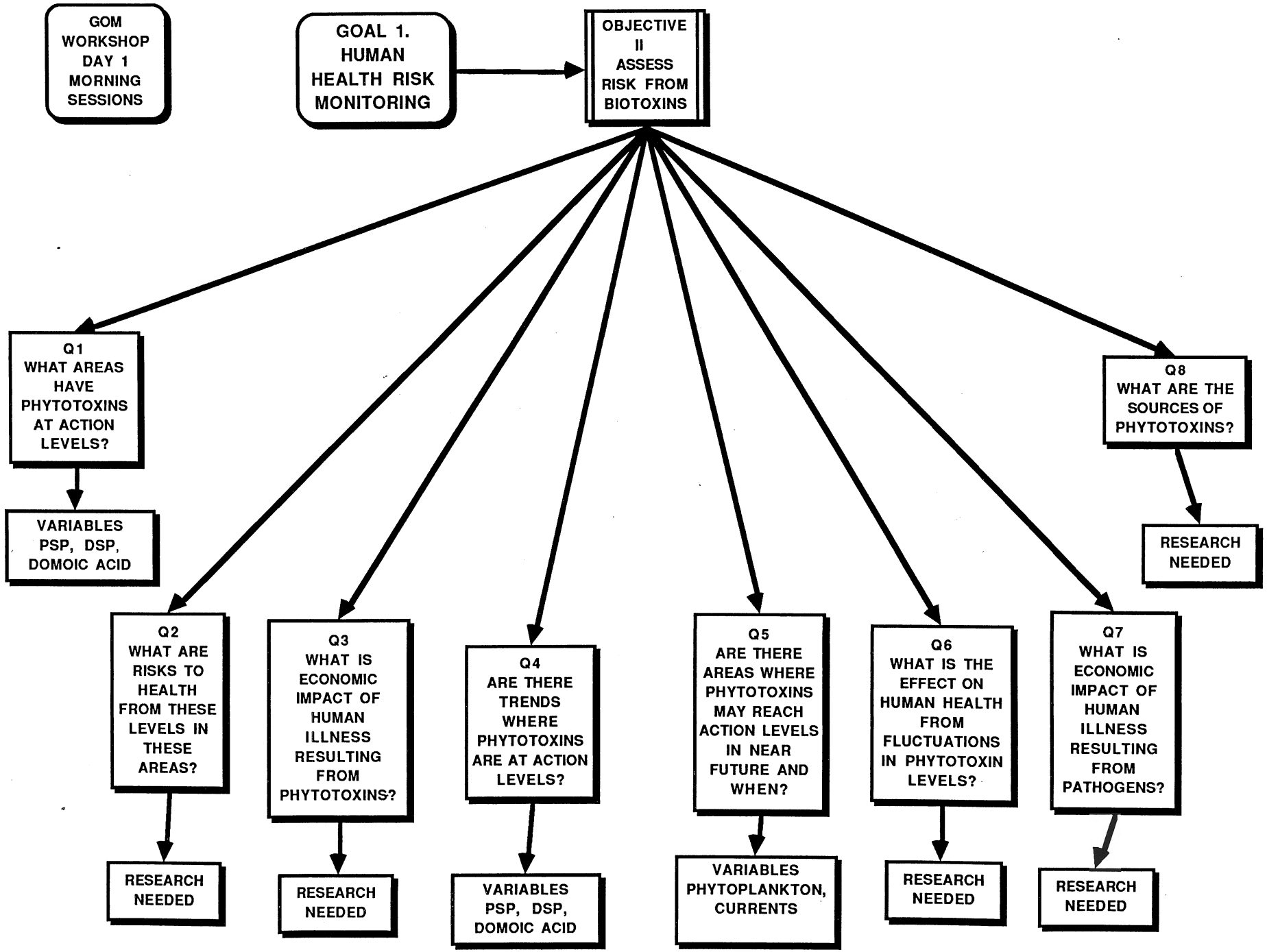
Each of the two groups, as might be expected, approached the problem differently. Group A reached a consensus among the scientists, managers and politicians that the levels, as measured, were within the normal range of copper and did not constitute a problem. Consequently, they took no steps to either close the area to lobstering, issue public warnings or to implement research into the problem.

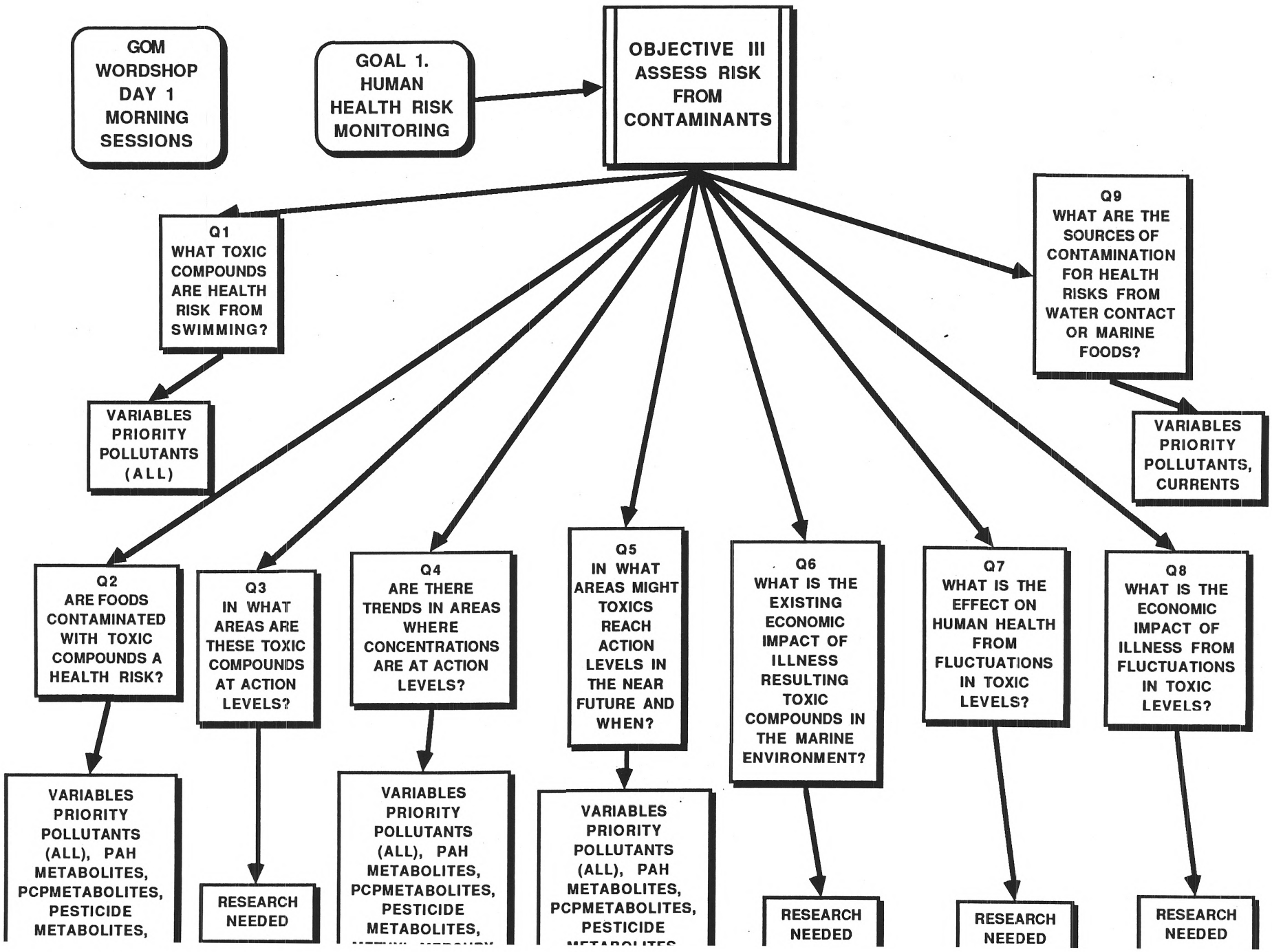
Group B, on the other hand, took the position that the data were significant and required further action. The scientists recommended leaving the fishery open for the time being, but suggested resampling the lobsters and doing additional testing of heavy element concentrations in the sediments as well as the river and municipal discharges into the bay. The politicians were also hesitant to close the fishery, but did recommend a task force be formed to study the problem. The managers, on the other hand, opted to close the fishery on a short-term basis, gather additional data, judge the severity of the problem and develop an appropriate action plan.

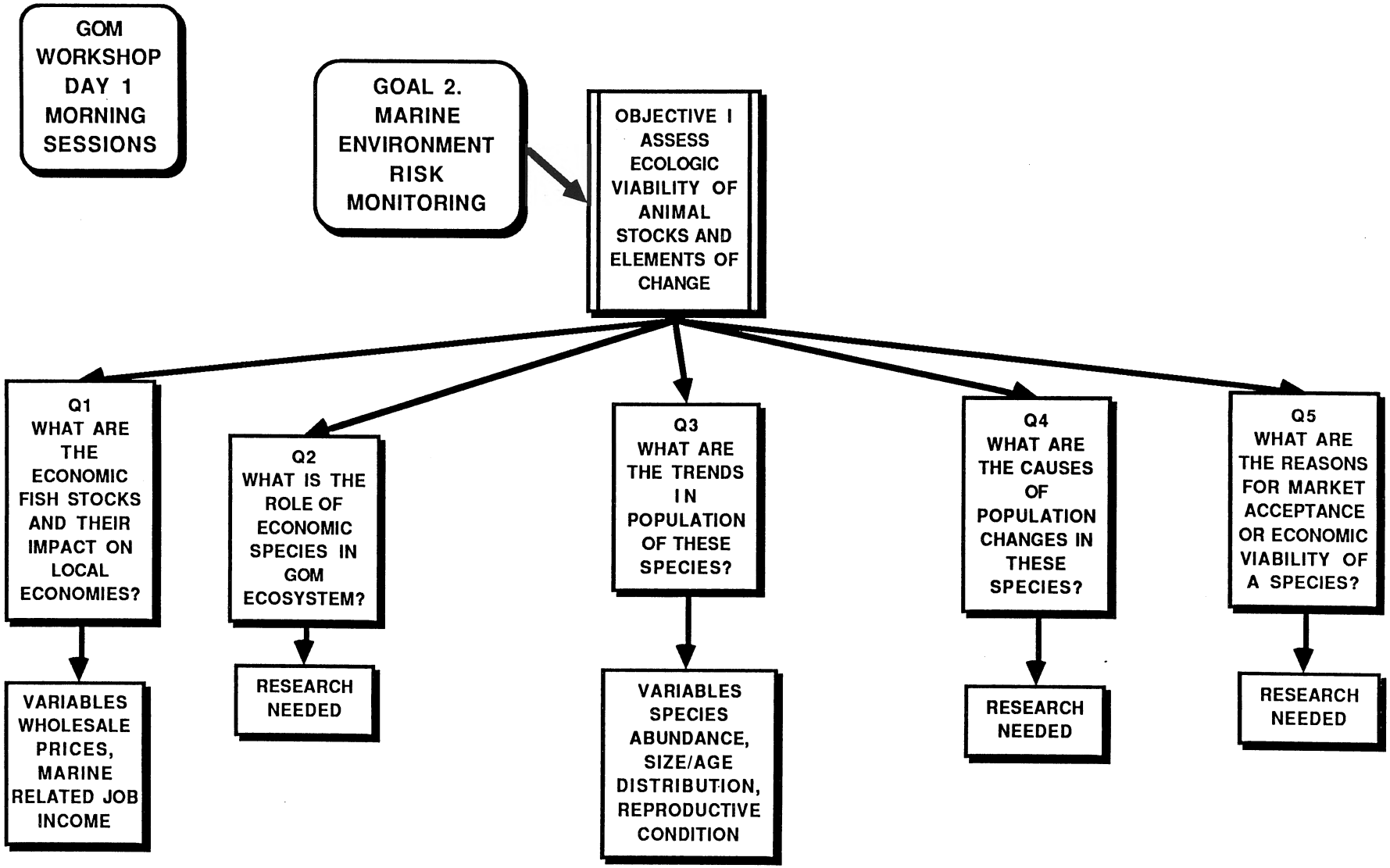
The results of the two groups were presented and discussed in the final plenary session. The conclusion of all participants was that the responses of the two groups were, indeed, all too realistic and demonstrated in a very real way the need for the GOM Monitoring Plan.

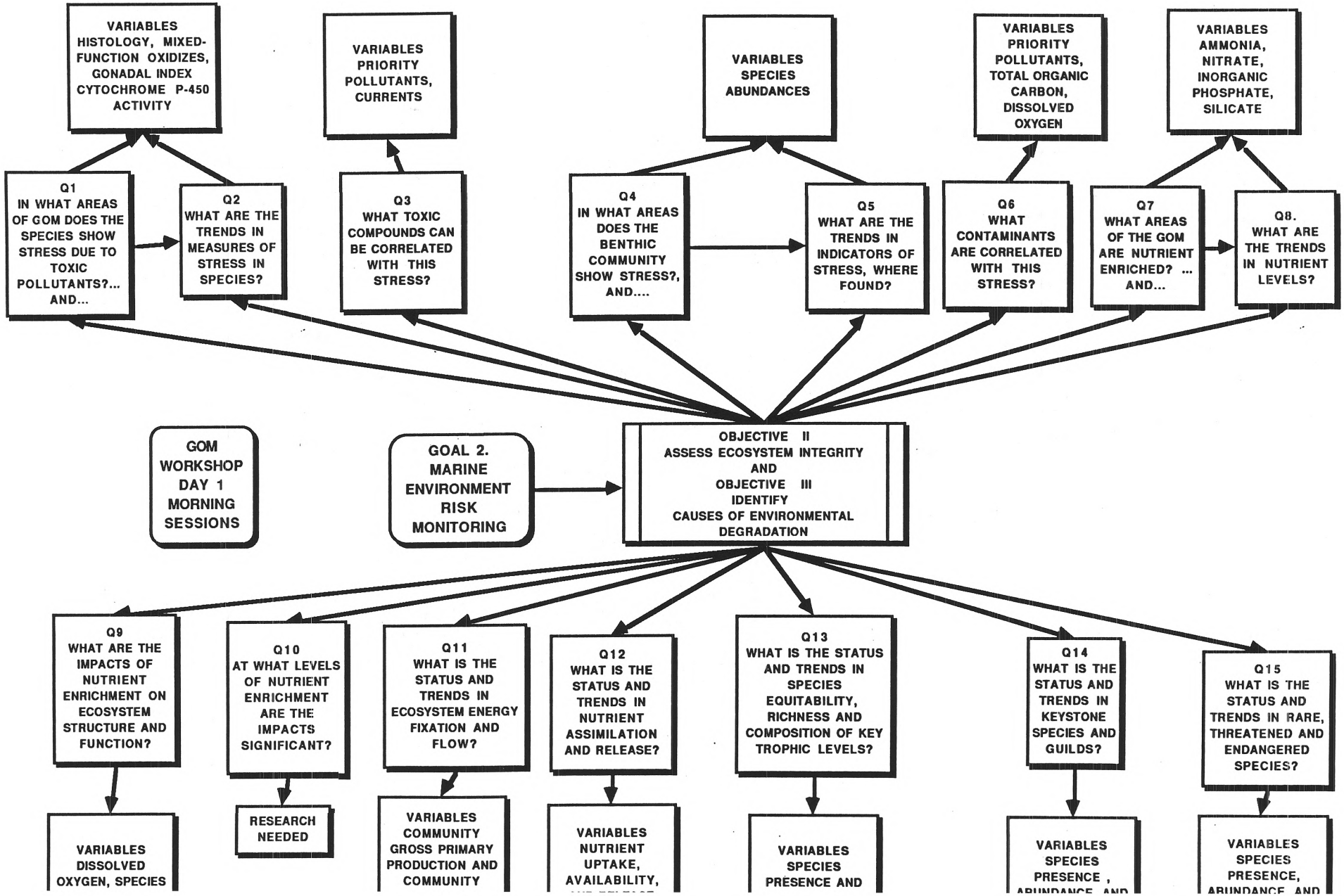

GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 1. HUMAN HEALTH RISK MONITORING
GOAL 2. MARINE ENVIRONMENT RISK MONITORING
OBJECTIVE I ASSESS RISK FROM PATHOGENS
OBJECTIVE II ASSESS RISK FROM BIOTOXINS
OBJECTIVE III ASSESS RISK FROM OTHER CONTAMINANTS
OBJECTIVE I ASSESS ECOLOGIC VIABILITY OF ANIMAL STOCKS STOCKS AND ELEMENTS OF CHANGE
OBJECTIVE II ASSESS ECOSYSTEM INTEGRITY
OBJECTIVE III IDENTIFY CAUSES OF ENVIRONMENTAL DEGRADATION
OBJECTIVE IV ASSESS IMPACTS OF ENVIRONMENTAL CATASTROPHES

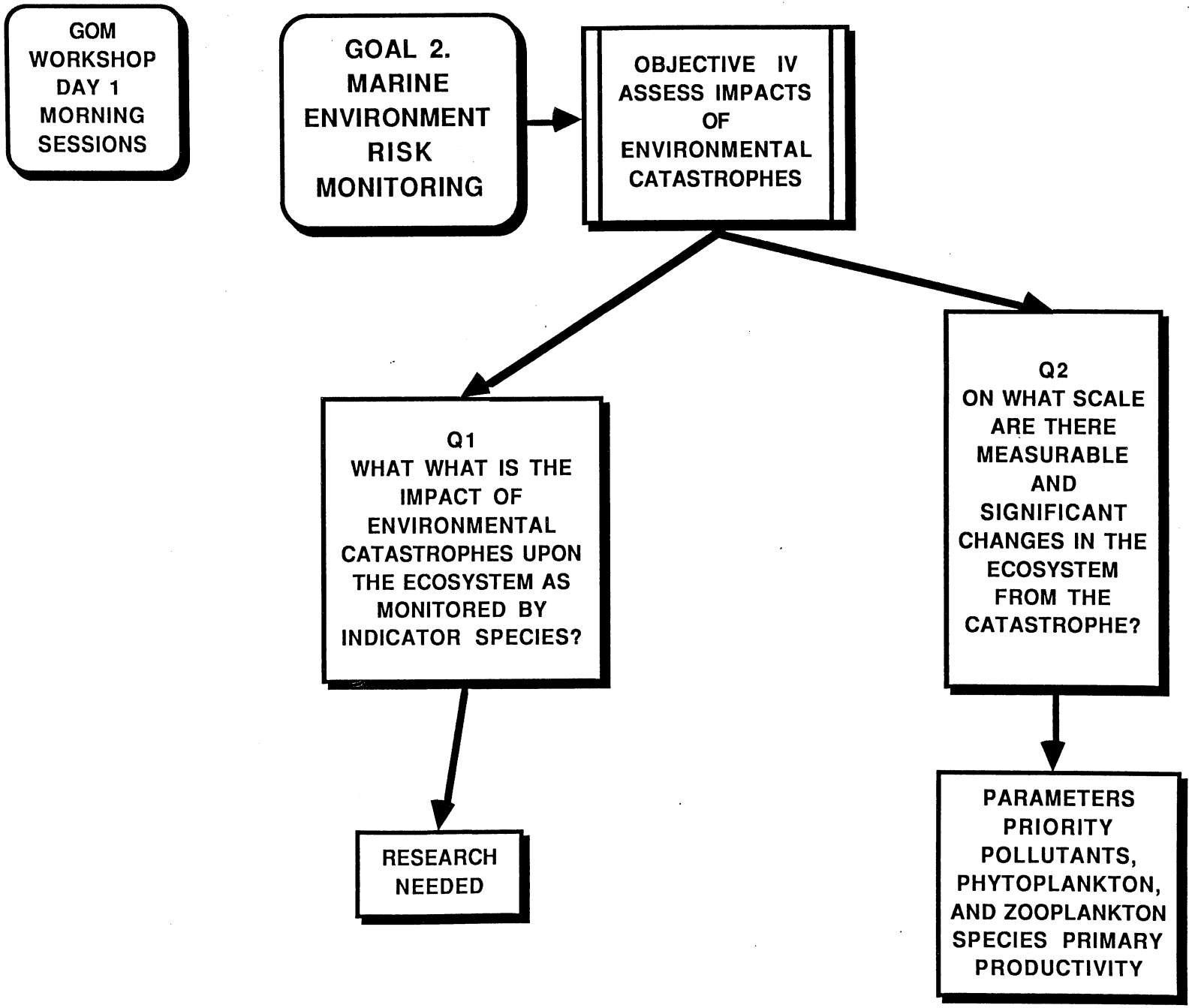

GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 1. HUMAN HEALTH RISK MONITORING
OBJECTIVE I ASSESS RISK FROM PATHOGENS
Q1 WHAT AREAS HAVE PATHOGENS AT ACTION LEVELS?
Q2 WHAT ARE RISKS TO HEALTH FROM THESE LEVELS IN THESE AREAS?
Q3 ARE THERE TRENDS IN PATHOGEN ANALOGS IN THESE AREAS?
Q4 IN WHAT AREAS MIGHT PATHOGEN ANALOGS REACH ACTION LEVELS?
Q5 WHAT IS THE EFFECT ON HUMAN HEALTH FROM FLUCTUATIONS IN PATHOGEN LEVEL?
Q6 WHAT IS THE ECONOMIC IMPACT OF ILLNESS RESULTING FROM FLUCTUATIONS IN PATHOGEN LEVEL?
Q7 WHAT ARE THE SOURCES OF MAJOR HEALTH RISKS FROM PATHOGENS
VARIABLE 1 FECAL COLIFORM, ENTEROCOCUS
RESEARCH NEEDED
VARIABLE 1 FECAL COLIFORM, ENTEROCOCUS
VARIABLE 1 FECAL COLIFORM, ENTEROCOCUS, CURRENTS, WINDS
RESEARCH NEEDED
RESEARCH NEEDED
VARIABLE 1 FECAL COLIFORM, ENTEROCOCUS

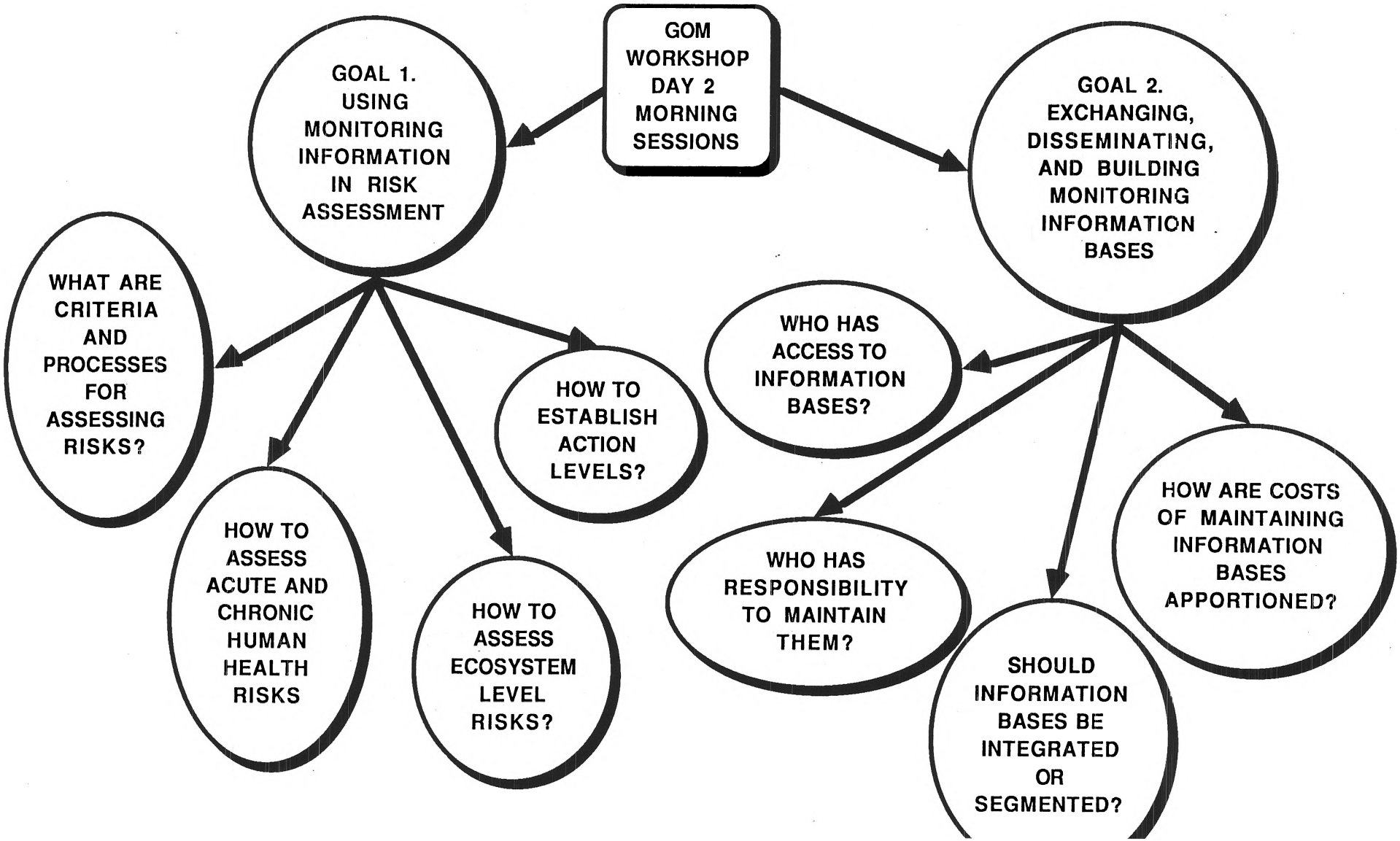

GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 1. HUMAN HEALTH RISK MONITORING
OBJECTIVE II ASSESS RISK FROM BIOTOXINS
Q1 WHAT AREAS HAVE PHYTOTOXINS AT ACTION LEVELS?
VARIABLES PSP, DSP, DOMOIC ACID
Q2 WHAT ARE RISKS TO HEALTH FROM THESE LEVELS IN THESE AREAS?
RESEARCH NEEDED
Q3 WHAT IS ECONOMIC IMPACT OF HUMAN ILLNESS RESULTING FROM PHYTOTOXINS?
RESEARCH NEEDED
Q4 ARE THERE TRENDS WHERE PHYTOTOXINS ARE AT ACTION LEVELS?
VARIABLES PSP, DSP, DOMOIC ACID
Q5 ARE THERE AREAS WHERE PHYTOTOXINS MAY REACH ACTION LEVELS IN NEAR FUTURE AND WHEN?
VARIABLES PHYTOPLANKTON, CURRENTS
Q6 WHAT IS THE EFFECT ON HUMAN HEALTH FROM FLUCTUATIONS IN PHYTOTOXIN LEVELS?
RESEARCH NEEDED
Q7 WHAT IS ECONOMIC IMPACT OF HUMAN ILLNESS RESULTING FROM PATHOGENS?
RESEARCH NEEDED
Q8 WHAT ARE THE SOURCES OF PHYTOTOXINS?
RESEARCH NEEDED

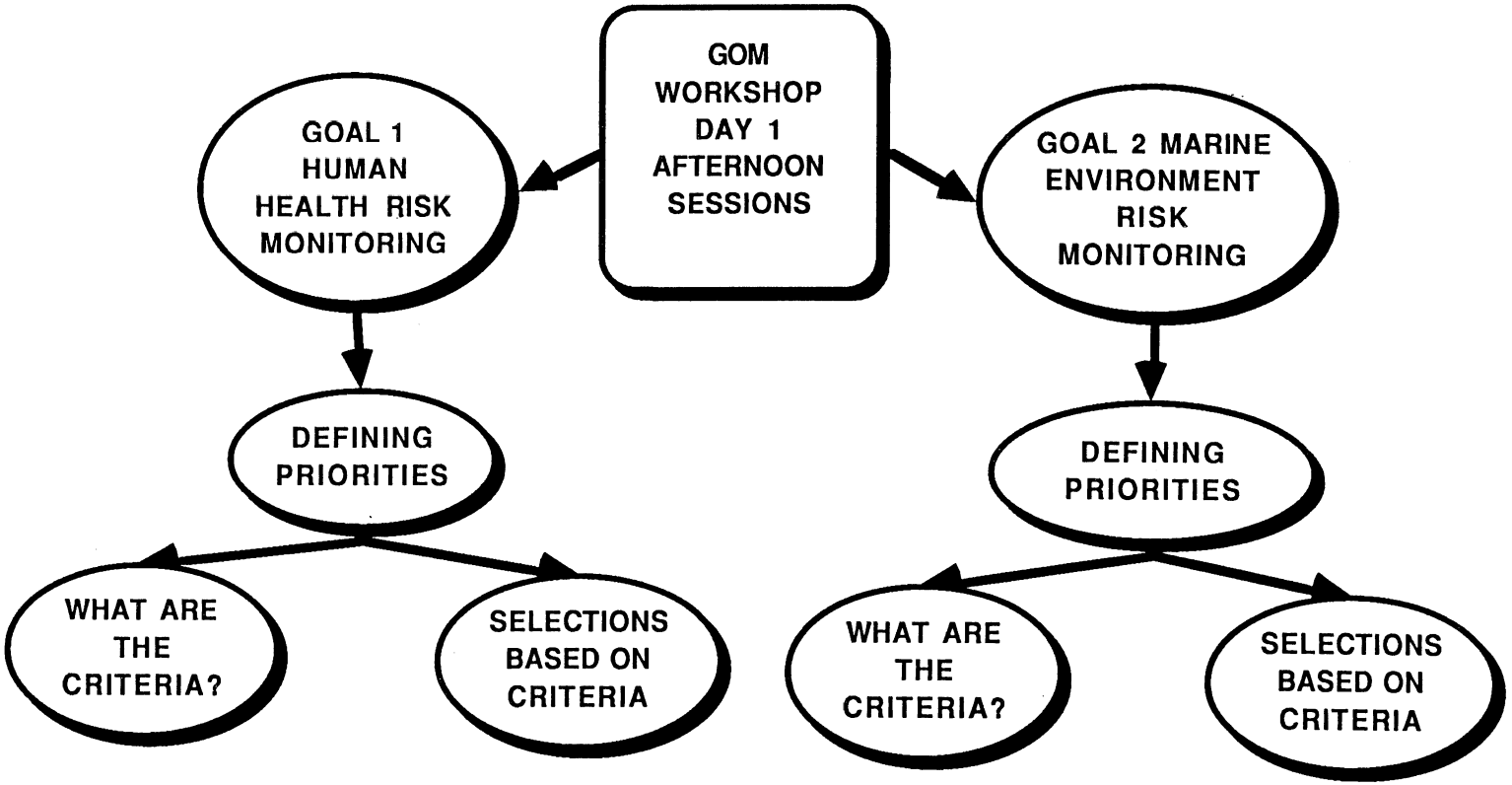

GOM WORDSHOP DAY 1 MORNING SESSIONS
GOAL 1. HUMAN HEALTH RISK MONITORING
OBJECTIVE III ASSESS RISK FROM CONTAMINANTS
Q1 WHAT TOXIC COMPOUNDS ARE HEALTH RISK FROM SWIMMING?
VARIABLES PRIORITY POLLUTANTS (ALL)
Q2 ARE FOODS CONTAMINATED WITH TOXIC COMPOUNDS A HEALTH RISK?
VARIABLES PRIORITY POLLUTANTS (ALL), PAH METABOLITES, PCPMETABOLITES, PESTICIDE METABOLITES,
Q3 IN WHAT AREAS ARE THESE TOXIC COMPOUNDS AT ACTION LEVELS?
RESEARCH NEEDED
Q4 ARE THERE TRENDS IN AREAS WHERE CONCENTRATIONS ARE AT ACTION LEVELS?
VARIABLES PRIORITY POLLUTANTS (ALL), PAH METABOLITES, PCPMETABOLITES, PESTICIDE METABOLITES,
Q5 IN WHAT AREAS MIGHT TOXICS REACH ACTION LEVELS IN THE NEAR FUTURE AND WHEN?
VARIABLES PRIORITY POLLUTANTS (ALL), PAH METABOLITES, PCPMETABOLITES, PESTICIDE
Q6 WHAT IS THE EXISTING ECONOMIC IMPACT OF ILLNESS RESULTING TOXIC COMPOUNDS IN THE MARINE ENVIRONMENT?
RESEARCH NEEDED
Q7 WHAT IS THE EFFECT ON HUMAN HEALTH FROM FLUCTUATIONS IN TOXIC LEVELS?
RESEARCH NEEDED
Q8 WHAT IS THE ECONOMIC IMPACT OF ILLNESS FROM FLUCTUATIONS IN TOXIC LEVELS?
RESEARCH NEEDED
Q9 WHAT ARE THE SOURCES OF CONTAMINATION FOR HEALTH RISKS FROM WATER CONTACT OR MARINE FOODS?
VARIABLES PRIORITY POLLUTANTS, CURRENTS

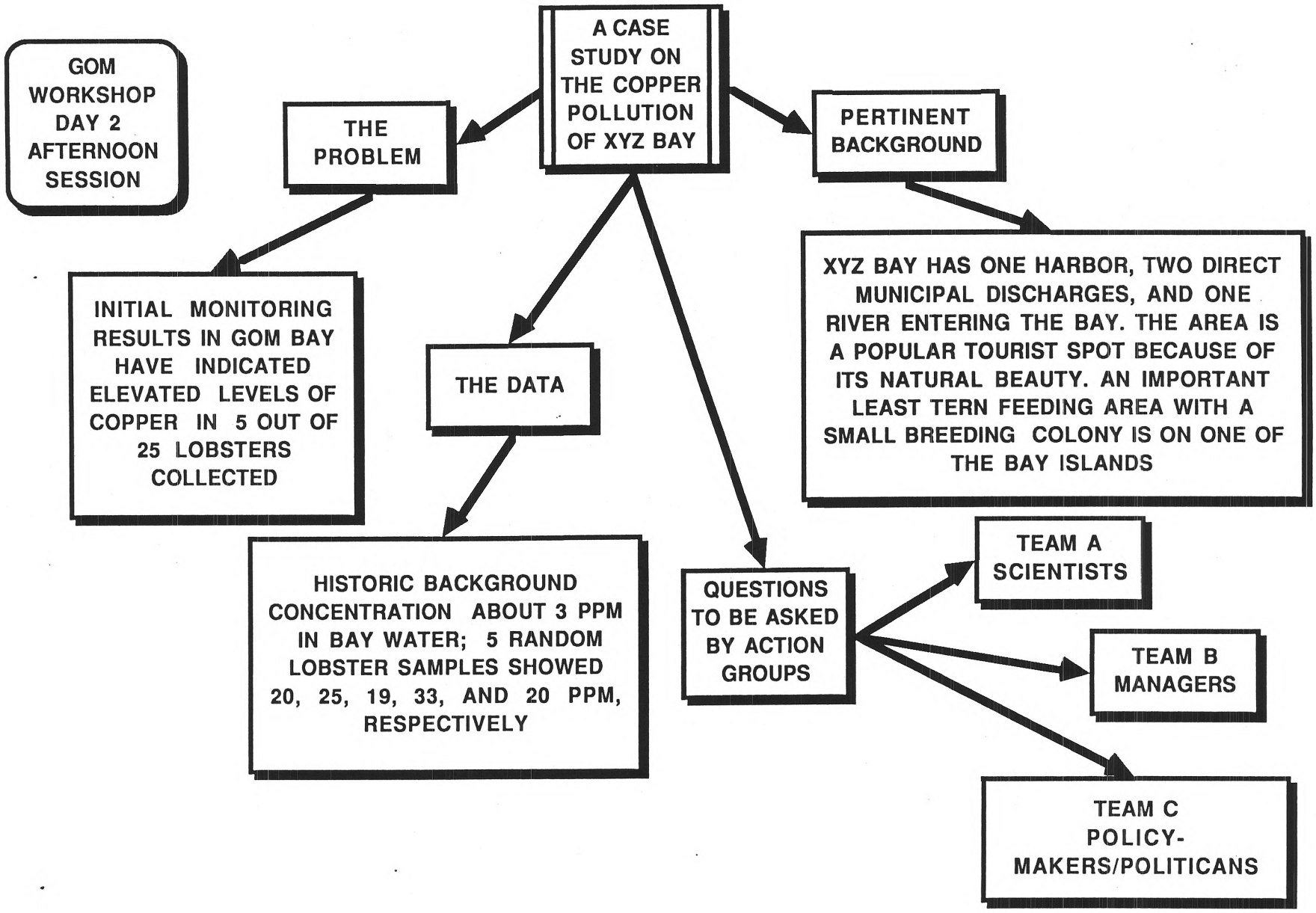

GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 2. MARINE ENVIRONMENT RISK MONITORING
OBJECTIVE I ASSESS ECOLOGIC VIABILITY OF ANIMAL STOCKS AND ELEMENTS OF CHANGE
Q1 WHAT ARE THE ECONOMIC FISH STOCKS AND THEIR IMPACT ON LOCAL ECONOMIES?
VARIABLES WHOLESALE PRICES, MARINE RELATED JOB INCOME
Q2 WHAT IS THE ROLE OF ECONOMIC SPECIES IN GOM ECOSYSTEM?
RESEARCH NEEDED
Q3 WHAT ARE THE TRENDS IN POPULATION OF THESE SPECIES?
VARIABLES SPECIES ABUNDANCE, SIZE/AGE DISTRIBUTION, REPRODUCTIVE CONDITION
Q4 WHAT ARE THE CAUSES OF POPULATION CHANGES IN THESE SPECIES?
RESEARCH NEEDED
Q5 WHAT ARE THE REASONS FOR MARKET ACCEPTANCE OR ECONOMIC VIABILITY OF A SPECIES?
RESEARCH NEEDED


VARIABLES HISTOLOGY, MIXED-FUNCTION OXIDIZES, GONADAL INDEX CYTOCHROME P-450 ACTIVITY
VARIABLES PRIORITY POLLUTANTS, CURRENTS
VARIABLES SPECIES ABUNDANCES
VARIABLES PRIORITY POLLUTANTS, TOTAL ORGANIC CARBON, DISSOLVED OXYGEN
VARIABLES AMMONIA, NITRATE, INORGANIC PHOSPHATE, SILICATE
Q1 IN WHAT AREAS OF GOM DOES THE SPECIES SHOW STRESS DUE TO TOXIC POLLUTANTS?... AND...
Q2 WHAT ARE THE TRENDS IN MEASURES OF STRESS IN SPECIES?
Q3 WHAT TOXIC COMPOUNDS CAN BE CORRELATED WITH THIS STRESS?
Q4 IN WHAT AREAS DOES THE BENTHIC COMMUNITY SHOW STRESS?, AND....
Q5 WHAT ARE THE TRENDS IN INDICATORS OF STRESS, WHERE FOUND?
Q6 WHAT CONTAMINANTS ARE CORRELATED WITH THIS STRESS?
Q7 WHAT AREAS OF THE GOM ARE NUTRIENT ENRICHED? ... AND...
Q8. WHAT ARE THE TRENDS IN NUTRIENT LEVELS?
GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 2. MARINE ENVIRONMENT RISK MONITORING
OBJECTIVE II ASSESS ECOSYSTEM INTEGRITY AND OBJECTIVE III IDENTIFY CAUSES OF ENVIRONMENTAL DEGRADATION
Q9 WHAT ARE THE IMPACTS OF NUTRIENT ENRICHMENT ON ECOSYSTEM STRUCTURE AND FUNCTION?
Q10 AT WHAT LEVELS OF NUTRIENT ENRICHMENT ARE THE IMPACTS SIGNIFICANT?
Q11 WHAT IS THE STATUS AND TRENDS IN ECOSYSTEM ENERGY FIXATION AND FLOW?
Q12 WHAT IS THE STATUS AND TRENDS IN NUTRIENT ASSIMILATION AND RELEASE?
Q13 WHAT IS THE STATUS AND TRENDS IN SPECIES EQUITABILITY, RICHNESS AND COMPOSITION OF KEY TROPHIC LEVELS?
Q14 WHAT IS THE STATUS AND TRENDS IN KEYSTONE SPECIES AND GUILDS?
Q15 WHAT IS THE STATUS AND TRENDS IN RARE, THREATENED AND ENDANGERED SPECIES?
VARIABLES DISSOLVED OXYGEN, SPECIES
RESEARCH NEEDED
VARIABLES COMMUNITY GROSS PRIMARY PRODUCTION AND COMMUNITY
VARIABLES NUTRIENT UPTAKE, AVAILABILITY,
VARIABLES SPECIES PRESENCE AND
VARIABLES SPECIES PRESENCE ,
VARIABLES SPECIES PRESENCE,


GOM WORKSHOP DAY 1 MORNING SESSIONS
GOAL 2. MARINE ENVIRONMENT RISK MONITORING
OBJECTIVE IV ASSESS IMPACTS OF ENVIRONMENTAL CATASTROPHES
Q1 WHAT WHAT IS THE IMPACT OF ENVIRONMENTAL CATASTROPHES UPON THE ECOSYSTEM AS MONITORED BY INDICATOR SPECIES?
RESEARCH NEEDED
Q2 ON WHAT SCALE ARE THERE MEASURABLE AND SIGNIFICANT CHANGES IN THE ECOSYSTEM FROM THE CATASTROPHE?
PARAMETERS PRIORITY POLLUTANTS, PHYTOPLANKTON, AND ZOOPLANKTON SPECIES PRIMARY PRODUCTIVITY


GOM WORKSHOP DAY 2 MORNING SESSIONS
GOAL 1. USING MONITORING INFORMATION IN RISK ASSESSMENT
GOAL 2. EXCHANGING, DISSEMINATING, AND BUILDING MONITORING INFORMATION BASES
WHAT ARE CRITERIA AND PROCESSES FOR ASSESSING RISKS?
HOW TO ESTABLISH ACTION LEVELS?
HOW TO ASSESS ACUTE AND CHRONIC HUMAN HEALTH RISKS
HOW TO ASSESS ECOSYSTEM LEVEL RISKS?
WHO HAS ACCESS TO INFORMATION BASES?
WHO HAS RESPONSIBILITY TO MAINTAIN THEM?
HOW ARE COSTS OF MAINTAINING INFORMATION BASES APPORTIONED?
SHOULD INFORMATION BASES BE INTEGRATED OR SEGMENTED?


GOM
WORKSHOP
DAY 1
AFTERNOON
SESSIONS
GOAL 1
HUMAN
HEALTH RISK
MONITORING
GOAL 2 MARINE
ENVIRONMENT
RISK
MONITORING
DEFINING
PRIORITIES
DEFINING
PRIORITIES
WHAT ARE
THE
CRITERIA?
SELECTIONS
BASED ON
CRITERIA
WHAT ARE
THE
CRITERIA?
SELECTIONS
BASED ON
CRITERIA


GOM WORKSHOP DAY 2 AFTERNOON SESSION
A CASE STUDY ON THE COPPER POLLUTION OF XYZ BAY
THE PROBLEM
PERTINENT BACKGROUND
INITIAL MONITORING RESULTS IN GOM BAY HAVE INDICATED ELEVATED LEVELS OF COPPER IN 5 OUT OF 25 LOBSTERS COLLECTED
THE DATA
XYZ BAY HAS ONE HARBOR, TWO DIRECT MUNICIPAL DISCHARGES, AND ONE RIVER ENTERING THE BAY. THE AREA IS A POPULAR TOURIST SPOT BECAUSE OF ITS NATURAL BEAUTY. AN IMPORTANT LEAST TERN FEEDING AREA WITH A SMALL BREEDING COLONY IS ON ONE OF THE BAY ISLANDS
HISTORIC BACKGROUND CONCENTRATION ABOUT 3 PPM IN BAY WATER; 5 RANDOM LOBSTER SAMPLES SHOWED 20, 25, 19, 33, AND 20 PPM, RESPECTIVELY
QUESTIONS TO BE ASKED BY ACTION GROUPS
TEAM A SCIENTISTS
TEAM B MANAGERS
TEAM C POLICY-MAKERS/POLITICANS

THE GULF OF MAINE
WORKING GROUP

April 17, 1990

Dear Colleague:

Thank you for your interest in the Gulf of Maine Initiative. As a major step in that initiative, The Gulf of Maine Working Group has contracted with Camp Dresser & McKee, Mainewatch Institute, and the Research and Productivity Council of New Brunswick to develop an environmental monitoring plan for the Gulf of Maine. The enclosed materials relate to that project.

Enclosed please find the following:

- SURVEY OF MONITORING IDEAS AND CONCERNS: The purpose of the enclosed survey is to obtain ideas and feedback from scientists, policy-makers, managers, and others interested in the Gulf of Maine on the following:
    1. monitoring goals and objectives as defined by the Gulf of Maine Working Group;
    2. monitoring priorities in the event that financial resources are limited;
    3. communication of monitoring information and needs; and
    4. monitoring efforts currently underway by survey participants.

  This information is needed to put together an interim report on the monitoring plan and to determine issues in need of discussion at an upcoming working conference. We look forward to your anonymous input. We must receive the completed survey form no later than May 7 in order to incorporate survey information in the interim report. Please send the completed survey to: Mainewatch Institute, P. O. Box 209, Hallowell, ME 04347.

- WORKING CONFERENCE: You are invited to participate in a working conference, *Developing An Environmental Monitoring Plan for the Gulf of Maine* , to be held at St. Mary's University, Halifax, Nova Scotia on May 31 and June 1, 1990. If you plan to attend, please fill out the enclosed conference and residence registration forms. Please note that we must receive your conference registration form no later than May 7 and the St. Mary's University Conference Center must receive your residence registration form by the same date.

- EXECUTIVE SUMMARY: Also enclosed is a copy of the executive summary from The Gulf of Maine: Sustaining Our Common Heritage in order to provide more information on the Gulf of Maine Initiative.

Thank you for your time in filling out the survey form. Please call either Kathi Fortin or Susan Farady at (207) 622-7000 if you have questions regarding the survey form or the conference. We hope to see you at the conference.

Sincerely,

John H. Fitch, Ph. D.
President and Senior Fellow
Mainewatch Institute
P. O. Box 209
Hallowell, Maine 04347
Telephone: (207) 622-7000 Fax: (207) 621-0308

GULF OF MAINE MONITORING CONFERENCE/WORKSHOP

ST. MARY'S COLLEGE, HALIFAX, NOVA SCOTIA
MAY 31 AND JUNE 1, 1990

THE GULF OF MA
WORKING GRC

AGENDA

MAY 30 WEDNESDAY

• **4:00-5:00 p.m.**	**Registration** • Susan Farady and Kathi Fortin	**Burke Lobby**

MAY 31 THURSDAY

• **8:00-9:00 a.m.**	**Registration** • Susan Farady and Kathi Fortin	**Burke Lobby**
• **8:30-8:50 a.m.**	**Welcome and Introductions** • Nova Scotia Ministry of the Environment Welcome • St. Mary's University Welcome: Dr. Kenneth L. Ozmon (President) • Gulf of Maine Working Group and Action Plan: John Pearce	**Burke Theatre B**
• **8:50-9:00 a.m.**	**Presentation of Workshop Goals and Structure** • Introduction of Contractors: Anne Johnson Hayden • Workshop Goals and Structure: John Fitch and Tom Hruby	**Burke Theatre B**
• **9:00-9:15 a.m.**	**Introduction to Morning Working Sessions on Aligning Monitoring Goals, Objectives, Questions, and Techniques** • Introduction of Working Session Issues: John Fitch and Michael O'Connor	**Burke Theatre B**
• **9:15-11:45 a.m**	**Concurrent Morning Working Sessions (Coffee/tea breaks at 10:30 a.m.)**	**Burke Lobby**
	a. Human Health Risk Monitoring • Moderator: Brian Marcotte • Facilitator: Michael O'Connor • Scribe: Susan Farady	**Burke 218**
	b. Marine Ecosystems Risk Monitoring • Moderator: Wayne Barchard • Facilitator: Anne Johnson Hayden • Scribe: Kathi Fortin	**Burke 219**
• **11:45-1:15 p.m.**	**Cafeteria Lunch and Break**	**Residence Cafeteria**
• **1:15-2:00 p.m.**	**Plenary Session to Discuss Results of Morning Working Sessions on Aligning Monitoring Goals, Objectives, Questions, and Techniques** • Moderator Reporters: Brian Marcotte and Wayne Barchard • Facilitator: Michael O'Connor and	**Burke Theatre B**

Introduction to Afternoon Working Sessions on Defining Monitoring Priorities in Relation to Current Efforts and Anticipated Costs
• Introduction of Working Session Issues: Tom Hruby and Michael O'Connor

• **1:45-4:30 p.m.**	**Concurrent Afternoon Working Sessions (Coffee/tea breaks at 3:00 p.m.)**	**Burke 218**
	a. Human Health Risk Monitoring • Moderator: Brian Marcotte • Facilitator: Michael O'Connor • Scribe: Susan Farady	
	b. Marine Ecosystems Risk Monitoring • Moderator: Wayne Barchard • Facilitator: Anne Johnson Hayden • Scribe: Kathi Fortin	**Burke 219**
• **5:30-7:00 p.m.**	**Reception**	**Courtside Lounge**
• **7:00-9:00 p.m.**	**Banquet**	**Courtside Lounge**

JUNE 1 FRIDAY

• **8:00-8:30 a.m.**	**Registration** • Susan Farady and Kathi Fortin	**Burke Lobby**
• **8:30-9:15 a.m.**	**Plenary Session to Discuss Results of Previous Afternoon Working Sessions on Defining Monitoring Priorities in Relation to Current Efforts an Anticipated Costs** • Moderator Reporters: Brian Marcotte and Wayne Barchard • Facilitator: Michael O'Connor and **Introduction to Morning Working Sessions on Using and Disseminating Monitoring Information** • Introduction of Working Session Goals: John Fitch and Michael O'Connor	**Burke Theatre B**
• **9:15-11:00 a.m.**	**Concurrent Morning Working Sessions (Coffee/tea breaks at 10:00 a.m.)**	**Burke Lobby**
	a. Using Monitoring Information in Risk Assessment: Critical Needs and Opportunities • Moderator: Don Gordon • Facilitator: Anne Johnson Hayden • Scribe: Susan Farady	**Burke 218**

	b. Exchanging, Disseminating, and Building upon Monitoring Information Bases • Moderator: Judy Pederson • Facilitator: Michael O'Connor • Scribe: Kathi Fortin	**Burke 219**
• **11:00-11:45 p.m.**	**Plenary Session to Discuss Results of Morning Working Sessions on Using and Disseminating Monitoring Information** • Moderator Reporters: Don Gordon and Judy Pederson • Facilitator: Michael O'Connor	**Burke Theatre B**
• **11:45-1:15 p.m.**	**Cafeteria Lunch and Break**	**Residence Cafeteria**
• **1:15-1:30 p.m.**	**Plenary Session: Introduction to Afternoon Working Sessions on Developing an Action Plan for a Hypothetical Environmental Problem** • Introduction of Working Session Issues by John Fitch and Michael O'Connor	**Burke Theatre B**
• **1:30-3:45 p.m.**	**Concurrent Afternoon Working Sessions (Coffee/tea breaks at 3:00 p.m.)**	**Burke Lobby**
	a. Action Planning Group 1 • Referee: Wayne Barchard • Scribe: Susan Farady	**Burke 218**
	b. Action Planning Group 2 • Referee: Jack Pearce • Scribe: Kathi Fortin	**Burke 219**
• **3:45-4:30 p.m.**	**Plenary Session to Discuss Results of Case Study Projects** • Reports by Action Planning Groups 1 and 2 • General Discussion of Results and Issues: facilitated by Michael O'Connor	**Burke Theatre B**
• **4:30-4:45 p.m.**	**Workshop Closing Remarks** • Sum-up by John Fitch and Tom Hruby	**Burke Theatre B**

GULF OF MAINE MONITORING CONFERENCE/WORKSHOP

FICTITIOUS ENVIRONMENTAL PROBLEM FOR CASE STUDY

Friday, June 1 Afternoon Working Session Instructions

THE GULF OF MAINE
WORKING GROUP

PROBLEM

Data were collected during an April 1990 lobster study in the Bay of XYZ of the Gulf of Maine. Elevated levels of copper above previous background levels were found in 5 out of 25 lobsters collected.

PRELIMINARY DATA

The previous mean background copper concentration level in the bay was 3 ppm and the copper concentrations in the 5 lobsters (collected at random in the bay) were 20, 25, 19, 33, and 20 ppm, respectively.

BACKGROUND INFORMATION

XYZ Bay has one harbor, two direct municipal discharges, and one river entering the bay. It is renowned for its beauty and is a popular tourist spot. Least terns feed in the bay and a small tern breeding colony is established on one of its islands.

PROCEDURE

Two Groups will develop action plans that will include a monitoring plan, management strategies, and communication needs. Each group will have a referee and will be divided into three teams. Team "A" will be designated as scientists, Team "B" will be managers, and Team "C" will be policy-makers/politicans. Each team will reach consensus on questions directly relating to its role in the action plan. Then, the teams of each group will work together to reach consensus on the overall action plan. Group action plans and ideas for improving the process will be discussed at the following plenary session.

EXAMPLES OF QUESTIONS TO BE ADDRESSED BY GROUP TEAMS

Team A (Scientists)

- What is the potential source(s) of copper pollution?
- What are the potential ecosystem impacts?
- What are the potential human health risks?
- What are the recommended action levels for copper?
- What types of monitoring information are required to define the problem and to evaluate management efforts to address it? Is any of it already available?
- What data bases are required to monitor the impacts of copper pollution?
- What are the management options that can be taken to reduce copper pollution and its impacts?
- How can scientific/technical information be communicated effectively to managers and policy-makers.

Team B (Managers)

- What are the ecosystem action levels for copper?
- What are the human health action levels for copper?
- What types of data are needed to monitor the impacts of copper pollution?
- What types of useful monitoring data are already being collected?
- What are the recommendations for management actions to reduce copper pollution?
- What are the likely socioeconomic impacts of copper pollution and actions to reduce its impacts?
- What types of data are needed to evaluate management actions to reduce copper pollution?
- How can monitoring needs be communicated effectively to scientists?
- How can scientific/technical information needs be communicated effectively to scientists?
- How can management options and policy needs be communicated effectively to policy-makers?

Team C (Policy-makers/ politicans)

- What is the magnitude of the problem relative to other Gulf of Maine problems?
- What organizations/groups should be involved in its solution?
- What are the socioeconomic and political impacts of copper pollution and actions to reduce its impacts?
- What are the policy options for reducing copper pollution?
- What are the policy options for reducing human health risks?
- What are the policy options for reducing ecosystem impacts?
- What types of scientific/technical and management information are required to make policy decisions?
- How can policy decisions be communicated effectively to scientists and managers?
- What are the policy implications and priorities of this emerging problem within the broader context of other Gulf of Maine issues?

SUGGESTED QUESTIONS TO BE ADDRESSED BY GROUP CONSENSUS ACTION PLAN

- What monitoring approaches are needed to determine the magnitude of the problem, to provide a future baseline, and to evaluate management efforts?
- What management plans are needed to reduce copper pollution and to reduce risks to human health and ecosystem integrity?
- What policies are needed to reduce copper pollution and to reduce risks to human health and ecosystem integrity?
- How can involved organizations and concerned citizens be kept informed?
- How can monitoring approaches, management plans, and policies be integrated in an action plan to address this emerging problem?
- What priority should be given to implementing the action plan on this issue? What criteria were used in defining its priority?

APPENDIX E

APPENDIX E

GLOSSARY

Action Level - The critical value of an environmental variable, which if exceeded, indicates that a significant change has occurred in human health risks, environmental quality, or natural resources. Such exceedances indicate the need for some management action.

Action Plan - A compilation of agreed-upon goals and objectives and the specific strategies and actions that will achieve the objectives for each goal.

Database - A compilation of data and information that is organized in such a way that the data can be sorted by different subjects, variables, or other conditions.

Ecological Integrity - The natural interrelationships that exist between organisms and their environment; undisturbed by human influences.

Ecosystem - Self-regulating community(s) of living organisms interacting with one another and with their non-living environment.

Environmental Management - The process of protecting, maintaining, restoring, and/or optimizing long term environmental quality, biodiversity, and natural resources by maintaining ecosystem integrity.

Environmental Monitoring - A program of observations for the purpose of determining whether the presence, or change in the incidence, of a factor(s), has adversely affected human health, critical biological processes, or the physical, chemical, geological nature of an ecosystem.

Goal - General statement that describe what the human community would like to achieve in the future. Goals reflect a joint vision for a specific or general resource.

Habitat - The parts of the environment in which an organism lives and with which it interacts.

Hypothesis - A statement whose probability of being true can be established using statistical procedures on collected data.

Keystone Species - A species that, through its role in the ecosystem, controls the presence, absence, or abundance of other species; especially if these other species are not directly linked to it in a predator-prey relationship.

Objective - Specific, measurable, milestones that incrementally attain long-term goals as they are achieved.

Sustainable development - Use of resources in a manner that meets present needs and assures resource use by future generations.

Trophic Level - A group of organisms which are on the same level in the tranformation and passage of energy in the ecosystem. An example is the primary production level, or the level at which photosynthesis occurs and light energy in transformed into chemical energy in the form of carbohydrates.

Variable - A factor, feature, or element in the ecosystem that can change and take on different values.