STATE OF MAINE

MARINE RESEARCH BOARD

April 1991

MARINE RESEARCH PRIORITY AND ACTION PLAN

FY 1992 - FY 1993

Biennium

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TABLE OF CONTENTS

		PAGE
MARINE RESEARCH BOARD		
TABLE OF CONTENTS		i
EXECUTIVE SUMMARY		1
SECTION 1.0	BACKGROUND	4
1.1	Introduction	4
1.2	Importance of Research	5
1.3	Marine Research Institutions in Maine	6
1.4	The Commission on Marine Research	8
1.5	The Marine Research Board	9
1.6	Development and Rationale of Report	9
SECTION 2.0	GENERAL OVERVIEW OF MAJOR ISSUES	10
2.1	Balancing Growth and Development with Environmental Quality	11
2.2	The Wise Granting of Permits	11
2.3	Managing A Dynamic Marine Ecosystem	12
2.4	Maine's Fishing Industry	13
2.5	Capturing New Opportunities	13
SECTION 3.0	PRIORITIZATION CRITERIA	14
SECTION 4.0	HIGH PRIORITY RESEARCH THEMES	15
SECTION 5.0	ACTION PLAN	18
5.1	Unified Marine Agenda	18
5.2	Marine Science Advisory Capacity	18
5.3	Grant Review/Communication and Education.	18
5.4	Development of a Proposal Solicitation Document.	19
5.5	Rules and Procedures for the Competitive Grants Program.	19
5.6	Support for the University of Maine System Marine Studies Initiative.	20
5.7	Support for the ARGO MAINE Research Vessel.	21

TABLE OF CONTENTS

		PAGE
5.8	Coordination of Marine Research..... Needs Among State and Regional Agencies.	21
5.9	Alternative Sources of Funding..... for Research.	22
5.10	Change Reporting Deadline for ..... Submitting the Research Priority Statement and Action Plan.	23
SECTION 6.0	FY92-FY93 BIENNIUM BUDGET REQUEST.....	23
ACKNOWLEDGMENTS.....		25
Appendix A	Invitation letter and lists of..... invitees to and participants at the September 10, 1990 Roundtable Discussion.	26
Appendix B	List of marine concerns identified..... at the September 10, 1990 Roundtable Discussion.	30
Appendix C	Consolidated 5 major issues, research... themes, and questions.	32
Appendix D	Proposed cooperative agreement..... between the Marine Research Board and the ARGO-Maine.	40
Appendix E	Proposed legislation to change the..... legislative deadline for submitting the Board's biennial report.	43

EXECUTIVE SUMMARY

Maine's marine environment is at the threshold of an exciting new era. The economic boom of the 1980s provided a preview of change to come. Unlike our neighboring states to the south, we remain in a position to develop our coastal resources in both an environmentally responsible and economically sustaining manner. Managed properly, Maine's coastal environment can provide its citizens great opportunities indefinitely into the future. Imperative to sound management is a firm understanding of Maine's coastal and offshore marine environment. A fundamental strategy to increase our knowledge base in this area is research.

The Marine Research Board (MRB) was created by the 114th Legislature within the Maine Science and Technology Commission in recognition of the importance of research in an overall strategy to identify a balance between protection of the marine environment and continued development. Appointed by the Governor and confirmed by the Legislature, the 15 statutory members of the MRB represent the global interests of various marine resource constituents in industry, academia, foundations, environmental, and state government.

The MRB is the first attempt by state government to comprehensively integrate science into marine resource management on an ecosystem basis. It also is an attempt to tap into Maine's largely unrecognized body of scientific expertise existing within our collection of public and private institutions. The collective intellectual capacity has not been well integrated into the marine policy decision making process. This coordinated approach will provide more efficient use of limited research dollars and enable the State of Maine to understand and eventually manage its marine systems in the best public interest for future generations.

The MRB is authorized to identify high priority research needs of relevance to the state; to develop and administer a competitive grants program to fund projects designed to meet those needs; to identify facility needs; and to submit a biennial report identifying research needs and an action plan. This inaugural report represents an important opportunity for the marine research community within Maine to communicate the state's needs in a coordinated manner.

In preparation of this report the MRB held informal roundtable discussions with invited members of the state's marine community to identify coastal and marine issues which they believed would be important to Maine over the next

decade. Over 40 different issues (Appendix B) were identified which were subsequently consolidated into the following 5 major issues:

- o Balancing Growth and Development with Environmental Quality.
- o The Wise Granting of Permits.
- o Managing A Dynamic Marine Ecosystem.
- o Maine's Fishing Industry.
- o Capturing New Opportunities.

These major issues were dominated by (1) concerns for the impact of activities along the coast and in adjacent watersheds on water quality, (2) concerns for a rational and predictable permitting environment for coastal activity and development, (3) concerns for a healthy environment for fisheries and aquaculture development, and (4) a general interest in identifying the limit of coastal growth beyond which the social costs will exceed any benefits. For all of these issues there was a deep concern for the inadequacy of our present level of scientific understanding of estuarine and marine ecosystems. Nearly all of the issues identified are inextricably interrelated and many are connected in some way to each of the others.

With assistance from Dr. Ronald Dearborn of the University of Alaska, Dr. James Wilson of the University of Maine, ARGO-Maine, and the Maine Sea Grant College Program, Maine's marine scientific community was surveyed for suggestions on research themes and questions that could begin addressing the major issues (Appendix C). These themes, subsequently prioritized, would serve as the basis for soliciting and supporting specific scientific projects by the MRB through a legislatively authorized competitive grants program.

The MRB developed criteria for the purposes of prioritizing research themes for possible support under the competitive grants program. The criteria evaluated the applicability and uniqueness of each research theme to identified marine management concerns as well as the timeframe for completion and cost. The application of the prioritization criteria to the list of research themes yielded seven highest priority themes that will be considered by the MRB for support through the competitive grants program. The seven research themes are:

- o New Tools/Criteria
- o Critical Life Histories and Ecological Factors
- o Characteristics
- o Baseline
- o Carrying Capacities
- o Pollution
- o Linkages

An assessment of the priority research themes points clearly to the need for a better understanding of Maine's marine ecosystem, its functioning and variability. This highest priority is not surprising since it is that ecosystem which underlies the first four substantive issues. The health of the coastal and marine ecosystem are what may be impacted by coastal development in general and inappropriate permitting specifically. This ecosystem and its natural variability are the baseline against which we must measure or predict any changes caused by our activities. The state and functioning of this ecosystem also determine the nature of our capture fishery and provides the environmental resources and constraints for our culture fishery. Accruing knowledge of this ecosystem should be continually factored into the effective management of both of these fisheries.

The MRB also identified a 10-point action plan for the upcoming biennium to strengthen Maine's research community and to support marine research of relevance to the state. Major elements of the action plan include (a) unifying the state's marine agenda, (b) establishing cooperative agreements with ARGO-Maine and the UMaine Sea Grant College Program to provide assistance to the MRB in implementing its manadates; (c) developing a Proposal Solicitation Document and (d) the Rules and Procedures for the Competitive Grants Program; (e) coordinating marine research needs among State agencies; and (f) identifying alternative sources of funding for research.

The action plan outlined in this report represents the next critical step in the development of an effective state-supported marine research program. However, realization of the program's objectives will require state investment. After careful consideration of its workplan, the Board has submitted to the Governor and the Legislature a prudent and reasonable biennium budget request for $135,000 in FY92 and $733,458 in FY93. The bulk of the funding in FY93 will be used to support the highest priority research themes identified in this report under the Competitive Grants Program.

During the first year of the biennium, the Board will focus its attention on the development of rules and procedures related to the grants program, on strengthening the state's marine-related education and communication activities, and on fine tuning the research priorities. These activities are necessary to prepare for implementation of the grant program by the beginning of the second year of the biennium, July 1, 1992, pending the availability of state funding.

1.0 BACKGROUND

1.1 Introduction

In his book entitled "Islands of Maine" William Caldwell observed that the first roots of the United States were not in the soil of the mainland but in the fishing grounds off the coast of Maine. Indeed, it was the demand for fish by Europeans which caused the rush to exploit the "silver mines of Maine" and led to the first settlements in Maine approximately 500 years ago.

To date, Maine's coastal heritage; its 3,500 miles of coastline, hundreds of communities and their residents, approximately 3,000 islands, and the Gulf of Maine, continues to be an important natural resource to the State of Maine. The aesthetic and recreational values embodied in this heritage are envied by the millions of tourists who flock to Maine annually and by the millions of would-be, world-wide tourists who can only dream about visiting Maine. Precisely because of these diverse uses it is not possible to provide a reasonable figure for the economic value of Maine's marine environment. It can be determined, however, that Maine's marine environment generates tens of thousands of jobs, pumps over $1 billion dollars annually into the state's economy, and provides countless and priceless hours of enjoyment.

Maine's marine environment is at the threshold of an exciting new era. The economic boom of the 1980s provided a preview of change to come. Unlike our neighboring states to the south, we remain in a position to develop our coastal resources in both an environmentally responsible and economically sustaining manner. Our remoteness from the rest of the more developed seaboard has afforded us an opportunity to work with a relatively clean slate; unencumbered by serious pollution, development demands and depleted or degraded resources.

Managed properly, Maine's coastal environment can provide its citizens great opportunities indefinitely into the future. Management decisions made today affect if not determine the course and types of decisions necessary tomorrow. Imperative to sound management is a firm understanding of Maine's coastal and offshore marine environment.

This growth is not without controversy, however. There is growing concern about the stresses on the marine environment that usually accompany population growth. Human activities that contribute to marine pollution include discharges from sewage treatment plants and disposal systems and run-off from

urban areas and construction sites. Pollution from human activities are increasingly contaminating Maine's valued estuaries and bays. Closure of mussel and clam flats are more frequent and commercial fish landings are declining without a clear cause. The need to balance preservation of the fragile marine environment with economic prosperity has created schisms within the several Maine coastal communities and between coastal communities and non-coastal communities.

There is another dimension to this concern that goes beyond the boundaries of Maine's marine environment. It is the growing realization that local ecosystems from different parts of the world are interconnected and the effects of both human and natural activities on one part of the world can influence the ecosystem in another part. This realization points toward a process of creating policies, laws and regulations regarding the uses and protection of Maine's environment (terrestrial, airborne, and marine) that is cognizant of implications to and from neighboring ecosystems.

1.2 Importance of Research

In the coming years the Maine Legislature, state regulatory agencies with responsibilities over bodies of water, and local municipalities will have to make very difficult decisions regarding the use of Maine's marine resources and future coastal developments. These decisions must be based on a reasonable understanding of the dynamics of near-shore and off-shore marine ecosystems and related social interactions. Without such an understanding, decisions which do not have scientific bases may be too liberal or too stringent thereby adversely impacting the marine ecosystem or local marine industries. The entire State along with its coastal communities will suffer from faulty decisions which lead to the destruction of Maine's marine resource heritage. Unfortunately, the dynamics of the marine ecosystems and related social interactions are not well understood. A fundamental strategy to increase our knowledge base in this area is research.

Research on Maine's marine ecosystem of the sort needed has never been adequately supported within the programmatic or budgetary limitations of existing research support programs. It is deemed too applied and/or of only local/regional interest to gain support from the National Science Foundation. It is too basic and long-term to have garnered state support in the past. Support from the Sea Grant Program has been sporadic and limited by inadequate budgets and the small, discrete project approach currently used in that program.

The inability to effectively exploit competitive federal funds to conduct marine research of local concerns creates an enormous barrier in the state's ability, in an effective and timely manner, to balance the needs of environmental protection with those of coastal development, resource utilization, sustainable development, and use of marine waters for recreation. It is quite apparent that there is increasing pressure on Maine State Government to support that marine research which will provide the knowledge base to develop effective, efficient, and balanced marine policies, laws, and regulations.

1.3 Marine Research Institutions in Maine

Within Maine, there exists a unique but as yet untapped ability to provide a greater understanding of Maine's marine environment. A largely unrecognized body of scientific expertise exists within our collection of public and private institutions. This collective intellectual capacity has not been well integrated into the marine policy decision making process.

The Maine Department of Marine Resources (DMR) was established long ago to provide the basis for managing the state's living marine resources. It has a long history of applied fisheries assessment research and has recently assumed lead agency responsibility for aquaculture development. DMR's research bureau is located at McKown Point in West Boothbay Harbor on a site shared with the Bigelow Laboratory for Ocean Sciences. The research facilities are currently being upgraded and renovated.

The Maine Geological Survey (MGS) has an active seafloor, coastal and estuarine mapping program and works cooperatively with the University of Maine, the Department of Marine Resources, and Maine Maritime Academy on a variety of projects. The MGS is involved in sea-level change studies, sand beach and coastal bluff hazard mapping programs, as well as estuarine sediment budget projects. The MGS also provides technical advice to other governmental agencies regarding dredging and spoils disposal, coastal zone construction, and other marine activities with geological emphasis.

Bigelow laboratory for Ocean Sciences is an independent, creative scientific community where oceanographers and marine scientists pursue excellence on critical global and regional issues concerning natural resources and the environment. Founded in 1974, Bigelow Laboratory is one of the premier nonprofit marine science organizations in the country. Marine scientists at Bigelow Laboratory are nationally recognized for their research in biological and fisheries oceanography.

Mount Desert Island Biological Laboratory, located at Salisbury Cove, is an internationally recognized and envied haven for scientists from all over the world who spend their summer at the Laboratory to conduct interdisciplinary research on comparative physiology of marine and nonmarine animals. One of the significant research programs at the Laboratory is the Center for Membrane Toxicity Studies. Funded by the National Institute of Environmental Health Sciences, the Center allows several investigators from around the world with specialities in nephrology, biophysics, digestive diseases, pharmocology, molecular biology, and comparative physiology, to work together to study the effects of heavy metals and xenobiotics on the transport mechanisms of epithelial tissues.

The Wells National Estuarine Research Reserve comprises 1,600 acres of land in and around the Little River and Webhannet River estuaries in Wells, Maine. It is one of two National Estuarine Research Reserves located on the Gulf of Maine. Reserve habitats include streams, fresh and salt marshes, salt panes, tidal mud flats, sandy beaches and dunes, upland forests and fields. The Reserve directs and supports onsite research to improve tools for coastal resource management. Recent and ongoing projects investigate estuarine productivity; hydro-dynamics and sediment movement within coastal river-mouths; and sea-level and stratigraphic studies. A long-term ecological monitoring program combines with those of other Reserves to provide data on national trends in estuarine habitats.

The University of Maine System's diverse marine programs over the years have developed research and educational strengths in fish biology, marine ecology, aquaculture, marine geology, coastal engineering, resource economics and marine law. The Maine Sea Grant College Program has supported and built on these strengths and added strong public service and educational components through its Marine Advisory and Communications Programs. The University of Maine is now in the process of building long-needed strengths in oceanography and focusing its marine research and graduate education in a School of Marine Sciences and in degree programs in marine bio-resources and aquaculture.

Maine Maritime Academy (MMA) is expanding its curriculum to include a new undergraduate degree program in Ocean Sciences. MMA and other institutions of higher education around the state with interests in undergraduate marine education have recently formed a consortium, MEDUSA, under the auspices of the Maine Science and Technology Commission, to further these interests. MMA also owns the 80-foot Research Vessel ARGO MAINE and operates it in support of marine research throughout the Gulf of Maine.

Maine institutions and organizations with marine research interests several years ago formed the Association for Research on the Gulf of Maine (ARGO-Maine). This federation has played an active role in the development of marine ecosystem research plans and programs for the Gulf of Maine. It was also instrumental in the assignment of the RV ARGO MAINE to Maine Maritime Academy and the development of Senator Mitchell's Marine Research Act. Finally, ARGO-Maine played an important advisory role to the State's Commission on Marine Research.

National and regional new initiatives are also focused on coordinating marine research. At the national level, the U.S. Global Change Research Program has very significant marine components. Also Senator Mitchell's recently enacted Marine Research Act authorizes the establishment of marine research programs in the coastal regions of the United States. The Gulf of Maine is one of those regions. Also at the regional level, Maine, Massachussetts, New Hampshire, New Brunswick and Nova Scotia have recently established the Gulf of Maine Council on the Marine Environment. The Council is an unprecedented international cooperative effort to monitor and preserve the environmental quality of the Gulf of Maine. The Council recently obtained federal funds to develop a data management program for coordinating monitoring data collection for the Gulf of Maine region. The Council also sponsored a major research conference in January at the Woods Hole Oceanographic Institute to discuss research and monitoring activities on the Gulf of Maine.

1.4 The Commission on Marine Research

In the second session of the 113th Legislature, the Commission on Marine Research was created by resolution to investigate the status of the state's marine research infrastructure, to identify federal, state, and privately supported marine research activities, to identify marine research gaps, and to develop recommendations for state actions and funding to support these actions.

Under the leadership of its Chairman, Representative James Reed Coles, the Commission held a public hearing in July of 1988 and met several times in the summer and fall before issuing its final report in December of the same year. Based on its findings the Commission issued seven recommendations one of which was to create a Marine Research Board within the Maine Science and Technology Commission to identify high priority research needs of relevance to the state; to develop and administer a competitive grants program to fund projects designed to meet those needs; and to identify facility needs.

Other recommendations of the Commission included strengthening research programs of the Department of Marine Resources; increasing state support for marine mapping and monitoring programs undertaken by state and private organizations; new, continued or expanded state support for private organizations whose marine research missions are of importance to the state (e.g., Bigelow Laboratory for Ocean Sciences and Mount Desert Island Biological Laboratory); and the importance of providing state match for the Sea Grant Program.

1.5 The Marine Research Board

The Marine Research Board (MRB), as created by the 114th Legislature, represents the global interests of various marine resource constituents in Maine. Appointed by the Governor and confirmed by the Legislature, the 15 statutory members of the MRB represent the University of Maine System, the marine resource industry, the marine scientific community, State Government, independent higher educational institutions, not-for-profit environmental organizations, and the public at large.

The creation of the MRB by the Legislature is testament to the recognition by the citizenry of this state that research is an essential element of an overall strategy to identify a balance between protection of the marine environment and continued development. The MRB also is the first attempt to comprehensively integrate science into marine resource management on an ecosystem basis. Prior to this, each marine interest; whether scientific, regulatory, academic, private, or environmental, focused on specific mandates or project goals; at times conflicting with but also duplicating each others efforts. This comprehensive coordinated approach taken by the MRB will provide more efficient use of limited research dollars and enable the State of Maine to understand and eventually manage its marine systems in the best public interest for future generations. This inaugural report represents an important opportunity for the marine research community within Maine to communicate the state's needs in a coordinated manner.

1.6 Development and Rationale of Report

Preparation of this report has proceeded through a multi-stage process to maximize broad input from marine policymakers, regulators, and users of the marine environment. On September 10, 1990, in Augusta, the MRB held an informal roundtable discussion with invited members of the state's marine community (Appendix A) to identify coastal and marine issues which they believed would be important to Maine over the next decade. At this meeting, over 40 different issues were identified (Appendix B). These issues were subsequently consolidated into 5 major issues (Appendix C).

The MRB requested the assistance of ARGO-Maine, the Maine Sea Grant College Program, and Dr. James Wilson of the University of Maine to facilitate the surveying of Maine's scientific community for suggestions on research themes and questions that could begin addressing the major issues. These themes (Appendix C), subsequently prioritized, would serve as the basis for soliciting and supporting specific scientific projects by the MRB through a competitive grants program.

The MRB also retained the services of Dr. Ronald Dearborn, Director of the Alaska Sea Grant Program to facilitate the September 10 meeting and subsequent discussions with the marine scientific community. Dr. Dearborn is an educator, worked in Maine State Government for a number of years, and was the Director of the Maine Sea Grant College Program at the University of Maine before taking on his present position at the University of Alaska. Because of his understanding of the marine resource issues of the State of Maine, Dr. Dearborn brought with him a wealth of experience that was deemed very valuable for facilitating discussions with members of the marine community who have varying interests and concerns.

The major issues and associated research themes are summarized in Section 2.0. The prioritization criteria are discussed in Section 3.0 and Section 4.0 outlines the high priority research themes. Section 5.0 outlines the Board's action plan to effectively support marine research activities. Section 6.0 describes the Board's biennium budget request to the Governor and the Legislature to support its activities as presented in this report.

2.0 GENERAL OVERVIEW OF MAJOR ISSUES

The points raised at the September 10, 1990, meeting were dominated by (1) concerns for the impact of activities along the coast and in adjacent watersheds on water quality, (2) concerns for a rational and predictable permitting environment for coastal activity and development, (3) concerns for a healthy environment for fisheries and aquaculture development, and (4) a general interest in identifying the limit of coastal growth beyond which the social costs will exceed any benefits. For all of these issues there was a deep concern for the inadequacy of our present level of scientific understanding of estuarine and marine ecosystems. There was strong support for the initiation of a state marine research program which would lay the foundation of understanding of Maine's coastal and marine environment so that future decisions affecting activity on the Maine coast could be made wisely. Nearly all of the issues identified are inextricably interrelated and many are connected in some way to each of the others.

2.1 Balancing Growth and Development with Environmental Quality

Parts of the Maine coast are already heavily used and pressures are expected to increase over the decade. For many the lifestyle of coastal living is directly tied to its coastal environmental quality. Most coastal industries, such as fishing, aquaculture, and tourism, are directly tied to environmental quality. Other coastal activities may be less dependent on the quality of the marine environment, and therefore are less directly sensitive to it in the short term. Many citizens are also concerned for the economic viability of coastal Maine, and recognize the value of appropriate development. Most of them also recognize that such development will benefit from maintaining environmental quality.

The common dilemma which threads through these concerns is the traditional conflict between protection of the environment and development. Specifically, the dilemma phrased in a question format is "Are coastal growth and development and the preservation of environmental quality at odds with one another? How and where can economic growth be accommodated?" The answers to these questions must be based on the recognition that (1) most human activity along the coast impacts to some degree the coast's estuarine and marine environment, (2) in some instances, increased use of the Maine coast can be accommodated with minimal impact, and (3) almost all uses and users in the long-term will benefit from a healthy marine environment.

The MRB clearly recognizes that the state must increase its knowledge base on the ways in which human activities affect the coastal environment, the Gulf of Maine, and our quality of life, to assess specific and cumulative impacts. Research efforts could assist in the development of model land-use/zoning plans which are able to accommodate the diversity of uses and values of the coastal zone. Research could also support efforts to determine how the state's socio-economic structure may be able to effectively and efficiently respond to and accommodate a variety of coastal interests.

2.2 The Wise Granting of Permits

Uncertainty of the type and magnitude of environmental degradation from expanded or new uses of the Maine coast often delays or hinders an applicant from receiving a permit from the State. This uncertainty often inhibits development more than does a particular environmental standard. Maine's coastal residents and state agencies need a better understanding of how human activity affects the estuarine and

marine environment. Without an understanding of how these ecosystems work, society's effect on those systems cannot be reasonably quantified. Increased knowledge is needed before a predictable environment for growth can be described.

Research could address specific permitting concerns in a variety of ways such as focusing on assessment of the direct and indirect impacts of specific development projects on the local biota/environments. An equally important research effort should evaluate the bases for current permitting regulations (scientific, political, economic), determine the extent to which these bases intermingle with one another and if they are out of date. The knowledge base accumulated from these research efforts and related activities could significantly contribute to and enhance a state strategy by which regulations and the decision-making processes can maintain currency in the face of new scientific knowledge or changing socio-economic and political realities. Successful implementation of such a strategy could help state agencies set less ambiguous environmental standards and regulations which are important to decreasing uncertainty and to facilitating the permitting process.

2.3 Managing A Dynamic Marine Ecosystem

Change is a constant feature of the Maine coast; change from natural environmental processes and changes caused by human activity. Anticipated changes in the coastal environment, either cyclical or long term, may affect coastal use in two ways. First, changes in sea level, water temperatures, and tidal currents, among others, would likely affect coastal productivity, the shape and structure of the coast itself, and its usefulness for certain activities. Second, these natural changes could mask or even magnify the effects of human activity. Neither our present understanding of the ecosystem nor our governance institutions are adequately prepared to ensure wise management of our coastal or marine environment against a backdrop of constant change.

The concept of optimum yield in the MFCMA and the planning expectation in the shape and features of Maine's coast and adjacent marine environment are inadequate. Each institutionalizes an erroneous concept of constancy. Not only does human activity change, but the nearby marine environment is changing as well. Dredging may be perceived as necessary for development (i.e. new marina), restoring from sedimentation (i.e. dredging maintenance), or correcting for sea level rise (dredging of newly submerged shallow land). The political realities will be different depending on the cause, usefulness, and longevity of the decision. Without a sound understanding of the dynamics of the natural systems at work, questions of what should be done and who should pay are not likely to receive satisfactory answers.

2.4 Maine's Fishing Industry

The standing stock of fish in the Gulf of Maine is different than it once was. Changes caused by the level of fish activity, the gear used, pollution from shoreside activity, and natural changes (either long term or cyclical) are likely contributors. If the health of this important industry is to be maintained or even enhanced, the natural systems at work in the Gulf of Maine and how human activity impacts on those systems must be better understood. With increased public awareness of human influence on the ocean environment has come a concern for the quality of food coming from the ocean. It will be increasingly important to ensure that Maine's fish not only are in fact among the safest of foods but acknowledged to be as well.

The MRB believes that fisheries management and the fishing industry as a whole could be best served by research activities that focus on ways to match the variability of the natural environment (and the variable fisheries supplies that result) with the demands for high quality, stable and predictable supplies that emanate from the modern food distribution system. Equally important are research efforts directed to generating information that will ultimately lead to marketing of end products that are untainted and of high quality.

2.5 Capturing New Opportunities

Research over recent years has led to the development of new technologies which, if properly used, could significantly enhance our knowledge base about the estuarine and marine ecosystems. These new and emerging technologies also provide new opportunities for businesses in areas related or unrelated to marine resources such as aquaculture, marine biotechnology, remote sensing, numerical modeling, and spatial positioning capabilities. To gain a better understanding and appreciation of the potential new opportunities resulting from new technologies, research efforts must first identify those new and emerging technologies relevant to our marine enterprise. A followup effort should focus on assessing the most cost effective ways to integrate new technologies into research, development, and management.

Finally, interlaced within each major issue is the clear need for an effective education and communication strategy. The MRB wishes to emphasize that the knowledge gained by quality research has little impact if there is no effective and efficient mechanism to transfer the knowledge to the public, the scientific community, marine industry, regulators, and policymakers.

3.0 CRITERIA FOR RESEARCH THEMES PRIORITIZATION

After careful considerations of the issues and definitions, the Marine Research Board has developed the following criteria for the purposes of prioritizing research themes for possible support under the competitive grants program.

- **Applicability:** This criterion evaluates the likelihood that the research theme is valid in terms of addressing identified marine management concerns.

- **Uniqueness:** This criterion acknowledges that research should build upon and not duplicate similarly directed research already conducted or underway which is pertinent to Maine but done by others elsewhere. This criterion discriminates toward those research themes which are directly and uniquely applicable to Maine.

- **Multi-applicability:** Under this criterion, research that is applicable to several issues, is of higher priority than that pertinent to only one. This criterion thus discriminates against narrow site- and pollutant-specific research.

- **Timeframe:** This criterion evaluates the likelihood that research under the research theme will require a short period (less than 3 years) or a longer period (greater than 3 years) to generate data useful to marine managers. Although research requiring shorter periods to generate useful data will probably be prioritized for funding over longer period projects, the importance of the latter should not be understated given the status of our limited knowledge of the characteristics of Maine's estuarine and marine ecosystems. For this reason and others, the applicability of research themes to a particular marine concern may require state support for research projects that require several years to generate useful data.

- **Sequence:** This criterion acknowledges that certain research themes should come first in order to make scientific progress in dealing with the other research themes or questions listed. In essence this criteria brings to bear a hierarchy in the conduct of research. It says for example that (1) before we can reasonably

evaluate the human carrying capacity of our coastal regions, we have to know more than we do about the natural marine ecosystem and how it will be perturbed by human activities and (2) before we can assign and quantify anthropogenic causes to ecosystem changes, we must distinguish between the natural function and variability of that ecosystem.

o Cost: This criterion evaluates the likelihood that the cost of conducting a set of research projects under a particular research theme will be prohibitive to the state and will require additional support from other sources. A cost prohibitive rating should not preclude the state from supporting an important research theme. Rather the MRB should consider innovative ways to supplement its funding for these research projects at the same time it funds less cost prohibitive priority projects. The criterion also evaluates the likelihood that a project will not receive adequate support from currently available funding sources for programmatic and budgetary reasons. The general principle here is to support that important and high quality research which falls in those significant areas inadequately or not supported by the National Science Foundation, NOAA Sea Grant and the Maine Aquaculture Innovation Center, among other sources.

4.0 HIGH PRIORITY RESEARCH THEMES

The application of the prioritization criteria to the list of research themes listed in Appendix C yielded 7 important themes that will be considered by the Marine Research Board for state-support through the Competitive Grants Program. Because of the overlapping nature of the themes across major issues, prioritized themes are not described by the major issues listed earlier in Section 2.

o New Tools/Criteria: There is a need to identify, employ, or develop:

(a) new methodologies for detecting stress, determining causes, and distinguishing between anthropogenic and natural causes of changes:

- at the ecosystem level in order to improve our ability to assess broad anthropogenic impacts on the marine environment;

- at the organismal level in order to improve our ability to assess specific anthropogenic impacts at the local level;

- to improve our ability to assess changes in marine ecosystems and populations;

- at the population level in order to improve our ability to assess natural and anthropogenic impacts on commercially valued species;

(b) the most effective land use management tools and techniques to protect the coastal marine environment; and

(c) methodologies to assess the impacts of specific development projects on coastal waters and marine habitat.

o Critical Life Histories and Ecological Factors: There is a need to understand natural forces which:

- control the carrying capacities of major waters for anthropogenic impacts and which might be altered through coastal development;

- govern marine populations and which might be impacted by regulated and nonregulated activities;

- control populations of important marine species including recruitment of species of commercial importance to Maine.

o Characteristics: This theme addresses the need to understand natural delivery and flushing rates and ranges, transformations, dispersal, and the mechanisms and rates of sequestering of significant dissolved and particulate material in the coastal marine environment.

o Baseline: This theme addresses the need to measure and understand the natural background, features, trends, variability of the coastal and offshore Gulf of Maine in order to adequately measure, monitor, and distinguish between anthropogenic and natural causes of changes in the marine environment.

o Carrying Capacities: This theme addresses the need to measure and understand the extent to which Maine's coastal marine habitats are able to support commercially and ecologically important species. Information resulting from research on this theme also will help determine environmental thresholds for development on Maine's beaches and tidal marshes beyond which these systems no longer function naturally.

o **Pollution:** This theme addresses the need to measure and understand:

- the mechanisms by which pollutants are introduced to, distributed, and altered within the marine environment;

- how pollution could alter the trophodynamics of the Gulf of Maine;

- the direct and indirect effects of pollution on marine biota, the ecosystem as a whole, on the level of fisheries production, and on human health.

o **Linkages:** This theme addresses the need to measure and understand the relationships and extent of linkages between physical, chemical, and biological processes of the marine environment and fisheries production.

An assessment of the priority research themes points clearly to the need for a better understanding of Maine's marine ecosystem, its functioning and variability. This highest priority is not surprising since it is that ecosystem which underlies the first four substantive issues. The health of the coastal and marine ecosystem are what may be impacted by coastal development in general and inappropriate permitting specifically. This ecosystem and its natural variability are the baseline against which we must measure or predict any changes caused by our activities. The state and functioning of this ecosystem also determine the nature of our capture fishery and provide the environmental resources and constraints for our culture fishery. Accruing knowledge of this ecosystem should be continually factored into the effective management of both of these fisheries.

In addition to this top priority research need for improved knowledge of the marine ecosystems within the Gulf of Maine, there is also a fundamental socio-economic area which may warrant serious attention in the future. It revolves around the general question of the extent to which our current regulatory laws and practices, organizational structures, and valuation techniques are adequate and appropriate to the tasks with which they have to deal. This is an extremely complex question to deal with. But it is also an extremely important one. While it does not involve research along the Maine coast or within the Gulf of Maine, it's potential significance to all of the issues raised must be noted.

5.0 ACTION PLAN

The preceding sections outlined the priority research themes which should be funded under the Marine Research Board Competitive Grants Program as authorized by the Legislature. However, as presently structured, organized, and funded, the Marine Research Board cannot undertake an effective plan to stimulate, promote, and support marine research in Maine without taking or supporting the following additional and necessary steps.

5.1 Unified Marine Agenda

Paramount for an efficient marine research program in Maine is a well coordinated marine research community. In a period of limited resources, the marine community must present a unified front when seeking financial support from state government for research activities. Although the Marine Research Board has legislative sanction to coordinate marine research in Maine, such coordination will not be possible without prior understanding among the leaders of Maine's marine research institutions on a common marine agenda that articulates each institution's role in addressing Maine's marine research needs. Discussion of a common agenda was initiated between the University of Maine Chancellor's Office, the University of Maine, Maine Maritime Academy, the Department of Marine Resources, the Bigelow Laboratory for Ocean Sciences, the Marine Research Board, and the Maine Science and Technology Commission. These discussions will be expanded to include the Maine Geological Survey, the Department of Environmental Protection, State Planning Office and other agencies/programs involved in marine research.

5.2 Marine Science Advisory Capacity

The Marine Research Board is a policy board by design. Although some of its members are marine scientists in their own right, the Board is not setup to design scientific projects. As such the Board must have access to the state's marine scientific community for assistance in prioritizing marine research. Accordingly, the Board is presently negotiating a cooperative agreement (Appendix D) with ARGO-Maine to serve the Board in a scientific advisory capacity. This agreement will recognize ARGO-Maine as Maine's intellectual center for marine science. The agreement will also recognize and protect the autonomy of each party.

5.3 Grant Review/Communication and Education

Review of grants is vitally important to assuring that only scientifically meritorious proposals are supported by the Marine Research Board. Equally important to the mission

of the Board is the need to ensure that the results of the research are quickly and effectively communicated to the scientific community, the public and the Legislature. The Marine Research Board will enter into a cooperative agreement with the University of Maine Sea Grant Program to access the existing administrative procedures of the Sea Program for grants reviews and extension/education services. It is important to emphasize that although the Board will utilize the Sea Grant Program's administrative know-how for the purposes outlined, the Board will develop its own peer review and extension/education requirements. Under this agreement, the Marine Research Board will have office space at the University of Maine in order to maximize contact with the Sea Grant Program. The Board will apportion staff time between the Augusta and Orono offices.

5.4 Development of a Proposal Solicitation Document

As previously discussed, this report outlines priority research themes. The next step in the process is the development of a substantive proposal solicitation document including a set of requirements and evaluation criteria. This document will drive the Board's requests for proposals in the next biennium. The Board, working with ARGO-Maine and the Maine Sea Grant College Program office, will begin the process of developing this document in the Spring of 1991. Completion of this task is anticipated in the Fall of 1991.

5.5 Rules and Procedures for the Competitive Grants Program

The Marine Research Board is authorized to develop and administer a competitive research program in order to support the research areas. The Board is required to develop rules and procedures for the grants program pursuant to the Maine Administrative Procedures Act. The new rules and procedures should become effective in the Fall of 1991/Winter of 1992. At that time the Board will issue a statewide solicitation for research proposals based on the solicitation document and subject them to rigorous scientific reviews. The anticipated start date for selected projects will be July, 1992. The rules and procedures will include the following operating procedures and principles:

1. Relationship to research themes priorities.

2. High quality, credible work is of paramount importance, and requires unbiased peer review.

3. Proposal solicitations and evaluation criteria must provide a level playing field.

4. Expectations for costs and results must be realistic.

5. Conflicts of interests must be avoided.

6. Proposal preparation, defense, and reporting requirements should be kept to the minimum which will meet program goals.

7. Principal Investigators on a project must be associated with a Maine institution or organization.

8. The involvement and support of cooperating non-Maine scientists in the research will be encouraged.

9. The normal evaluation criteria associated with a grants program will include:

   a) the extent and quality of cross-institutional, multi-PI collaboration;

   b) effective plans to disseminate the results of the research to users and the public;

   c) the extent to which grant support would bring to the state the data and results of pertinent research supported from other sources; and

   d) a clearly defined plan for data management to assure its effective use by both the research and environmental management communities.

5.6 Support for the University of Maine System Marine Studies Initiative

The University of Maine System's FY92-FY93 budget package to the Governor and the Legislature includes a $1.45 million dollars request over the biennium to build long-needed strengths in oceanography, and to focus its marine research and graduate education programs in a School of Marine Sciences and in degree programs in marine bio-resources and aquaculture. This initiative, if funded, will also be supportive of a new undergraduate degree program in Ocean Sciences at Maine Maritime Academy, and will further the stature and leadership of the state in marine research and education.

Initiatives such as those of the University of Maine System and Maine Maritime Academy are essential if Maine is to conduct quality research to address marine concerns. For this reason, the Marine Research Board strongly supports the University of Maine System marine studies initiative and budget request and is committed to working closely with the University of Maine System Chancellor to obtain legislative approval.

5.7 Support for the ARGO MAINE Research Vessel

The granting of the ARGO MAINE Research Vessel by the National Science Foundation in 1987 to Maine Maritime Academy on behalf of the ARGO Maine Consortium was an unprecedented cooperative effort among several of the Maine marine research institutions and state government. Owned and operated by the Maine Maritime Academy under the grant agreement, the research vessel has significantly contributed to the conduct of quality marine research on the Gulf of Maine. Marine scientists from Bigelow Laboratory, the University of Maine, Department of Marine Resources, and other institutions have logged thousands of research hours on the ARGO MAINE.

Funds from research grants have been the primary source of financial support for the vessel. However, in a period of diminishing resources nationally and locally, smaller fractions of research grants are being allocated for shiptime. The Maine Maritime Academy has been offsetting the deficit in operational cost of the vessel with its own funds thereby causing undue hardship on the Academy's own budget. In fact, a recent estimate projects a $100,000 deficit in the ship's operation by the end of June 30, 1991. This situation cannot continue. Clearly, the loss of the ARGO MAINE will have a significant impact on the quality of marine research generally and on the ability of the Marine Research Board to support research of relevance to Maine specifically.

The Marine Research Board concurs with the recommendation of the Legislative Commission on Marine Research that state-support for the ARGO MAINE is a legitimate function of the Board. Therefore, the Board has included in its biennium budget request funds to support shiptime on research vessels in general and on the ARGO MAINE specifically. The fund will be used as shiptime match to research grants.

5.8 Coordination of Marine Research Needs Among State and Regional Agencies

In practice, Maine State Government is ultimately responsible for the protection and proper management of Maine's coastal heritage. The generation of information for sound management decisions requires a coordinated effort among the several Maine state agencies responsible for managing the marine environment. An integral component of the Board's charge to identify and prioritize state government's marine research needs within the context of the Board's overall prioritization effort. To ensure coordinated state agency advice, the Board will work closely with the leaders of marine-related state agencies to establish an interagency working group to assist the Board in identifying and prioritizing marine research needs of state government.

The creation of the Gulf of Maine Council on the Marine Environment and the federal Gulf of Maine Marine Research Board (per Marine Protection, Research and Sanctuaries Act of 1991) provides an opportunity for the State of Maine to play an important role in defining the marine research needs for the region. A successfully integrated regional marine research workplan provides a powerful tool to begin understanding the interrelationships between the near-shore and off-shore marine environments. In developing Maine's marine research priorities, the Maine Marine Research Board is committed to working with these two regional agencies to identify mutually beneficial relationships that would strengthen the state's and the region's ability to identify and pursue practical and relevant marine research activities.

5.9 Alternative Sources of Funding for Research

The Board has submitted its budget request for the FY92-FY93 biennium to the Governor and the Legislature. However, because of the economic slowdown the State is currently experiencing, the Board is committed to identifying and pursuing all available funding alternatives to support its programs and activities.

The Board has entered into a partnership with the Massachusetts Centers of Excellence Corporation, the New Hampshire State Planning Office, and the Oceanic Institute in Hawaii to secure congressional funding through the National Fisheries Management Service for a 5-year research project on fisheries recruitment in the Gulf of Maine. The Board, through the Maine Science and Technology Commission, will serve as the fiscal agent for the project. Under this partnership, the research will be conducted by a coalition of marine scientists from each state partner. Interstate partnerships like the one described above will provide the Board an important vehicle to secure congressional funding for marine research of importance to the state.

Consolidation of existing in-state sources of research funding is also being considered by the Board. In the Spring of 1991 the Board will inventory marine research funding and expenditures and types of marine research conducted at all of Maine's public and private research institutions. This information will be analyzed to determine the likelihood for consolidating marine research funding to support marine research of mutual interests. If such consolidation is possible, the Board will enter into discussions with the appropriate leaders of the marine research institutions to discuss this possibility and arrangements.

Another source of funding for marine research activities is the Maine Coastal Environmental Trust Fund which was created during the Second Session of the 114th Legislature (5 M.R.S.A. Sections 13130 et seq.). The purpose of the trust is to provide grants to qualifying organizations for activities to advance scientific research concerning the nature, magnitude and effect of pollution of the State's estuarine, near-shore, and off-shore marine environment and the means to abate pollution of habitats. Sources for the trust include gifts from private individuals, grants from public and private foundations, legal settlements related to violations of environmental laws, rules, or regulations, research grants from the federal oil spill trust fund, revenues from public bond issues, and federal grants and loans. Presently, the trust fund is not capitalized. The Board will develop and implement a vigorous campaign to increase awareness of the trust in order to attract research funds from a variety of sources.

5.10 Change Reporting Deadline for Submitting the Priority Research Statement and Action Plan

Current law (5 M.R.S.A Section 13127 et seq.) requires the Board to submit to the Governor and the Legislature a biennial priority research statement and action plan no later than January 1st of each even-numbered year, except that the first statement was to be submitted in January, 1991. The statement and plan are to guide the Board's funding decisions and activities. As presently mandated, the report would be developed and submitted during the Second Session of the Legislature. The Board believes that the report should be the basis for its biennial budget request in the Fall prior to the 1st session of the Legislature and biennium. Therefore, the Board has submitted draft legislation (Appendix E) to synchronize the reporting schedule with the budget period by changing the deadline to January 1st of each odd-numbered year.

6.0 FY 1992-FY 1993 BIENNIUM BUDGET REQUEST

The enabling legislation of the Marine Research Board authorized the hiring of a clerk typist II and included an initial budget for the FY90-FY91 biennium to be allocated as follows:

	FY90	FY91
Positions	(1)	(1)
Personal Services	$15,449	$20,599
All Other	6,000	5,500
Capital Expenditures	2,000	--
	$23,449	**$26,099**

In the first year of operation, a clerk typist II was hired by the Maine Science and Technology Commission (MSTC) to provide support to the Marine Research Board. To provide professional and administrative support, the MSTC apportioned 25% of the Associate Director's time to the Board. The remaining funds were used to develop the present report.

The action plan outlined in this report represents the next critical step in the development of an effective state-supported marine research program. However, realization of the program's objectives will require state investment. After careful consideration of its workplan, the Board believes that the budget outlined below is both prudent and reasonable during a difficult economic period for the State of Maine.

	FY92	FY93
PART I REQUEST		
Positions	(1)	(1)
Personal Services	$25,650	$26,933
All Other	5,525	5,900
Capital Expenditures	--	--
	$31,175	**$32,833**
PART II REQUEST		
Positions*	--	(1)
Personal Services*	--	$ 58,458
All Other**	$135,000	675,000
Capital Expenditures***	--	4,500
	$135,000	**$733,458**

* Grade 30, Range D, unclassified (professional level to assist the Board in carrying out its duties).

** Breakdown of All Other

1. Research Plan	$ 10,000	$ 40,000
2. Database/Bibliography	10,000	15,000
3. Conferences/Newsletter	15,000	20,000
4. Shiptime support	100,000	100,000
5. Grants Program	--	$500,000

*** Office equipment and supplies including computer for new position.

During the first year of the biennium, the Board will focus its attention on the development of rules and procedures related to the grant program, on strengthening the state's marine-related education and communication activities, and on fine tuning the research priority. These activities are necessary to prepare for implementation of the grant program by the beginning of the second year of the biennium, July 1, 1992, pending the availability of state funding.

ACKNOWLEDGMENTS

The Marine Research Board expresses its appreciation to the many individuals around the state in industry, government, and academia who invested their time and energy to assist in this most important effort. Special thanks are due Ron Dearborn, Director of the Alaska Sea Grant Program for serving as a facilitator, to Dr. David Townsend, Dr. Robert Wall, and Dr. James Wilson for contributing their valuable time to the first drafts of this report.

APPENDIX A

INVITATION LETTER AND LISTS OF INVITEES TO AND PARTICIPANTS AT THE SEPTEMBER 10, 1990 ROUNDTABLE DISCUSSION

August 15, 1990

Dear:

As Chairman of the Marine Research Board, I am writing to invite you or your designee to participate in a discussion examining the coastal and marine issues of importance to Maine over the next decade.

The Board was established within the Maine Science and Technology Commission by the 114th Legislature to identify the State of Maine's basic and applied marine research needs within the Gulf of Maine. These needs are to be presented to the Governor and the Legislature in the form of a biennial report by January, 1990.

The Board is implementing a process to define those areas of marine research needs. The first step in this planning process is to identify and examine coastal and marine issues of importance over the next decade, especially those which would benefit from increased research.

You or your designee are invited to join us and other individuals who have a keen interest in Maine's coastal and marine environment (see attached list of invites) to meet on September 10, between 9 a.m. and noon, in the Embassy Room of the Senator Inn, Augusta. I am requesting that you bring to that meeting a one or two page prospectus, which from your point of view, constitute two or three of the most important coastal and marine issues which the State of Maine will have to address over this decade.

The results of this discussion will form the basis of a challenge to representatives of Maine's research community to define a set of biological, physical, social and policy research plans and objectives which generate the knowledge

and information needed to address these issues of importance. The identified research methodologies will be reviewed by the Board before scheduled public hearings in November, as required by law. The report will undergo final review by the Board in December.

I hope you can join us on September 10 and participate in this critical first stage of prioritizing Maine's marine research needs. Please indicate your desire to attend the meeting by contacting Dr. Terry Shehata at 289-3703.

Sincerely,

James Storer
Chairman

Attachment

APPENDIX A (continued)

INVITEES

1. The Honorable Ken Curtis, Maine Maritime Academy.
2. Senator Joseph C. Brannigan and Representative Susan Farnsworth, Co-chairs, Legislative Oil Spill Preparedness Commission.
3. Representative James Reed Coles.
4. Commissioner William Brennan, Department of Marine Resources.
5. Commissioner Edward Meadows, Department of Conservation.
6. Commissioner Lynn Wachtel, Department of Economic and Community Development.
7. Commissioner Dean Marriot, Department of Environmental Protection.
8. Commissioner Dana Conners, Department of Transportation.
9. David Keeley, State Planning Office.
10. Walter Anderson, Director, Maine Geological Survey.
11. Robin Alden, Editor, Commercial Fisheries News.
12. Thomas Urquhart, President, Maine Audobon Society.
13. Don Perkins, Friends of Casco Bay.
14. Everett Brown, Executive Director, Natural Resources Council of Maine.
15. Ed Blakemore, Executive Director, Maine Lobstermen's Association.
16. Richard Clime, President, Maine Aquaculture Association.
17. Jeff Kaelin, Executive Director, Maine Sardine Council.
18. Arthur Odlin, DirectorMaine Fishermen's Cooperative Association.
19. Al Trefry, Maine Harbor Master's Association.
20. James Chandler, Executive Director, Maine Marine Trades Association.
21. Richard Steinbach, Rachel Carson National Wildlife Refuge.
22. Mathew Eddy, Director, Greater Portland Council of Governments.
23. Alison Rieser, Director, Marine Law Institute.
24. Philip Conkling, Island Institute.
25. James Espy, Maine Coast Heritage Trust.
26. Robert Suminsby, The Knowles Company (Realtor).
27. Amy Naylor-Davis, Planner, Town of Brunswick.
28. James Ruhlin, Chairman, Maine Tourism Commission.
29. Professor Jim Wilson, University of Maine.
30. Spencer Apollonio, Biotherm International.
31. Roger Mallar, Mallar Associates.

PARTICIPANTS

1. Commissioner William Brennan, Department of Marine Resources.
2. Walter Anderson, Director, Maine Geological Survey.
3. John Sowles, representing Commissioner Dean Marriot, Department of Environmental Protection.
4. David Keeley, State Planning Office.
5. Ann Hayden, State Planning Office, representing Director Richard Silkman.
6. John Catena, State Planning Office.
7. Jeff Kaelin, Executive Director, Maine Sardine Council.
8. Bill Sutter, Maine Harbor Masters Association.
9. Amy Naylor-Davis, Planner, Town of Brunswick.
10. Dana Wallace, Consultant, Town of Brunswick.
11. James Wilson, Professor of Resource Economics, University of Maine.
12. Robert Wall, Interim Director, Maine Sea Grant College Program.
13. James McCleave, Professor of Zoology, University of Maine.
14. Spencer Apollonio, Biotherm International.
15. Christopher Heinig, Intertide Corporation.
16. Edward Gilfillan, Bowdoin College.
17. James List, Wells National Estuarine Reserve.
18. David Townsend, Bigelow Laboratory for Ocean Sciences.

Staff:

James Storer, Chair, Marine Research Board.
Ronald Dearborn, consultant to the Board.
Terry Shehata, Associate Director, MSTC.
Carol Kurasz, clerk typist, MSTC.
Robert Kidd, Executive Director, MSTC.

APPENDIX B

LIST OF MARINE CONCERNS IDENTIFIED AT THE SEPTEMBER 10, 1990 ROUNDTABLE DISCUSSION

1. Estuarine use & Productivity.
2. Dredging & disposal of spoils.
3. Permits to develop on wetlands.
4. Understanding natural ocean systems, understand the impact of man's use of ocean & coast.
5. Pollution monitoring & effect on marine environmental quality.
6. Balancing environmental issues w/ economics.
7. Can biological knowledge let us capture market opportunity in aquaculture.
8. Access to the coast given developmental pressures.
9. Nutrient loading from upland including stormwater and septic systems.
10. Carrying capacity (broadly) w/ sustainable development.
11. Aquaculture--capitalization & labor issues.
12. Quantifying effects of human activity on the ecology at the ocean.
13. Quantifying of biological responses to pollutants.
14. Health risks of contaminants.
15. Affects in intertidal zone of upstream development, shellfish as indicators.
16. Understanding of natural setting of shellfish areas -healthy-.
17. Preservation of natural areas as a touchstone.
18. Affect on lobster habitat of fish harvesting.
19. Marketing research (lobster).
20. Affect of sea level rise on land use, also erosion issue.
21. Correctly reading public attitudes.
22. Understanding extant environment/ oceanorgraphic processes in determining productivity & critical habitat.
23. Priorities of response to transportation disaster (oil).
24. Research aiding fisheries managers
25. Economic viability of marine resource dependent companies.
26. Coastal governance/ gov't institutions.
27. Alternative disposal vs monitoring impact, avoid stern chase.
28. Revolution of fishing gear to achieve manageable fishery.
29. Understanding how the marine systems works for marine management (ecosystem principals).
30. Who pays for use of submerged lands & state waters.

31. Public education on environmental issues.
32. Population limits.
33. What is adequate mitigation?
34. Marine product quality certification.
35. How does targeted fishing affect structure of ecosystem.
36. Enforcement of existing/new laws, education?
37. Ecosystem issues.
38. Using new/latest technologies in addressing marine issues.
39. Prompt reporting mechanisms public support.
40. Paying full freight for growth.
41. Implications of global warming.
42. Broad environmental issues of water.
43. Marine environmental forecasting of weather and ocean currents.

APPENDIX C

CONSOLIDATED 5 MAJOR ISSUES, RESEARCH THEMES AND QUESTIONS

Presented at the October 17, 1990 Meeting of the Board's Research Priority Statement Planning Subcommittee

A. INTRODUCTION

"An Act to Promote Marine Research", passed by the Maine Legislature in 1989, established a Marine Research Board charged with, among other duties, identifying basic and applied marine scientific research needs within the Gulf of Maine of interest to the State. The Board was further empowered to develop a competitive grants program to address those needs. Under the provisions of the act the MRB shall develop biennially a priority statement and action plan of marine research needs in the State, the first of which shall be submitted to the Governor and Legislature by January, 1990.

The purpose of this report is to lay out the major marine issues facing Maine in the next decade and to interpret from those needs a set of marine research priorities.

Citizen and agency representatives met in Augusta on September 10, 1990 to articulate the coastal and marine issues which will be important to Maine over the next decade. The points raised were dominated by (1) concerns for the impact of activities along the coast and in adjaccent watersheds on water quality, (2) concern for a rational and predictable permitting environment for coastal activity and development, (3) concerns for a healthy environment for fisheries and aquaculture development, and (4) a general interest in identifying the limit of coastal growth beyond which the social costs will exceed any benefits. For all of these issues there was a deep concern for the inadequacy of our present level of scientific understanding of estuarine and marine ecosystems. There was strong support for the initiation of a state marine research program which would lay the foundation of understanding of Maine's coastal and marine environment so that future decisions affecting activity on the Maine coast could be made wisely.

Nearly all of the issues identified are inextricably interrelated and many are connected in some way to each of the others. We have assimilated the various points into 5 major issues, which are discussed in the following sections.

B. Maine's Marine Issues and Related Research Needs

1. BALANCING GROWTH AND DEVELOPMENT WITH ENVIRONMENTAL QUALITY.

Parts of the Maine coast are already heavily used and pressures are expected to increase over the next decade. For many the lifestyle of coastal living is directly tied to its coastal environmental quality. Some coastal industries, such as fishing, aquaculture, and tourism, are directly tied to environmental quality. Other coastal activities may be less dependent on the quality of the marine environment, and therefore are less sensitive to it. Many citizens are also concerned for the economic viability of coastal Maine, however, and recognize the value of wise development. These concerns give rise to a number of important questions, including: Are coastal growth and development and the preservation of environmental quality at odds with one another? How and where can growth be accommodated? The answers to these questions must be based on the recognition that (1) most human activity along the coast impacts to some degree the coast's estuarine and marine environment and (2) in some instances, increased use of the Maine Coast can be accomodated with minimal impact. We must learn enough about the ways in which human activities affect the coastal environment and the Gulf of Maine as a whole to assess cumulative impacts.

Sub-Issue Questions:

1. Does our current socio-economic structure fail to accommodate coastal development in a satisfactory manner? If so, in what ways and how might it be modified? What is meant by 'satisfactory'?
2. In what ways, and to what extent, does coastal development impact the natural environment and our quality of life, both specifically, and cumulatively?
3. How does this impact vary with type of development and location along the coast? How far dos the impact extend from its source?
4. Recognizing the diversity of uses and values of the coastal zone, what might be appropriate land-use/zoning plans to meet this diversity? How important to this are activities and how might they be factored in.
5. In a similar vein, given the diversity of uses on the water, should there be water-use zoning along the coast.

Research Themes and Questions:

1. What are the delivery and flushing rates and ranges, transformations, dispersal, and the mechanisms and rates of sequestering of significant dissolved and particulate material in the coastal marine environment?

2. What is the human carrying capacity of the coastal zone in terms of maintaining our quality of life? What are the significant factors and how might they be usefully quantified? Do we have in place public institutions and/or processes for determining and an enforcing an acceptable trade-off between development and environmental quality? Between all sorts of competing uses of the marine and coastal environment?
3. How can measurements or valuations of these parameters and this carrying capacity be improved? How can they be integrated into long-range planning for coastal land use and balanced against the benefits of economic development?
4. How is the marine environment linked with the coastal and State economy? What is the magnitude of its current value and how can we estimate its future importance?
5. What are the carrying capacities of Maine's coastal marine habitats for commercially and ecologically important species?
6. What are the critical life history and ecological factors which control these carrying capacities and which might be altered through coastal development.
7. What new tools/criteria for detecting stress and determining causes at the ecosystem level would most improve our ability to assess broad anthropogenic impacts on the marine environment.
8. What are the environmental thresholds for development on Maine's beaches and tidal marshes beyond which these systems no longer function naturally?
9. How does degradation of the marine and coastal environment alter the quality and characteristics of life in coastal communities?
10. Are there alternatives to current zoning and land-use procedures?

2. THE WISE GRANTING OF PERMITS

Uncertainty of the type and magnitude of environmental degradation of expanded or new uses of the Maine coast makes it difficult to predict whether an applicant will receive a permit from the State. This uncertainty often inhibits development more than does a particular environmental standard. Maine's coastal residents and their state agencies need a better understanding of how human activity affects the estuarine and marine environment. Without an understanding of how these ecosystems work, society's effect on those systems cannot be quantitatively assessed. Increased knowledge is needed before a predictable environment for growth can be described.

Sub-Issue Questions:

1. How does one proceed with well-controlled yet economically feasible coastal development projects given the current uncertainty and lack of knowledge about site-specific environmental variability?
2. To what extent, and in what ways, could environmental standards be set and clarified to decrease uncertainty and facilitate the permitting process?
3. What are the direct and indirect impacts of specific development projects on the local biota/environment?
4. Do permitting procedures pre-select the applicant pool?
5. How does one control boundary problems on lease sites and infringements on those leaser's rights?
6. What are the bases for current permitting regulations - scientific, political, economic? Are they intermingled with one another? out of date?
7. How can regulations and the decision making based on them maintain currency in the face of new scientific knowledge of changing socio-economic and political realities.
8. Would structural modifications eg a Coastal Commission, help us better deal with coastal development regulation.

Research Themes and Questions:

1. What is the baseline picture of the marine environment and its natural variability against which we must measure/predict anthropogenic impacts?
2. For important marine species what are the critical life history and ecological factors which govern populations and which might be impacted by permitted human activities.
3. Would a multi-disciplinary simulation modeling exercise lead to a refinement of our understanding of the nature and scale of physical, biological and socio-economic interactions in the coastal environment?
4. How can our current understanding of environmental variability best be used in designing effective long-term, site-specific monitoring?
5. What is involved in effectively developing and maintaining long term marine data bases for both site-specific and research/monitoring measurements?
6. To what extent do current permitting procedures bias the applicant pool and how might these procedures be modified to reduce this bias?
7. How and why do general carrying capacities vary from place to place and over time?
8. What are the mechanisms by which pollutants are introduced to, and distributed and altered within the marine environment? What are their direct and indirect effects on marine biota and the ecosystem as a whole?

9. Can the property or use-rights regIme be altered to reduce uncertainty?
10. Are there alternative approaches (e.g. market incentives) to our traditional regulatory approach especially given environmental variability?
11. What new tools/criteria for detecting stress and determining causes at the organismal level would most improve our ability to assess specific anthropogenic impacts at the local level.
12. How can managers and scientists meld insight from the permit applicant pool with research and regulatory strategies and needs?

3. MANAGING A DYNAMIC MARINE ECOSYSTEM

Change is a constant feature of the Maine coast, change from natural environmental processes and changes caused by human activity. Anticipated changes in the coastal environment, either cyclical or long term, may affect coastal use in two ways. First, changes in sea level, water temperatures, and tidal currents, among others, would likely affect coastal productivity, the shape and structure of the coast itself, and its usefulness for certain activities. Second, these natural changes could mask or even magnify the effects of human activity. Neither our present understanding of the ecosystem nor our governance institutions are adequately prepared to ensure wise management of our coastal or marine environment against a backdrop of constant change.

The concept of optimum yield in the MFCMA, and the expectation by planners of the constancy of the shape and features of Maine's coast and adjacent marine environment are inadequate. Each institutionalizes an erroneous concept of constancy. Not only does human activity change, but the nearby marine environment is changing as well. A perceived need to dredge may be caused by an illogical request for development, existing upstream uses, or sea level rise. The political realities will be different depending on the perceived cause, usefulness, and longevity of the decision. Without a sound understanding of the dynamics of the natural systems at work, questions of what should be done and who should pay are not likely to receive satisfactory answers

Sub-Issue Questions:

1. Do our legal and regulatory regimes reflect current scientific knowledge with regard to environmental variability?
2. Given the concept of environmental impact, how can we assess cause and effect with regard to human activities before and after the fact?

3. What is the least significant level of social or natural change and how do we determine that level?
4. Do our management institutions have the ability to respond to unanticipated change or unintended results of policies?

Research Themes and Questions:

1. What life history and ecological factors, combined with environmental variability and change, control populations of important marine species?
2. What can we learn about specific and cumulative impacts, the associated costs, and their assignment from analysing the historical record.
3. What are the important processes and features of the coastal and offshore Gulf of Maine with respect to its natural environmental state? How can we measure/monitor these processes and features to identify change?
4. What are the present rates and scales of environmental change? What are their actual and predicted impacts.
5. What are the natural forcing functions that drive the various large- and small-scale oceanographic processes?
6. How might the rates and scales of these processes and features be altered by human activities?
7. To what extent do our current laws and regulatory procedures presume an unchanging environment and how might they be altered to better manage a continually changing environment? Are these new and better environmental management tools/approaches available?
8. What new tools/criteria for detecting stress, determining causes, and distinguishing between anthropogenic and natural causative changes would be most useful in assessing changes in marine ecosystems and populations.

4. MAINE'S FISHING INDUSTRY.

The standing stock of fish in the Gulf of Maine is different than it once was. Changes caused by the level of fishing activity, the gear used, pollution from shoreside activity, and natural changes (either long term or cyclical) are all likely contributors. If the long term viability of this important industry is to be maintained, or even enhanced, the natural systems at work in the Gulf of Maine and how human activity impacts on those systems must be better understood. With increased public awareness of human influence on the ocean environment has come a concern for the quality of food coming from the ocean. It will be increasingly important to ensure that Maine's fish are among the safest of foods.

Sub-Issue Questions:

1. To what extent is our fisheries management resilient to our lack of knowledge about, or inability to predict change in, the marine environment?
2. How can we create a management and market environment in which wild and cultured fisheries complement one another?
3. What are the costs of our overlapping multi-jurisdictional fisheries management regime?
4. How do we match the variability of the natural environment (and variable fisheries supplies that result) with the demands for high quality, stable and predictable supplies that emanate from the modern food distribution system?
5. How can we best assure that the end product marketed is untainted and of high quality.

Research Themes and Questions:

1. What factors determine recruitment, especially for the species of commercial importance to the State?
2. What are the ecological interactions among harvested and unharvested species?
3. How might we improve our understanding and management of fisheries by taking an ecological approach to population dynamics?
4. How tightly coupled and what are the linkages between physical, chemical, and biological processes and fisheries production?
5. How can pollution alter the trophodynamics of the Gulf of Maine, and thereby affect the level of fisheries production?
6. How are pollution, and nuisance/toxic plankton blooms related to the magnitude and style of fisheries production (both capture and culture)?
7. What are the important processes that govern the populations of newly exploited (under-utilized) species?
8. How can managers and scientists meld insight from the fishing community with research and regulatory strategies and needs.
9. What determines the feasibility and enforceability of fisheries and other environmental regulations? How might we evaluate the usefulness of specific management measures such as quotas, effort reduction, minimum sizes?
10. What new tools/criteria for detecting stress and determining causes at the population level would most improve our ability to assess the impacts of natural and anthropogenic stress on commercially valued species.
11. Can we identify/measure Gulf of Maine resources in terms of (a) reasonable management units, (b) standing stock size, and (c) annual recruitment, sufficiently enough to use them as management tools?

12. Are there long term market and/or population trends that will affect fisheries and aquaculture?
13. What is the relationship of Canada to the long-term regulatory and economic health of Maine fisheries and aquaculture?
14. How does the act of fishing itself impact the environment?

5. CAPTURING NEW OPPORTUNITIES.

Research over recent years has provided new tools and understanding which should enable the residents and businesses of Maine to capture new opportunities: aquaculture, marine biotechnology, remote sensing, numerical modeling, spatial positioning capabilities. Application of state-of-the-art knowledge should enable Maine to capture opportunities in the marketplace, research, development and environmental regulation.

Sub-Issue Questions:

1. What are the emerging technologies and opportunities relevant to our marine enterprise?
2. What are the most cost effective ways to integrate new technologies into research, development and management?
3. What kinds of institutions are required to accomplish efficient technology transfer?
4. Is marine research itself an economic opportunity for the State?
5. Are there other uses for aquaculture techniques such as waste processing and detoxification?
6. Is the aquaculture industry taking full advantage of advances in biotechnology? Should this be facilitated; in what ways and in what areas?

The research theme and question involves anticipating and evaluating new opportunities and determining how best to take advantage of them.

APPENDIX D

COOPERATIVE AGREEMENT

Between

The State of Maine Marine Research Board

and

Association For Research On The Gulf Of Maine (ARGO-Maine)

PREAMBLE

The Marine Research Board was created by the 114th Legislature to identify basic and applied research within the Gulf of Maine relevant to the state's needs and to develop and administer a competitive grants program to address those needs. The Marine Research Board is also charged with the responsibility of fostering cooperation among marine research agencies and institutions to efficiently carry out marine research activities. To effectively implement its mandates, the Marine Research Board requires input from marine scientists in Maine and elsewhere.

In a period of diminishing resources, it is vitally important to maximize existing resources and expertise in marine research. Duplication of existing resources and expertise will not serve the public interest. In Maine, the Association for Research on the Gulf of Maine (ARGO-Maine) is comprised of Maine institutions that conduct or are interested in research in the Gulf of Maine. ARGO-Maine serves as an intellectual center of Maine marine scientists who have worked together for several years in the pursuit of high quality research in the Gulf of Maine, and estuarine and near-shore ecosystems, to increase the knowledge base of the marine environment. For these reasons, the Marine Research Board has determined that a cooperative relationship with ARGO-Maine would be mutually beneficial and would serve the best interest of the State of Maine.

In summary, therefore:

WHEREAS, the Maine Marine Research Board is charged with prioritizing marine research needs relevant to the state;

WHEREAS, the Association for Research on the Gulf of Maine serves the interests of the marine scientific community as an intellectual center for marine science;

WHEREAS, both parties agree that the public is best served when the resources and expertise of organizations are shared to address topics of common interests,

THEREFORE, the Marine Research Board, hereinafter referred to as the Board, and the Association for Research on the Gulf of Maine, hereinafter referred to as ARGO-Maine, this _____ day of _____, 19__, enter into an agreement for the purposes outlined under the terms and conditions specified below. These terms and conditions of shall remain in force and effect until amended or terminated. This agreement shall reviewed and reaffirmed biannually, and may be terminated by the Board or by ARGO-Maine following 30 days written notice.

TERMS AND CONDITIONS

Both parties agree that:

1. ARGO-Maine may serve the Board in a scientific advisory capacity for the identification and prioritization of marine research relevant to the State. As part of its service to the Board, ARGO-Maine should seek the broadest scientific input from the marine research community at large.

2. The Board may seek additional scientific advise from other sources if the Board deems it necessary, and will inform ARGO-Maine of such intentions before taking any action.

3. The Board may request ARGO-Maine to assist in holding conferences.

4. The Board will be responsible for implementation of the peer review process for the competitive grants program and for general educational and extension activities.

5. ARGO-Maine, and any agents and employees of ARGO, in the performance of this agreement, shall act in an independent capacity and not as officers or employees or agents of the Board.

6. ARGO-Maine may seek federal funds independently of the Board.

7. As the state's marine research policy agency, the Board will be responsible for seeking state funding for research in the Gulf of Maine, estuarine and nearshore waters of Maine.

APPROVED AS TO FORM:

MARINE RESEARCH BOARD:

By: James A. Storer Date: April 10, 1991
Authorized Signature

James A. Storer, Ph.D., Chairman, Marine Research Board
Typed Name and Title

ASSOCIATION FOR RESEARCH ON
THE GULF OF MAINE

By: _____ Date: _____
Authorized Signature

Arthur M. Johnson, Chairman, ARGO-Maine Policy Board
Typed Name and Title

APPENDIX E

STATE OF MAINE

IN THE YEAR OF OUR LORD
NINETEEN HUNDRED AND NINETY-ONE

AN ACT to Change the Reporting Date of the Marine Research Board's Biennial Priority Research Statement and Action Plan

Be it enacted by the People of the State of Maine as follows:

Sec 3. 5 MRSA 13128, sub- 1, as enacted by PL 1989, c. 529, 2, and as amended by PL 1990, c. 903, 2, is further amended to read:

1. Research priorities statement. The board shall develop a biennial priority statement and action plan of marine research needs of this State. The Statement must be submitted to the Governor and the Legislature no later than Janaury 1st of each even-numbered odd-numbered year, except that the first statement must be prepared by January 1, 1991. The purpose of the statement and plan is to guide funding recommendations and activities of the board. The board shall hold public hearings to gain insight into research needs for the State.

STATEMENT OF FACT

Current law requires the Marine Research Board to submit to the Governor and the Legislature a biennial priority research statement and action plan no later than January 1st of each even-numbered year, except that the first statement was prepared and submitted in January, 1991. The statement and plan are to guide the Board's funding decisions and activities. The Board believes that the statement and plan should be the basis for its biennial budget request in the Fall prior to the new legislative session and biennium. This bill would, therefore, synchronize the reporting schedule with the budget period by changing the deadline to January 1st of each odd-numbered year.