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United States Interests and Needs in the Coordination of International Oceanographic Research

Ocean Policy Committee
Commission on International Relations
National Research Council

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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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PREFACE

The National Science Foundation (NSF), Division of Ocean Sciences, was concerned that the complex international arrangements that the United States now uses to facilitate and coordinate its international oceanographic research programs are becoming increasingly ineffective and may soon be inadequate to meet our needs in the face of the new legal and political environment emerging from the law of the sea negotiations. Because of this concern, NSF asked that the Ocean Policy Committee (OPC) and the Ocean Sciences Board (OSB) undertake a study (1) to estimate the extent to which facilitation and coordination of the U.S. program of international oceanographic research will be necessary; and (2) to recommend to NSF how such facilitation and coordination should be achieved. The chairmen of the OPC and OSB agreed that the OPC should have the main responsibility for this project and that the OSB would nominate individuals to participate in the study.

The OPC proposed a two-year study that would provide NSF with recommendations on how facilitation and coordination of international oceanographic research could be achieved. The objectives of the study were threefold:

1. To examine the existing ocean regime and the implications of possible changes in that regime for oceanographic research.

2. To examine the future direction of U.S. marine science programs and to assess the extent to which they would be affected by changes in the world ocean regime.

3. To recommend arrangements and procedures to facilitate and coordinate future marine science programs internationally.

To meet the study objectives, the OPC assigned its members and members of the OSB to write working papers on regime changes and their implications and on future directions in the marine sciences. Those papers are the basis for the first nine chapters of this report. Chapters 10 and 11 examine the arrangements needed to facilitate and coordinate future marine science programs.

The report reflects discussions of a workshop held at the Oregon State University Marine Science Center, September 10-12, 1979, in Newport, Oregon. The purpose of the workshop was to allow participants from the marine science community to exchange ideas and offer suggestions regarding projected needs in international cooperation, organizational arrangements and procedures, and the impact of changes in the ocean regime. The immediate objective of the workshop was to review the working papers and the recommendations for coordination of international oceanographic research in which U.S. institutions participate.

The report was written by the following working group: Edward L. Miles (chairman), Lewis Alexander, William T. Burke, John V. Byrne, Ann L. Hollick, Feenan D. Jennings, and Lauriston R. King. Mary Hope Katsouros provided staff support for the working group. It should be noted that Drs. Alexander, Hollick, and Byrne participated in the working group and wrote their sections of the report before accepting positions in the federal government.

EXECUTIVE SUMMARY

BACKGROUND AND OBJECTIVES

This report responds to the National Science Foundation's concern that existing arrangements for carrying out U.S. oceanographic research off the coasts of other countries are complex and are becoming increasingly ineffective. The agency's concern may be summarized in the following propositions:

1. The conduct of U.S. international oceanographic research depends on securing access to wide areas of the ocean and arranging for cooperative activities with oceanographic communities in other countries.
2. The United States has carried out these facilitating and coordinating functions through a variety of international means, including bilateral and multilateral agreements with other governments and participation in intergovernmental scientific organizations.
3. Some of these international arrangements appear to be increasingly ineffective under an ocean regime defined by discussions at the Third United Nations Conference on the Law of the Sea and including, in particular, the claims of extended maritime jurisdiction by coastal countries.
4. These arrangements soon may be inadequate to meet U.S. needs in the new ocean regime as it affects the conduct of marine scientific research.

This report draws upon the results of a workshop convened by the Ocean Policy Committee to consider those issues. The chapters that follow were written, in large part, as working papers for use during the workshop. Several chapters have been revised in light of law of the sea negotiations and other changes since the workshop.

The United States has a large and varied oceanographic research community with coastal as well as distant-water components. These components do not face the same problems nor do they have the same needs concerning international cooperation and access to foreign waters. This report considers primarily the interests and needs of the distant-water research community.

To understand the present arrangements for conducting U.S. oceanographic research in distant waters, it is necessary first to consider the goals of such research. What interests do U.S. oceanographers pursue through international research programs? Why should the United States government be concerned with removing impediments to such research by securing the rights of oceanographers to study in waters under the jurisdiction of other countries? Why must U.S. oceanographic research programs be developed cooperatively with other countries?

The answers to these questions are determined largely by the nature of oceanic phenomena. Large-scale, complex relationships exist between the physical, chemical, biological, geological, and geophysical characteristics of the ocean and between the ocean and the atmosphere. Because many important oceanic processes are global or regional, they cannot be studied or understood fully through research carried out in any single location. Oceanography is primarily a field science dependent upon exploration. As Warren Wooster put it:

> Exploration differs from experimentation. Much of science is dominated by the experimentalists who work on problems of a scale and simplicity that permit confinement within the boundaries of controlled experiments. The experimental approach is powerful and often can give reasonably unequivocal results. In the environmental sciences, on the other hand, scales are greater, at times with the dimensions of the globe, interactions and nonlinearities dominate, and experiments are no longer subject to the investigator's control.
>
> The environmental experiment is conducted by nature, and the scientist can interpret its progress and outcome only by making the right observations at appropriate places and times.[1]

Consequently, international oceanographic research programs require relatively unrestricted access to different areas of the ocean for research. Efficient study of oceanic phenomena requires that U.S. researchers seek substantive cooperation with others in defining the problems to be studied, determining coordinated methods of observation and measurement, establishing a free exchange of data and other information, and encouraging the open publication of research results. However, it is the problem of access that has become the

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[1]Warren S. Wooster. "The Contribution of Exploration to Marine Sciences," lecture presented at the 68th Statutory Meeting of the International Council for the Exploration of the Sea, Copenhagen, 6 October 1980, p.1.

most acute under the conditions imposed under the new ocean regime defined in the Third United Nations Conference on the Law of the Sea.

The means through which to achieve access to non-U.S. waters have been considerably constrained by the opposing interests of coastal states in, among other things, security, control over resources, and information related to resources. The future of international oceanographic research has thereby been affected both directly and indirectly. For example, perceived difficulties in getting access to foreign waters for research could discourage researchers from even proposing some important work. Since most of the world's advanced oceanographic research is done by a relatively few countries, any constraint on research can have an important effect on the sum of oceanographic knowledge.

The goals and interests of the distant-water oceanographic community indicate that the United States will continue to need access to oceans around the globe, even though the new regime has made the conditions for obtaining access more difficult. The United States will also continue to need to seek cooperation with others, given the nature of the world ocean and the major problems to be studied. Therefore this report deals first with the existing ocean regime, discernible changes in that regime, and their implications for international oceanographic research. In this way, the Ocean Policy Committee has attempted an evaluation of existing intergovernmental and nongovernmental arrangements at the global and regional levels. In addition, the assessment includes consideration of more informal bilateral and multilateral arrangements. Chapters 6, 7, and 8 of the report focus attention on the nature of the new ocean regime for marine scientific research as defined by the Draft Convention on the Law of the Sea and by national legislation in a large number of coastal states. Chapter 9 deals with the question: What future directions of marine scientific research are currently discernible, and how are these likely to be affected by changes in the world ocean regime? Finally, chapters 10 and 11 ask, What can we project about future arrangements for international oceanographic research programs?

THE EXISTING OCEAN REGIME AND ITS IMPLICATIONS FOR RESEARCH

Intergovernmental Oceanographic Commission

The Intergovernmental Oceanographic Commission (IOC) is the principal United Nations agency concerned with international oceanographic research. Organized in 1960 by the United Nations Educational, Scientific, and Cultural Organization, the IOC has been an important means for coordinating marine scientific research among its member states, including the United States. The IOC's first major activity was the coordination of the International Indian Ocean Expedition, a large-scale descriptive oceanographic survey involving many ships and many countries. It was considered highly successful. Since the early 1970s, however, nations active in marine research have

viewed the IOC as increasingly ineffective in meeting their needs in international research projects.

In chapter 1 the committee explores this growing dissatisfaction with the IOC, defines U.S. interests in the IOC, and determines the extent to which they may have been hindered by IOC's recent performance.

The committee finds that the most important reasons for the perceived decline in IOC's effectiveness are external to the organization. First, the IOC, like most other United Nations units, became caught up in conflicts between the predominantly developed countries of the Northern Hemisphere and the less developed countries of the Southern Hemisphere. Scientific research and its application are major issues in that conflict. Second, the large-scale descriptive oceanographic survey, such as the International Indian Ocean Expedition and several others organized by the IOC, no longer is a particularly useful method of oceanographic research. More useful are projects conducted on a somewhat smaller scale and directed toward specific oceanographic problems. Such projects generally are arranged through ad hoc means based on personal contacts between scientists in the countries involved rather than through the IOC. These external influences on the IOC have been reinforced by administrative difficulties within the organization.

Mindful of these limitations, the committee believes that the IOC can usefully contribute to future international oceanographic research under the following conditions: (1) in studies of global phenomena, such as links between climatic changes and the oceans; (2) in geographic areas where political conditions limit access for research and preclude more informal ad hoc arrangements; and (3) when a major maritime country may be more likely to provide funds for oceanographic research if such funds allow that country to meet its international commitments through the IOC (see p. 26).

The performance of individual IOC programs has been mixed. The planned involvement of the IOC in the World Climate Studies Program is considered useful because climate studies are global and cannot be pursued except through intergovernmental cooperation. IOC's proposed Ocean Science in Relation to Living Resources Program appears to combine successfully the interests of developed as well as developing countries. However, IOC performance in marine technical assistance, training, and education has been disappointing primarily because of a lack of funds for this purpose.

Despite the varied performance of specific IOC projects and doubt about the organization's overall effectiveness, the committee believes that present world conditions affecting marine research are such that future U.S. interests in the IOC cannot be limited to substantive scientific concerns. Future U.S. interests in the IOC will reflect the political aspects of gaining access to the exclusive economic

zones of other countries to conduct research. Whether the IOC is the most effective means to gain such access, however, must be determined on a case-by-case basis. The United States must recognize that its interests in the IOC probably differ from those of many other member countries and, for that reason, should expect to continue support for certain activities it deems to be of low priority. This may be considered part of the cost of retaining the IOC's more valuable services (see p. 41).

Existing Regional Arrangements for Marine Science

Although efforts to carry out oceanographic research through regional organizations have not generally been successful, the committee believes that advanced maritime countries will increasingly look to regional arrangements particularly as a means of gaining access to foreign waters for research. The committee examines this and other emerging trends in chapter 2, a discussion of present regional organizations associated with international marine research.

The only regional association within the Intergovernmental Oceanographic Commission is IOCARIBE, the IOC Association for the Caribbean and Adjacent Regions. The association was formed in 1976 to oversee IOC activities in the Caribbean and to promote cooperative ventures in marine science. Through its scientific workshops, its contacts with other organizations in the Caribbean, establishment of a regional data center, and other activities, IOCARIBE has increased the interaction among marine scientists and institutions in the region.

However, these accomplishments must be balanced against several problems--primarily delays in the start of projects recommended by the workshops and a lack of financial support from member countries. Although delegates to IOCARIBE workshops can recommend that their governments provide additional funds for research in the Caribbean, many IOCARIBE members, like the United States, may be unwilling or unable to increase their support for that association in view of their existing commitments to the United Nations as a whole.

Other U.N. agencies with present or potential involvement in regional marine science include the United Nations Environment Program, which has supported research on marine pollution, and the Food and Agriculture Organization through its regional fisheries organizations. Several U.N. agencies contribute to regional marine scientific activities indirectly; these agencies include the World Meteorological Organization and the Inter-Governmental Maritime Consultative Organization.

In the committee's view, one of the most effective regional marine science organizations is the International Council for the Exploration of the Sea (ICES), established in 1902. ICES members are predominantly northern European countries but include the United States and Canada.

Although increasing attention has been given to studies of marine pollution, the council's emphasis has been on studies of fishery problems in the North Sea and the Baltic. These studies have been carried out primarily through fishery laboratories rather than through universities or oceanographic institutions. Despite its past emphasis on fishery research, ICES appears to be developing a broader, interdisciplinary program that could lead to cooperative scientific activities of increasing interest to U.S. scientists.

The committee identified a number of potential trends in regional marine science (see pp. 51-52):

1. Regional organizations could increasingly stress applied rather than basic oceanographic research, reflecting the interests of the developing countries that make up the majority of members in the Intergovernmental Oceanographic Commission, for instance.
2. New regions as sites for oceanographic research may be defined geographically or to reflect specific oceanographic phenomena; one example is the Southern Ocean.
3. Advanced maritime countries will seek participation in regional research activities as a way of gaining access to the exclusive economic zones of other countries for research.
4. Expertise in oceanographic research could develop in new regional patterns among the oil-rich countries of the Middle East, for example, or among South American countries whose exclusive economic zones are in the Southwest Atlantic.

Regional arrangements for oceanographic research allow the United States to contribute to the needs of developing countries for applied marine research. Consequently, U.S. interests in regional marine research include fisheries conservation and management, pollution investigation and control, and coastal zone protection and development.

International Nongovernmental Organizations

Chapter 3 discusses the Scientific Committee on Oceanic Research (SCOR), established by the International Council of Scientific Unions in 1957 to further international oceanic research. SCOR was responsible for the planning of the International Indian Ocean Expedition from 1957 until it was transferred to the Intergovernmental Oceanographic Commission in 1962. SCOR activities include international scientific meetings, working groups on specific scientific questions or problems of oceanographic methodology or science policy, and advice to UNESCO and the IOC. Recent SCOR working groups have been concerned with a variety of physical oceanographic studies, relationships between oceanic phenomena and climatic changes, krill and other living resources, and problems of marine pollution.

United States scientists have been active in SCOR working groups, which have been important means for organizing assessments of scientific findings and their public presentation. Although the

widespread extensions of maritime jurisdiction have complicated intergovernmental actions in marine science, organizations such as SCOR probably will have an important role to play in organizing ocean research, particularly until formal arrangements are made through law of the sea negotiations (see pp. 60-61).

Bilateral Agreements in Marine Science Research

Formal agreements specifically concerning the cooperative conduct of marine research by two nations are a relatively recent development. Chapter 4 considers the history of U.S. bilateral agreements in fisheries research and in oceanography and discusses their probable use in the future.

The first U.S. bilateral agreements for marine research grew out of fishing agreements between the United States and Canada in 1958 and provided for cooperative research on fisheries. As the United States and other nations extended the zones in which they exercise control over fishing, the need for information on fish stocks, particularly migratory species, within those zones prompted bilateral agreements for research on fisheries. By the mid-1970s, the United States was involved in nine bilateral agreements concerning research in the eastern North Pacific.

The first U.S. bilateral agreement for research in the Atlantic was concluded with the USSR in 1967. Research carried out under this and other bilateral agreements was often planned and reviewed within the International Commission for the Northwest Atlantic Fisheries (ICNAF), which predated the agreements. The commission served as a useful multilateral means for coordinating these bilateral activities until 1978, when the United States withdrew from ICNAF in accordance with provisions of the Fisheries Conservation and Management Act of 1976 (Public Law 94-265).

Most present bilateral fishery agreements by nations other than the United States appear to be concerned solely with access to fishery zones and related matters. All such U.S. agreements, however, include provisions for research on stocks within the U.S. fishery zone to develop data on which to base decisions on fishery conservation and management. To carry out the provisions of these governing international fishery agreements, or GIFAs, the United States organizes meetings between U.S. scientists and those of nations that are parties to the agreements. These meetings have been considered successful in producing information for use under the Fisheries Conservation and Management Act.

Compared with bilateral fisheries agreements, relatively few bilateral agreements concern oceanographic research. The United States is party to such agreements with France, Japan, and the USSR. The records of accomplishment under these agreements differ. Besides

contributing to certain technical activities, the US-USSR agreement, concluded in 1973, has allowed U.S. scientists to become more familiar with the organization of Soviet science. These accomplishments must be balanced, however, against delays and other difficulties stemming from the centralized and relatively inflexible management of Soviet marine science.

Cooperation between the United States and Japan in marine research began in the early 1960s and has included information exchanges and various other cooperative activities concerned primarily with marine natural resources. However, US-Japanese cooperation in marine science has failed to achieve its potential despite important common interests between the two countries; this failure seems to be due in part to differences in language and culture.

Cooperation between the United States and France in oceanography occurs in many areas, including marine geology and geophysics, control of marine pollution, oceanographic instrumentation, and aquaculture. Annual meetings on US-French cooperation in oceanography have been held since 1972. A distinctive feature of the US-French agreement in oceanography is that it was concluded, and is carried out, between the relevant science agencies in the two governments. The National Oceanic and Atmospheric Administration is the lead agency in the United States; in France, the Centre National pour l'Exploitation des Oceans. The success of this arrangement for oceanographic research seems to indicate that bilateral scientific agreements concluded for high-level political purposes will be most successful when they directly involve scientists and government personnel closest to the scientific work (see pp. 69-70).

International Decade of Ocean Exploration

United States participation in the International Decade of Ocean Exploration (IDOE) was the principal U.S. involvement in international marine science in the 1970s. Chapter 5 is an overview of the U.S. experience in the IDOE and a discussion of ways in which that experience can be applied to future large-scale ocean research.

Before 1969, when the National Science Foundation assumed responsibility for U.S. participation in the IDOE, marine research had been organized primarily according to the major oceanographic disciplines--marine geology and geophysics and biological, chemical, and physical oceanography. The IDOE departed from this trend and established support for large-scale, long-term research involving scientists from many disciplines, institutions, and countries. The program emphasized basic, rather than applied, oceanographic research and was not intended to provide technical assistance to developing countries.

The U.S. experience in the IDOE prompts the following observations on future large-scale oceanographic research programs (see pp. 74-76):

1. Foreign policy objectives should be distinguished from scientific objectives. When science must be used to promote foreign policy goals, policy should be separated from the conduct of research.
2. Federal agencies concerned with oceanography should be able to accommodate the development of an international research project as the basis for political agreements. Sponsoring agencies should be able to make long-term commitments to support cooperative international projects and should be sensitive to the politicial implications of these projects.
3. Professional contacts among scientists are an essential basis for future cooperative research projects. Necessary financial support for those projects includes support not only for the research but also for travel to international scientific meetings.
4. For long-term oceanographic projects of major regional importance, sponsoring agencies, in collaboration with the Department of State, should seek the endorsement of international organizations, such as SCOR, the IOC, or the FAO.
5. Sponsoring agencies should ensure sufficient funds to allow foreign scientists to participate in the conduct, as well as the planning, of international ocean research.
6. Management of international projects for ocean research must be flexible in its encouragement of international participation.
7. Sponsoring agencies should hire specialists who are familiar with the politics, history, and personalities of the international oceanographic community to act as brokers between project leaders, federal agencies, and representatives of foreign governments.

THE CHANGING OCEAN REGIME

Third U.N. Conference on the Law of the Sea and its Implications for Marine Scientific Research

The outcome of the Third United Nations Conference on the Law of the Sea has important implications for the conduct of marine scientific research. Chapter 6 considers a number of possible outcomes of the conference in relation to U.S. research in the oceans.

Several trends in the use of marine resources and in national claims of maritime jurisdiction appear likely during the next decade whether or not a treaty on the law of the sea comes into force during that time (see pp. 77-79). Continued increase in use of the oceans and in exploitation of ocean resources is likely to be accompanied by problems of crowding and pollution. Conflicts over national boundaries in the ocean and over uses of the 200-mile economic zone probably will continue. There will be a need to develop new bilateral and multilateral arrangements for marine research, considering the

probable universal requirement to seek consent to conduct research in the 200-mile zone and on the continental shelf.

The committee believes that coastal nations will become increasingly aware that successful management of the living resources in their 200-mile zones requires that they take account of adjacent ocean areas that are part of the same ecosystem. But regardless of the efforts of any single coastal nation toward the conservation or the exploitation of its resources or the protection of its marine environment, certain activities of neighboring coastal states will be destructive of those efforts. This situation seems likely to result either in regional management of ocean resources, particularly in enclosed seas, or in expanded jurisdictional claims by coastal states. However, any international approach to the management of ocean resources probably will be undertaken only after national efforts have failed. For this reason, the committee believes that many local or regional instances of marine pollution or navigation accidents are likely to become quite severe before cooperative international measures are taken (see p. 79).

The committee identified a number of possible adverse effects on U.S. marine scientific research in the event that the United States fails to sign and ratify a law of the sea treaty. Clearances for U.S. research vessels to enter foreign economic zones could be withheld. Coastal states could place stricter conditions on marine research than now are foreseen under a law of the sea treaty. National boundaries in the ocean could be extended.

If, however, the United States ratifies a treaty on the law of the sea but too few additional ratifications are received to enact the treaty, the implications for U.S. marine research would depend critically on which nations supported the treaty and which did not. The committee believes that the nations that supported the treaty probably would choose in any event to observe certain widely accepted rules for use of the oceans. The most difficult outcome for marine research would be that in which the major coastal nations fail to ratify a law of the sea treaty (see p. 80).

The Draft Convention on the Law of the Sea: A New Regime for Marine Scientific Research

The system of conduct for marine scientific research under the Draft Convention on the Law of the Sea provides extensive benefits and protections for the coastal state. Article 246 of the Draft Convention grants coastal states the right to "regulate, authorize and conduct" marine research in their 200-mile economic zone and on their continental shelf and provides that within those areas all research "shall be conducted with the consent of the coastal State." Chapter 7 discusses the most restrictive provisions of the new regime for marine scientific research as defined in the Draft Convention.

Although the research regime largely favors the coastal state, two important protections are granted to the nations conducting research (see pp. 81-82). Those protections are (1) that coastal states shall "in normal circumstances" grant consent to conduct research and (2) that on the continental shelf beyond 200 miles, coastal-state control over research shall not apply except in publicly designated areas in which resource exploitation or exploration are occurring or soon will occur.

Article 249 of the Draft Convention imposes a set of obligations on nations seeking to conduct marine research in foreign waters. These requirements extend the amount of time necessary to plan a research project and will increase the costs of research. Article 249 also allows coastal states to impose restraints on publication of the results of research bearing on the exploration for, and exploitation of, natural resources in waters under their jurisdiction.

Under certain conditions specified in Article 252 of the Draft Convention, a nation wishing to conduct research has the implied consent of the coastal nation. However, these conditions include two important disadvantages for the nations seeking to conduct research. First, they allow a coastal state considerable opportunity to delay the granting of consent if, for example, it does not wish to deny consent outright. Second, the conditions provide that unfulfilled obligations against one research institution may be used by a coastal nation as the cause to deny consent and suspend research projects of other instutitions from the same country.

Marine scientific research farther than 200 miles from shore and in the international seabed remains relatively unregulated under provisions of the Draft Convention. However, some coastal nations are taking unilateral actions through national legislation affecting marine research, and these actions must be considered alongside the outcome of negotiations on a law of the sea treaty.

Trends in National Legislation Affecting Marine Scientific Research

In the absence of a law of the sea treaty, many coastal nations have, through national legislation, extended their jurisdiction over marine research conducted within 200 miles of their shores. Eighty-eight of the world's 135 coastal nations as of February 1981 claim jurisdiction over a 200-mile zone. Not all of those states, however, explicitly claim control over marine research; the 200-mile zones are variously designated territorial seas, fisheries zones, and economic zones.

The committee estimates that of the 88 nations claiming jurisdiction over 200-mile zones, at least 69 nations claim jurisdiction over marine research. Of those 69 nations, 41 have enacted laws or issued decrees claiming jurisdiction over marine

research conducted within their 200-mile zones. Nine nations claim 200-mile territorial seas and, considering the exclusive jurisdiction implied within territorial seas, may be expected to exercise at least some control over marine research. The remaining 19 nations claim jurisdiction over activities related to fisheries and other natural resources within their 200-mile zones and may be expected to claim jurisdiction over research related to those resources.

The United States claims jurisdiction over fisheries within a 200-mile zone but is the only nation explicitly to exclude scientific research from its jurisdiction.

Chapter 8 summarizes coastal nations' jurisdictional claims affecting marine research. It discusses specific examples of national legislation or regulation affecting marine research, comparing them with provisions of the Draft Convention on the Law of the Sea.

FUTURE DIRECTIONS IN MARINE SCIENTIFIC RESEARCH

Present understanding of the seafloor and of the ocean and its interaction with the atmosphere has resulted largely from unrestricted scientific inquiry. Enactment of the Continental Shelf Convention in the late 1950s was one of the first major constraints on the freedom to conduct marine scientific research anywhere outside the territorial seas. The negotiations at the Third U.N. Conference on the Law of the Sea are only one indicator of the trend toward relatively extensive constraints on future scientific research in the oceans.

Chapter 9 provides a foundation for assessment of the effects that these limitations will have on ocean science. The chapter discusses areas of the most promising inquiry and most likely advances in various ocean science disciplines. These predictions of the future directions of ocean science are based on five reports published in the late 1970s in response to the needs of federal agencies for long-term planning (see pp. 94-95).

This review indicates that future efforts in marine science are likely to include increasingly interdisciplinary studies conducted by teams of scientists using increasingly sophisticated equipment. Research activities seem likely to include increased study in the southern and the equatorial oceans and possibly the Arctic Ocean and increased drilling on both the active and the passive continental margins (see p. 103).

The extension of coastal state jurisdiction will be an important influence on these activities. Research in polar and equatorial waters is most likely to encounter difficulty where those waters occur within coastal nations' exclusive economic zones. Much continental margin research can be conducted on the margins off U.S. coasts. However, such research conducted elsewhere is likely to be constrained

by a desire of most coastal nations to control the waters over their continental margins. All types of ocean research will be affected by extended jurisdiction, but biological, geological, and geophysical studies are likely to be most severely affected because of their possible relation to the exploitation of fisheries and to mining.

Among other important constraints on future oceanographic research will be its increasing cost. Although inflation is a major factor in the rising cost of doing research, other factors include the need for complex equipment and the high costs inherent in certain activities, such as deep-sea drilling. Additional costs result from the marine technical assistance activities undertaken by researching nations often to gain access to the exclusive economic zones of coastal nations. In this way, technical assistance may become part of the price of doing research in foreign waters.

PROJECTED ARRANGEMENTS TO FACILITATE AND COORDINATE INTERNATIONAL OCEANOGRAPHIC RESEARCH

National Arrangements

Chapter 10 explores the new costs of conducting marine scientific research under the Draft Convention on the Law of the Sea and discusses steps that U.S. research organizations and governmental agencies can take to remove the obstacles to research in foreign waters.

The conduct of marine scientific research under the Draft Convention will involve a number of new costs, the most visible of which are financial. These include (1) costs associated with the participation of scientists from coastal states in research projects; (2) costs of ship operations related to the foreign participants; and (3) costs of technical assistance and cooperation. There are also less tangible costs, such as the cost of missed opportunities for research if funds are diverted from certain projects to meet expenses for others. Although all of these additional costs will fall first on the research institutions, they will pass to U.S. taxpayers unless arrangements are made to share the costs with foreign governments.

The committee sees two possible ways to deal with the added costs of marine research. First, the present level of funding for research might be maintained by reducing the amount of research conducted and using the remaining funds to cover costs of foreign participation, new requirements for sharing data, and so forth. Second, the present level of research could be maintained through increased funding to cover the new costs of doing that research. The committee suggests that, in general, the U.S. and foreign governments arrange to meet the new costs of marine research while maintaining or expanding the present level of research (see p. 110).

The Draft Convention on the Law of the Sea imposes two main types of requirements on nations seeking to conduct marine research in foreign waters: (1) requirements to provide information, and (2) requirements to comply with formal procedures to obtain clearances to conduct research. The U.S. Department of State will have important responsibilities in meeting these requirements. In providing the information required by coastal nations, the Department of State will need the assistance of the National Science Foundation and the University National Oceanographic Laboratory System (UNOLS). UNOLS could also develop contacts with foreign scientists who support official U.S. efforts to negotiate access to conduct research (see p. 112).

Other tasks of the Department of State will include (1) consolidating requests for research to be conducted in certain areas at certain times; (2) negotiating standing clearances for UNOLS ships in areas where research is conducted frequently; and (3) developing cooperative research programs through international organizations.

Besides imposing new requirements on U.S. governmental agencies, the Draft Convention and related trends affecting marine science have imposed on oceanographers themselves a need for new methods of operation. The committee proposes two U.S. research organizations--UNOLS and the Joint Oceanographic Institution (JOI), Inc.--to help in this regard. Because the Draft Convention places obligations on the researching state rather than on individual research institutions, each institution bears a responsibility to the others in complying with those obligations. Although the Department of State will be expected to document the fulfillment of obligations by research institutions before, during, and after research cruises, UNOLS institutions could assist officials in monitoring compliance with research obligations.

The oceanographic community must increasingly be able to negotiate informal arrangements for research in foreign waters. Although the Draft Convention permits such arrangements, they will require, among other things, a new level of cooperation between distant-water and coastal research institutions in the United States. Many developing coastal states need assistance in coastal and applied-science problems best addressed by coastal, rather than distant-water, research institutions. The committee believes that JOI, Inc., is an appropriate organization for the negotiation of informal arrangements for research especially in areas, such as the Caribbean, where there is a continuing demand for access to conduct research (see pp. 113-114).

International Arrangements

International arrangements for managing oceanographic research programs may be either intergovernmental or nongovernmental and operate at several levels: global, regional, multilateral, and bilateral. In chapter 11, the committee discusses the conditions that

determine which of these approaches is most appropriate for establishing cooperative programs in marine scientific research.

Global

The Scientific Committee on Oceanic Research (SCOR) is the primary nongovernmental means of promoting regular but informal contacts among marine scientists. The committee believes that SCOR can appropriately continue to carry out its usual functions under the changing regime for ocean research, except that SCOR will not be called upon to develop large-scale field experiments (see p. 115).

As the principal intergovernmental organization for arranging international marine research, the Intergovernmental Oceanographic Commission (IOC) is most appropriately used when the research concerns a global scientific problem, when more informal arrangements are not feasible, or when a nation's funding procedures allow the commitment of funds for marine research more readily if the IOC is seen to be the sponsor.

Regional

Arrangements at the regional level are predominantly intergovernmental. They include (1) the International Council for the Exploration of the Sea, an organization of advanced nations interested in pursuing applied research related to resources and marine pollution; (2) United Nations organizations operating regional programs that address mainly the interests of developing countries; and (3) limited arrangements among advanced and developing countries to promote the exchange of marine technical assistance for access to exclusive economic zones to conduct research. This last type of arrangement will become increasingly desirable under the new regime for ocean research (see pp. 117-118).

Multilateral (nonregional)

Both nongovernmental and intergovernmental multilateral arrangements for research can occur when (1) scientists from advanced maritime countries agree on a large-scale oceanographic problem to be addressed through basic research; (2) governments will support the planning and execution of the research; and (3) the research agenda can be insulated from political conflicts (see p. 118).

Bilateral

Many formal bilateral agreements between the United States and other developed nations have arisen for reasons not directly related

to research. However, the most efficient bilateral arrangements for marine scientific reseach are relatively informal and grow out of personal contacts between scientists. Although the negotiations at the U.N. Conference on the Law of the Sea coincide with a trend toward more formal arrangements for marine research, the committee believes that formal bilateral agreements should be sought mainly in areas where there is a continuing demand for access to conduct research (see (p. 119).

Because of the increasing costs of marine research, the choice of cooperative arrangement for a particular research project or program must be made on a case-by-case basis.

KEY RECOMMENDATIONS

- The United States should maintain a deliberately flexible attitude toward the range of existing and possible mechanisms for coordinating international oceanographic research (see chapters 5 and 11).
- The United States should create a separate funding mechanism to support the participation by scientists from developing countries in marine research projects (see chapter 10).
- To alleviate the intensity of North/South confrontation over issues of ocean use, the United States should (1) assist the IOC to design and carry out research in which developing as well as developed nations can participate; and (2) increase its contributions to the IOC's Voluntary Assistance Program (see chapter 1).
- The United States should seek to participate in regional programs of major scientific interest only; where participation serves primarily unrelated foreign policy objectives, the scientific program is likely to suffer (see chapters 2 and 11).
- Bilateral agreements for research should be as informal and as flexible as possible to improve on or interpret regulations applied under the Draft Convention on the Law of the Sea (see chapter 11).
- The scientific community should be given the opportunity to review the obligations under a bilateral agreement before it is formally negotiated (see chapter 4).
- The University National Oceanographic Laboratory System should serve as the academic community's tool to develop a monitoring procedure to ensure that research institutions meet their obligations under research agreements (see chapter 10).

CONCLUSIONS AND RECOMMENDATIONS

It is clear that even with the changes introduced by the new ocean regime, U.S. objectives for understanding natural processes within the ocean and for improving U.S. capabilities to observe and predict conditions in the atmosphere and the oceans require continued U.S. involvement in cooperative international oceanographic research projects. Some of the mechanisms that exist for coordinating such research, have declined in effectiveness for a variety of reasons. Others were never effective, while yet others have retained their effectiveness and remain highly desirable. The United States should therefore maintain a deliberately flexible attitude toward the range of existing and possible mechanisms for coordinating international oceanographic research.

To the extent that changes in the world ocean regime, fed by increases in the intensity of the North/South confrontation, are responsible for declines in effectiveness of existing mechanisms, U.S. distant-water oceanographers have to realize that cooperative research projects cannot serve only as a device for gaining access to waters under the coastal state's jurisdiction. Cooperative research projects must include planning for science development in developing countries and the interests of the latter must be adequately identified and served. This requirement implies that scientists from developing countries must have opportunities to engage in joint planning over longer periods. It also implies the need for U.S. distant-water oceanographers to engage in longer range, more systematic planning of research cruises. These changes will add significantly to the costs of doing marine research.

Developing countries need to focus on creation and expansion of the infrastructure for marine science and technology and on identifying their own needs and priorities. In this effort, they can and should be assisted by advanced maritime countries. At the same time, developing countries must be willing to make a sustained national commitment, including funds, for work in the ocean.

Since U.S. funds will be required to support participation by developing country scientists before, during, and after a project, a

separate funding mechanism should be created to provide a special appropriation for NSF to serve these needs. It might be desirable to specify a ceiling on the amount of money that could be allocated to a project for this purpose and it will be necessary to ensure that money is granted only for projects to which the developing country has made or is willing to make demonstrable commitments of support. The United States must also recognize that one of its major ocean-related objectives should be to alleviate North/South confrontation over issues of ocean use. This can be accomplished through efforts to expand the marine scientific research capabilities of developing countries.

On the other hand, changes in the world ocean regime do not adversely affect all existing mechanisms for coordinating the international oceanographic research in which U.S. distant-water oceanographers need to participate.

When the problem to be investigated is not global, and when the other participants in the project have significant research capabilities, either the problem-oriented multilateral or bilateral mode is preferable. These alternatives allow the greatest flexibility and promote effective scientist-to-scientist working relationships. However, under the problem-oriented multilateral or nonregional mode, care should be taken to insulate these activities from unrelated foreign policy interests of the United States.

Formal global and regional mechanisms should be used only when the problem to be investigated is fully global in scope, or when significant numbers of developing countries are involved, or where existing political conflicts make other alternatives infeasible. In this connection, the IOC, as the major global intergovernmental organization concerned with marine science, needs to develop a program that serves the mutual interests of both developed and developing countries in projects that call for the collaboration of several governments. In seeking to alleviate North/South confrontation over issues of ocean use, the United States should (1) assist the IOC to design and carry out research in which both developed and developing countries can actively participate; and (2) increase its contributions to the IOC's Voluntary Assistance Program.

Given the conditions under which the IOC mechanism is necessary and given current U.S. international oceanographic interests, the IOC is most important for facilitating the coordination of the following programs: Projects ERFEN, CINCWIO, WESTPAC and IOCARIBE, the World Climate Studies Program, Ocean Science in Relation to Living Resources, IODE, ITSU, and IGOSS. On the other hand, it must be admitted that major improvements are necessary in the capabilities and performance of IGOSS. Moreover, the United States should also expect to contribute resources to some activities it considers of lower priority in the interest of improving the overall utility of the organization.

Regional organizations abound through regionalization of programs established by global organizations or as a result of purely regional initiatives. However, the United States should choose carefully which regional programs and locations are of major scientific interest and seek to participate only in those. Where participation serves primarily unrelated foreign policy objectives, the scientific program is likely to suffer.

Moreover, given the effects of the changing ocean regime and the effects of inflation on the distant-water U.S. oceanographic fleet, regional programs of major scientific interest will have to be carefully structured and monitored, and corrective actions must be taken before the mandated formal review. Regional mechanisms can be useful for increasing contacts among government scientists and between research institutions in the region. For such regional programs to succeed, they must provide, and be seen to provide, a fair exchange between the interests of developed and developing countries. Success also requires a fair measure of national commitment and support from the developing countries themselves.

Bilateral arrangements between governments for the conduct of scientific affairs have long been regarded as a favorable type of activity, but discussion at Newport during the workshop raised a concern that the costs associated with such arrangements might be prohibitive; consequently, negotiations for bilateral agreements should be entered into with due care. For the purposes of the meeting, bilateral agreements were defined as government-to-government arrangements ranging from formal treaties to informal discussions. Although some consideration was given to scientist-to-scientist arrangements, the discussion centered primarily on formal government-to-government agreements. It was recognized that even under the umbrella of government-to-government arrangements, bilateral agreements could operate at various levels of government; for example, between institutions or government agencies.

The purpose of bilateral agreements is to improve the ability of oceanographers to conduct good science in the waters adjacent to coastal states. The primary motivation for a bilateral agreement should be to promote mutually beneficial scientific cooperation. It is to be hoped that, through bilateral agreements, access to the waters claimed by foreign nations would be provided, clearance procedures would be improved, and the conditions of such cooperative programs would be clearly spelled out. The obligations for both parties of the bilateral agreement would be included in a clear statement prior to the conduct of any research.

The present impetus for bilateral agreements seems to derive primarily from the consent/obligation regime being formalized in negotiations at the United Nations Conference on the Law of the Sea. Therefore, any future bilateral agreement should be as flexible and as informal as possible; the simpler, the better. Every attempt

should be made to minimize the level of red tape; bilateral agreements should improve the conditions of the Draft Convention or at least clarify them. From a tactical point of view, the agreement might be used by certain parties to interpret regulations applied by the Draft Convention.

Bilateral agreements should provide for scientific cooperation. They should include a timetable for conditions to be met, recognizing that different timetables may be needed for different types of research. A bilateral agreement should also allow for operational flexibility, set standards of scientific operation, and above all, introduce an element of predictability with respect to political actions concerning the arrangement for science.

To be successful, the bilateral agreement must provide benefits to both participating countries. These benefits most likely will not be the same for both parties, but they should be divided equitably, for example, between marine technical assistance on the one hand and scientific research on the other. A further benefit of a bilateral agreement is that it could lead to additional cooperative ventures, which will enhance scientific cooperation between the countries involved.

The initiation of bilateral agreements must take place formally through one federal agency. Presumably, the Department of State will serve as the focal point for the development of bilateral agreements. Other federal agencies may wish to initiate arrangements, but such initiation should take place in consultation with the Department of State. The scientific community should have the opportunity to review the conditions (obligations) of bilateral agreements before they are formally negotiated with other countries. Further, the appropriate U.S. federal agency should be in consultation with the oceanographic community during the formulation and negotiation of bilateral agreements. At the time of the initiation of this activity, careful assessment should be made to determine how much the U.S. scientific community is willing to "pay" to complete the bargain with the other nation.

Both partners in a bilateral agreement must complete stated obligations of the agreement, and this may result in additional bureaucracy, at least in the United States. The diversity of oceanographic operators in the United States requires that some type of coordinating mechanism be created to ensure that each operator successfully fulfills the obligations of the bilateral agreement. Most coastal developing nations will not recognize individual agencies or institutions within the United States, but only the flag of the United States. Consequently, it will be essential to set up some type of national arrangement to ensure an orderly and successful completion of the conditions of bilateral agreements.

For the academic community, it is generally agreed that some type of new mechanism is needed to ensure compliance by all of the various oceanographic institutions engaged in foreign research. The scientific community believes that it will be better for the community itself to monitor this activity than to delegate its responsibility to a federal agency. Inasmuch as the hour is late for initiating such a monitoring activity, the community should address this problem immediately. It is recommended that the University National Oceanographic Laboratory System (UNOLS) serve as the academic community's tool to develop a monitoring procedure to assure that obligations are met. This is not a new recommendation but one that was made at a workshop convened jointly by UNOLS and the Ocean Policy Committee in January 1978. UNOLS should review and implement the recommendations stated in the proceedings* of that workshop. Specific mechanisms by which such a monitoring activity could be carried out by UNOLS were discussed.

In addition, the federal agencies operating in foreign waters are also obliged to meet the stated obligations of bilateral agreements. It is recommended that representatives of the operating agencies meet in the near future to organize auditing procedures for these post-cruise obligations.

Renewal of existing bilateral agreements should be based on a review that involves the scientific community. Before a bilateral agreement is terminated, modified, or extended, an intensive assessment of the costs and the benefits of the agreement and its scientific achievements should be made.

It is clear that the enactment of bilateral agreements will involve an increase in costs not only to establish new bureaucratic monitoring schemes but also to support the marine technical assistance that in all likelihood will accompany bilateral agreements. Recognition of these added costs must take place in the agencies that are responsible for funding marine scientific research. To be successful, any marine bilateral agreement must have the support of the scientific community and, consequently, must involve the scientific community in all phases of the initiation, conduct, and termination of the agreement.

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*Proceedings of a Workshop on Procedures for Marine Scientific Activities in a Changing Environment, January 9-11, 1978. Ocean Policy Committee, Commission on International Relations, National Research Council (Washington, D.C.: National Academy of Sciences, 1978).

CHAPTER 1

AN EVALUATION OF THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

This chapter seeks to answer the following questions:

1. Is the Intergovernmental Oceanographic Commission (IOC), as the sole global intergovernmental organization with responsibility for marine science, becoming less effective in coordinating and facilitating international oceanographic research?

2. If so, what dynamics explain this deterioration in the IOC's performance?

3. To what extent is U.S. oceanographic research adversely affected by a decline in IOC performance?

4. Given the requirements of conducting oceanographic research programs in the new ocean regime, what changes are necessary to make the IOC a more efficient instrument for performing its assigned tasks?

ON THE DECLINE IN IOC PERFORMANCE

Since the early 1970s major maritime countries, especially those with significant oceanographic research capabilities, have looked upon the IOC as having deteriorated steadily in performance and in relevance to their concerns. The first seven to eight years of the organization's existence, after its creation in 1960-61, were taken up with coordinating the International Indian Ocean Expedition and then six other large-scale, multiship, multination descriptive oceanographic surveys. These, in fact, represented the programmatic reason for the organization's existence.

In addition to coordinating and facilitating the conduct of international oceanographic research, the IOC also embarked upon a program to provide scientific services to its constituencies, and two of these have been significant successes: the Tsunami Warning System for the Pacific (ITSU) and the International Oceanographic Data Exchange (IODE).

For the first decade of the IOC's existence, there was a relatively good fit between the organization's program, the interests of the small number of nation-states that were members of the IOC, and the interests of oceanographers from major maritime countries, as these were organized in the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU).

However, it is important to realize that the IOC activities never accounted for the major portion of national oceanographic research programs in the advanced oceanographic countries. The IOC was instead the intergovernmental mechanism created as a result of lobbying by scientists within SCOR and by their national governmental allies who wished to increase budgetary allocations for oceanographic research in order to expand their studies of the relationships between the flora and fauna of the deep ocean and the dynamics of the upper water layers. Moreover, such an expansion would facilitate the study of the region below the thermocline down to the deep seafloor, including the floor itself.

It is this concern that explains the proposal by SCOR in its constitutive meeting at Woods Hole in 1957 to create the International Indian Ocean Expedition (IIOE). The Indian Ocean was chosen because it was the area about which the least was known at the time. The organizational model adopted for the IIOE, and later followed in all cooperative investigations, was a loosely coordinated, multination, multiship expedition. Once SCOR had created and begun to implement the expedition, it soon became clear that the scope of the undertaking far surpassed the resources then available to the working scientists and that government commitment and support were absolutely necessary. Governments in 1959-61 were receptive to the idea of creating the IOC for a variety of reasons, including the perception that advances in oceanography are clearly linked both to national security and to the supply of natural resources.

It is possible to argue from hindsight that two conceptual errors were made by those individuals responsible for creating the IOC. First, membership was limited to those countries active in oceanographic research. The IOC then became, and later was seen by developing countries to be, an exclusive club of the advanced maritime countries. This perception generated a considerable amount of hostility toward the IOC in the U.N. Seabed Committee and the early years of the Third United Nations Conference on the Law of the Sea (UNCLOS III). Second, the programmatic focus was too narrowly confined to large-scale multiship, multination descriptive oceanographic surveys. The utility of this approach was relatively short-lived and the directions in which oceanography advanced, in addition to the emergence of ad hoc organizational alternatives perceived as being more useful than the IOC, precipitated a decline in interest in the IOC on the part of countries with advanced oceanographic research capabilities.

By the late 1970s, the organization was in a great deal of trouble. Its traditional constituencies complained that it had become irrelevant to marine science and an unproductive debating society. In the meantime, the organization's membership had expanded rapidly to include a large number of developing countries. IOC's membership had grown from forty in 1961 to seventy-two in 1971 and ninety-three in 1978. The new group of member states also complained that the IOC had traditionally been a club of the major maritime countries; that membership had been restricted to those doing oceanographic research; and that so far the IOC had not been given the resources to be of great benefit to developing countries.

This North/South cast to the conflict in the IOC began in the late 1960s and rapidly expanded after 1970. The organization responded by attempting unsuccessfully to modernize its structure between 1971 and 1973 and, once again, in 1978/79, the IOC created a Working Group on the Future Role and Functions of the Commission, which was charged with studying the problem and making recommendations.[1]

The reasons for the perceived decline in IOC's performance are quite clear. The most important ones are external to the organization and these were reinforced by difficult internal administrative and organizational problems as well. In the first place, the IOC, being a unit within the U.N. system, reflects political changes that occur in the structure of the international system as a whole. This is inescapable. No member of the U.N. family can be completely insulated from these larger changes.

In the late 1960s and early 1970s, the global system was shifting from one in which the East/West confrontation predominated in all global intergovernmental organizations to one in which the North/South confrontation predominates. This conflict is particularly intense in all organizations in which knowledge production and utilization is a major concern. That the IOC reflected this development almost from its beginning (say 1966) is coincident with the increase in importance of ocean issues, conveniently represented by the debate on and passage of General Assembly Resolution 2172 (XXI) on the Resources of the Sea in 1966. The year after this, Ambassador Arvid Pardo of Malta made his famous speech before the U.N. General Assembly, proposing that the mineral resources of the deep seabed be designated "the common heritage of mankind" and used for the benefit of mankind. In 1968 the General Assembly established the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction (Sea-Bed Committee), and the process that led to the convening of the Third U.N. Conference on the Law of the Sea in 1973 was begun.

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[1] See William L. Sullivan. "Constituting the IOC as a More Autonomous or Independent Body," Marine Policy, October 1980, pp. 290-308.

Before 1974, when the first substantive session of the Third United Nations Conference on the Law of the Sea was held in Caracas, as countries developed their positions on the issues, some countries, in particular those in Latin America, made use of all U.N. organizations involved with the oceans. This was especially important after 1971/72 when a possible basis of accommodation between the Latin American and African groups emerged on the concept of the Patrimonial Sea/Economic Zone. The IOC could not have escaped this infection for two reasons: (1) contrary to the codification conferences of 1930, 1958, and 1960, science per se was a major contentious issue between the potential North and South coalitions; and (2) jurisdiction over scientific research in the economic zone was important in comprehensively expanding the jurisdiction of the coastal state. In fact, one proposed IOC program concerning Ocean Data Acquisition Systems (ODAS) ran aground rather quickly for these reasons and others concerning national security.

As the North/South conflict increased in salience, and with it the Law of the Sea issue, the composition of delegations to IOC meetings changed rapidly. More diplomats and lawyers began to attend IOC meetings and this tended to create two sets of competing communication systems both within and across delegations. Lawyers and diplomats tended to respond to the expectations of conducting business in an intergovernmental setting; the consequence was heavy emphasis on structural problems. Scientists, in turn, became increasingly restive and resentful because more and more of the debate did not focus on substantive and organizational problems of actually doing science. This development added to the discontent of scientists who claimed that little worthwhile business was now transacted in the IOC and that more and more time was taken up by symbolic political problems.

It was particularly unfortunate for the IOC that the second major external cause of the perceived decline in the quality of its performance was coincident with, though unrelated to, the first. This cause is a shift in the nature of large-scale oceanographic research as a field science. As noted above, the success of the IIOE, proliferated six other large-scale surveys. The performance here was in fact quite mixed; after the late 1960s and early 1970s many oceanographers were arguing that there was little utility in continuing this mode of research, since it was unlikely to produce major advances in knowledge of ocean variability.[2] The growing trend after this time was a succession of attacks on problem-oriented, mesoscale research projects like MODE, POLYMODE, FAMOUS, BOMEX, and GATE, and some of longer duration like JOIDES.

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[2]Warren S. Wooster. "International Cooperation in Marine Science," Ocean Yearbook 2 (Chicago and London: University of Chicago Press, 1980), pp. 123-136.]

These projects were effective because they offered promise of major theoretical advances in oceanography; they combined government commitment with scientist-to-scientist contact for planning programs of high priority and mutual interest on a relatively informal and restricted arena; and very few extraneous issues affected their work, since only the major players were involved. On the other hand, this trend was competitive with the IOC, because these scientists turned to ad hoc mechanisms for coordinating the research.

Given the IOC's unsuccessful experience with the Long-Term and Expanded Program of Oceanic Research (LEPOR), the IOC role in marine scientific research now seems limited to certain conditions. Thus, the IOC can be an effective mechanism for coordinating research where:

1. The scientific problem to be investigated is clearly a global problem, as in the case of climatic changes and the ocean.
2. Political problems make access difficult and the ad hoc mode infeasible, e.g., Project CINCWIO and Project ERFEN.
3. Internal funding problems in a major maritime country allow new funds to be committed to marine scientific research more easily if the request can be presented in the form of living up to that country's international commitments, e.g., the U.S. allocations for the IDOE or the USSR allocations for the Cooperative Study of the Kuroshio and, more recently, Project WESTPAC.

LEPOR was intended to be the accelerated phase of the International Decade of Ocean Exploration, a U.S. initiated-project. The IDOE was in fact an attempt to respond to the changing nature of oceanography. It led to major innovations and advances nationally in the United States but was never more than a paper exercise in the IOC. Therefore, LEPOR remained a shopping list and never became a successful program. The reluctance of other advanced maritime countries to see LEPOR/IDOE as anything more than a U.S. program underscores the difficulties, if not the futility, of large-scale scientific planning that is not directed toward clearly defined scientific goals that are also responsive to national needs.

Interests and resources vary greatly among scientists within and between nations. Since it is really the choices of individual scientists that explain scientific advance, there is considerable reluctance among scientists to make commitments to long-term, large-scale, centrally directed plans. Broadly defined research programs are therefore not usually implemented in a comprehensive, systematic manner. Moreover, a major implementation problem arises out of the differences in the planning schedules of governments. Most government agencies cannot commit themselves five years in advance. Many can plan only one year in advance with respect to committees' real financial resources. Furthermore, national programs tend to be fixed so that research institutions do not have much flexibility for the commitment of resources to new programs, especially if they see those programs as reflecting the priorities primarily of others.

The most that could have been expected for LEPOR as a result, therefore, was that from time to time various countries would choose items that interested their working scientists and the existence of a presumed governmental commitment to this program could be used effectively at the national level in securing additional resources to do the job. This occurred to some extent, but much more significant collaboration occurred outside the IOC among the advanced maritime countries in organizational arrangements that were seen by the participants to be easier to handle and much more efficient than IOC mechanisms.

The IOC's major internal administrative and organizational difficulties have been constant from the time of its creation and are the result of IOC's peculiar position with respect to UNESCO. The organization is a semiautonomous unit within UNESCO with its own member states, officers, staff, and statutes. As a result, IOC's program is determined by its own constituencies with minimal substantive interference from UNESCO. At the same time, UNESCO controls the IOC budget, UNESCO rules apply to staff operations and scheduling of meetings, and the UNESCO General Conference approves or rejects amendment of the IOC statutes. This situation has caused difficulties in two ways. First, occasionally the IOC Secretariat has had to face conflicting instructions from its membership and the UNESCO bureaucracy on matters affecting budget and, therefore, program priorities. Second, IOC has been at a disadvantage sometimes in its external relations with the other parts of the U.N. system.

On several occasions, these internal problems have generated moves in some quarters to separate IOC from UNESCO and make it a completely autonomous body. These moves have failed usually because the national constituency for oceanography is too limited to provide for a separate organization and because the issue of splitting IOC from UNESCO always became entangled in the major political conflicts occurring in the organization.

For instance, between 1971 and 1973 the North/South confrontation in the IOC was fueled by a fight over the relative priority to be accorded technical assistance versus research on marine pollution. At this time, the Director-General of UNESCO (René Maheu) perceived that the thrust of U.S. policy was to separate IOC from UNESCO. The Latin American countries, particularly Brazil and Argentina, wished to increase the priority of technical assistance in the IOC's work program and to expand the role of UNESCO's Office of Oceanography, which had been separated from the IOC since 1971. As a result, the Latin Americans were opposed to making the IOC an autonomous body. This coincided with the Director-General's preference. A natural coalition formed and was augmented by the USSR, which, for primarily internal reasons and fears about FAO's intentions with respect to an independent IOC, also opposed splitting the IOC from UNESCO.

The organization rapidly bogged down in the mid-to-late 1970s, and these difficulties were reinforced by the unwillingness of major maritime countries to make major contributions to technical assistance programs within the IOC. As more developing countries joined the organization, and as the world ocean regime was being radically altered through the Third United Nations Conference on the Law of the Sea, the question, Whither the IOC? was being raised in the organization as a whole as well as in its member countries.

Recent Evaluations of the IOC Program

The IOC Program for 1975-78 consisted of the following elements:

A. Ocean Science

1. General Bathymetric Chart of the Oceans (GEBCO). (Joint with the International Hydrographic Organization).

2. Cooperative Investigation of the Northeast/Central Atlantic (CINECA). Joint with ICES and FAO (Committee for East Central Atlantic Fisheries).

3. Investigations of El Niño (Project ERFEN).

4. Cooperative Investigation in the North and Central Western Indian Ocean (CINCWIO).

5. Joint CCOP-IOC Working Group on IDOE Studies of East Asia Tectonics and Resources (SEATAR).

6. Marine Resource Investigations and Activities in the South Pacific (CCOP/SOPAC).

7. Working Group for the Western Pacific (WESTPAC) - (successor to the Cooperative Study of the Kuroshio).

8. Cooperative Investigations in the Mediterranean (CIM).

9. Termination of CICAR and creation of the IOC Association for the Caribbean and Adjacent Regions (IOCARIBE).

10. Global Investigations of Pollution in the Marine Environment (GIPME).

11. WMO/ICSU Global Atmospheric Research Program (GARP).

    a. First GARP Global Experiment (FGGE).

b. Climatic Changes and the Ocean.

c. GARP Atlantic Tropical Experiment (GATE) - Oceanography.

12. International Southern Ocean Studies (ISOS).

B. Ocean Services

1. Integrated Global Ocean Station System (IGOSS).

a. BATHY/TESAC Operational Program.

b. IGOSS Data Processing and Services System (IDPSS).

c. IGOSS Pilot Project on Marine Pollution (Petroleum) Monitoring (MAPMOPP).

2. International Oceanographic Data Exchange (IODE).

3. Tsunami Warning System for the Pacific (ITSU).

C. Training, Education, and Mutual Assistance in the Marine Sciences

In addition, during 1979/80, the following potentially significant additions and expansions were introduced:

A. Ocean Science

1. World Climate Studies Program (joint with WMO) - The IOC committed itself to a long-term, large-scale involvement in these investigations and exercised primary responsibility for the oceanographic component.

2. Ocean Sciences in Relation to Living Resources (joint with FAO). The IOC authorized preliminary planning that would focus primarily on the needs and interests of developing countries.

B. Ocean Services

The IOC proposed major expansions for IGOSS relative to IOC involvement in world climate studies and authorized expansion of pollution monitoring from the petroleum pilot project to a broader concern with a variety of substances.

C. Technical Assistance

The IOC decided to produce a comprehensive plan for a major assistance program aimed at strengthening the marine science infrastructure in developing member states.

With respect to the dissatisfaction expressed over continuing cooperative investigations, the complaints have been that these programs tend to drag on much longer than necessary, that they are no longer central to advances in oceanography, that governmental commitments have been declining, and that the atlases take much too long to be produced and therefore are much less useful than they should be.

CINECA was terminated in 1978; the Cooperative Study of the Kuroshio (CSK) has been transformed into WESTPAC; CICAR has been terminated, and a new IOC experiment in regionalization of programs has been created in IOCARIBE; CINCWIO is a new program and CIM continues with very little support from member states. (In fact, there was an unsuccessful move in the IXth session of the executive council in 1978 to terminate this program.)

During the IOC executive council meeting held June 21-26, 1976 (IOC/EC/-VII/3), Dr. George Humphrey of Australia argued that WESTPAC and CINCWIO offered the commission the opportunity to change its way of operating with respect to cooperative investigations and he suggested the following principles as guidelines:

> Firstly, the member states of the Cooperative Investigation should establish very carefully the major problems that can only be solved by cooperative study. These problems must relate to the real needs of the region. The assistance of other United Nations agencies such as FAO, WMO and UNESCO (Division of Marine Sciences), as well as IOC itself, should be sought to establish these basic problems. Subsidiary bodies of these agencies such as OPFC could also have a role.
>
> Secondly, after the basic problems are established, a proper scientific formulation of the programme necessary to achieve solutions, either within the means and expertise of the Member States or with external assistance, must be arrived at. The newly-formed Scientific Advisory Board could be a means to achieve this clear formulation of a programme. The IOC should then examine the programme in relation to its budget and other considerations before accepting responsibility.
>
> Thirdly, an evaluation of the present state of knowledge of the oceanography of the region, particularly as it relates to basic problems, must be an integral part of the programme

definition. The use of consultants, or scientific bodies such as SCOR, supervised by the Scientific Advisory Board could be the mechanism to achieve this evaluation.

Finally, the Working Committees for TEMA and IODE, and in some circumstances for GIPME and IGOSS, should have direct representation in the programme design and executive states of the cooperative investigation. The role of these Working Committees in the success of any cooperative investigation cannot be over-estimated.[3]

These principles were later incorporated into Resolution EC-VII.6, establishing the WESTPAC program.

In their evaluation of several aspects of the IOC program, the Scientific Advisory Board in 1977 gave most detailed consideration to IOCARIBE, SOPAC, CINCWIO, GARP, and CIM. The criteria used by the advisory board were more detailed than those adopted by the executive council for WESTPAC. They are as follows:

1. Does the program fall within the scope of the commission's scientific objectives?

2. Is the project scientifically important, urgent, and technically feasible?

3. Does the project contribute to the enhanced utilization of the ocean and its resources?

4. Does the project call for concerted action by the commission's member states?

5. Is it likely that sufficient scientific and technical resources will be made available to initiate the project successfully, through the active participation of member states?

6. Will the project contribute to the needs of the developing countries?

7. Is it likely that sufficient resources will be made available, both from the developed and the developing countries, to permit meaningful participation in the program by the developing countries?

[3] IOC. Summary Report: Seventh Session of the Executive Council, June 21-26, 1976, DOC. IOC/EC-VII/3, July 8, 1976, pp. 17-18.

8. Is the time frame proposed for fulfilling the project realistic?[4]

On the basis of these criteria, the board gave high priority to IOCARIBE, CINCWIO, and GARP but low priority to SOPAC and CIM. The reasons for doing so in the case of IOCARIBE are that the program satisfied all the criteria and represents a unique opportunity to develop into a model regional program. The board recommended, however, that the research program of IOCARIBE be more narrowly focused than it was initially conceived to be, with the priorities being put on fisheries oceanography and environmental geology.

The CINCWIO program also provided the opportunity for developed and developing member states to satisfy their different but complementary interests. Countries within the region seem to be primarily interested in fisheries oceanography and related coastal physical oceanography. Countries from outside the region are interested primarily in the dynamics of the Somali Current and related open-ocean physical oceanography. If the Indian subcontinent is included, then interest in climate studies will also be significant.

Unlike these two primarily regionally oriented programs, the oceanographic components of GARP are of high scientific priority and the board sought to increase the attention given to related oceanographic components of FGGE by the GARP Activities Office.

With respect to the other two programs to which the board gave a low priority, namely, SOPAC and CIM, the difficulties in each case seemed to be low commitments by member states and insufficient resources. In addition, the international coordination mechanism for CIM seemed to be "awkward and confusing." This is not surprising since CIM was intended to encourage participation by a number of states who were frequently at war with each other in the eastern and western Mediterranean.

The Scientific Advisory Board decided to defer a full investigation of GIPME until a later time but, from the available evidence to date, the performance of GIPME is disappointing. The group took several years to agree on a "Comprehensive Plan" because the scientists involved disagreed over the content of an appropriate program of investigations. Earlier in its work, the advisory board had pointed out that the following factors have usually been responsible for slow progress on many projects in the IOC.[5]

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[4] IOC. Summary Report of the First Session of the Scientific Advisory Board, New York, July 12-16, 1976, Doc. #IOC/SAB-I/3, Annex IV.

[5] IOC. Summary Report of the Second Session of the Scientific Advisory Board, Paris, April 12-16, 1977, Doc. #IOC/SAB-II, p. 3.]

1. Lack of evaluation of necessary commitments at the beginning of planning for the project.

2. Too optimistic an estimate of the real interest and possibilities of national laboratories in putting specialized personnel at the disposal of the projects.

3. Lack of firm commitments by member states (taking into account the usually multi-annual time frame of the project).

GIPME is a vivid example of the results of these three factors. The board could have referred also to the fact that no nation formally questions the utility and effectiveness of a program in which it does not have an interest.

The International Coordination Group for GIPME completed the work on the "Comprehensive Plan" in 1975. Later that year, this plan was adopted by the IOC, and the ICG was converted into a working committee of the commission. Since that time, however, very little has been done to implement the plan, apart from the work of the Group of Experts on Methods, Standards and Intercalibration. GIPME has not turned out to be the focal point for U.N. investigations of marine pollution as was initially hoped. In that sense, the IOC has done very little to implement the resolutions addressed to it by the Stockholm Conference. In addition, since no one ever pushed these resolutions in the IOC, there was no follow-through.

The earlier fight between developed and developing countries concerning the relative priority of pollution investigations versus technical assistance tainted the GIPME program in the eyes of developing countries, since GIPME was seen to be responsive primarily to the needs and interests of developed countries. The fact was, however, that even within developed countries the real priorities accorded GIPME were quite low and the performance has consequently been satisfactory to no one. It seems clear, therefore, that GIPME cannot satisfy the evaluation criteria used by the Scientific Advisory Board and should be accorded a commensurately low priority within the IOC.

While the board did not evaluate Project ERFEN, it does appear that investigations of El Niño would satisfy all the board's criteria for awarding high priority to a program. The scientific and practical significance of this program is at least as great as that of CINCWIO. However, the political sensitivities of the countries in the region may prevent Project ERFEN from emerging as a full-blown IOC program. In any event, it is to be hoped that the joint IOC/WMO/Comision Permanente del Pacifico Sur Working Group will be able to surmount these difficulties.

With respect to the ocean services program, the Scientific Advisory Board did spend some time evaluating the performance of IGOSS

and, in this connection, heard a detailed report from Ferris Webster.[6] The following is a summary of that report and the recommendations of the Scientific Advisory Board.

> The Chairman invited Dr. Ferris Webster to present his views on the relationship between IGOSS and the Commission's scientific programmes. Dr. Webster introduced the report which he had prepared for the meeting. He emphasized that the above relationship is a two-way street which requires improvement in both directions. The IGOSS data base is now approximately one-seventh of that which is necessary to provide a base for useful products. Dr. Webster stated that scientists must provide quality control for IGOSS by carefully defining for IGOSS the scientists' requirements for data, by developing modelling techniques to improve the use of IGOSS data, by providing scientific guidance to non-scientific users of IGOSS data who otherwise could not accurately define their own requirements for such data, and by submitting the data which the scientists collect to the IGOSS system for inclusion in the IGOSS data base.
>
> Dr. Webster noted that there has been no focused demand for IGOSS products by IOC scientific programmes because most scientists recognize that the IGOSS data base is presently too small to permit the development of useful products. On the other hand, these same scientists are submitting to the IGOSS system only one-fifth of the data they collect. If the scientists submitted all of the data they collect, then the IGOSS data base in the areas would be close to the minimum necessary to produce useful products.
>
> Dr. Webster noted that GARP will provide an excellent opportunity for IGOSS to demonstrate whether it can provide high-quality data and useful products for non-oceanographic users. He emphasized the need for IGOSS to develop trial products related to GARP requirements and to improve its tele-communications system. He pointed out, however, that IGOSS is not being developed as quickly as it should be to meet these needs. Dr. Webster cited two important problems in this respect. First, since the disbandment of IRES (the Group of Experts on Oceanographic Research Related to IGOSS), IGOSS has not been receiving <u>regular</u> scientific guidance for its work and has not been responsive to the advice which it has been given. Second, both the international coordination of IGOSS operations have not been adequate to effectively implement IGOSS.

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[6] Ferris Webster. "IGOSS and the Scientific Programs of the IOC," prepared for the second meeting of the Scientific Advisory Board of the IOC, February 22, 1977.

Dr. Webster noted that the IOC Secretariat had done an excellent job of providing Secretariat-type assistance to IGOSS, but suggested that it is now essential for the IOC to have someone working full-time on the implementation of IGOSS without having to assume Secretariat-type responsibilities. This IGOSS operations coordinator should work directly with the various national coordinators for IGOSS to assure that the plans for IGOSS (which are developed by the Working Committee for IGOSS with the assistance of the Secretariat) are efficiently implemented. Dr. Webster also emphasized the need for national governments to assist in improving the implementation of IGOSS, not only by designating a national coordinator for IGOSS in each country, but by giving this coordinator sufficient authority to assure that the coordinator is able to implement IGOSS within his or her own country.

The Board strongly concurred with the views expressed by Dr. Webster. The Board decided that, although it should not now undertake a detailed review of IGOSS, it would be appropriate to transmit the Board's views on IGOSS to the Tenth Assembly.

RECOMMENDATIONS

The Board recommends: IOC identify IGOSS as one of the Commission's high priority programmes. The Board recognizes, however, that it is necessary to further develop the IGOSS programme, particularly the implementation of some existing IGOSS plans. In order to successfully implement IGOSS, it is essential to improve the quality control of IGOSS in order to enable the production of useful IGOSS products and services.

In the Board's view, the present system of drawing upon a roster of experts to provide scientific guidance to IGOSS is not completely adequate. Therefore, the Board recommends: the IOC establish a Group of Experts or similar body to provide regular scientific guidance to the Working Committee for IGOSS. It is essential that this body be composed of active scientists.

The Commission should also assure that the Working Committee for IGOSS receives guidance from other scientists concerned specifically with IGOSS, particularly scientific users of IGOSS products, and the IOC's scientific subsidiary bodies. These scientists, in providing guidance to IGOSS, should focus on carefully defining users' requirements for IGOSS data, products and services and on the development of needed models and prediction methods. The scientists must also, however, greatly increase their submission of the data

they collect to the IGOSS system. The Board recommends: the terms of reference for the new joint Working Committee for IGOSS be redrawn to assure increased interaction between IGOSS and the IOC's scientific programmes, along the lines presented above.

The Board recommends: the IOC arrange for an IGOSS operations coordinator be assigned full-time to assure the implementation of the IGOSS plan, as developed by the Working Committee for IGOSS with the assistance of the IOC Secretariat. The Board strongly recommends: IOC Member States participating in IGOSS be requested not only to designate national coordinators from IGOSS, but to assure that these coordinators have sufficient authority within their own countries to effectively implement IGOSS programmes.

The Board recommends: the WMO be asked to assure that staff personnel which it seconds to the IOC Secretariat are assigned on a long-term basis and that, when it is necessary to replace such personnel, an overlap of assignments is arranged, rather than a gap between them. The Board also recommends that: the IOC give wide circulation to Dr. Webster's report on IGOSS and that the Commission consider initiating publication of an IGOSS Newsletter which would regularly provide information as to the availability of IGOSS products, centres and data.

On the basis of the evidence presented by Dr. Webster, it is difficult to see how IGOSS at that time satisfied the board's criteria for awarding high priority to a program, and therefore it is difficult to understand the board's recommendation in this case. While the program certainly fell within the scope of the commission's objectives, there was no basis in 1977 for arguing its urgency and there was considerable divergence of views in the scientific community over the program's scientific importance. In addition, while the program does require concerted action among member states, the level of participation, particularly among developing countries, has been poor. It was therefore not at all clear that sufficient resources would be made available in the near future to produce significant advances in capability for developed as well as developing countries.

On the other hand, the performance of IGOSS since 1977 begins to suggest a greater promise than was discernible before. For instance, the Scientific Advisory Board's special review of IGOSS in 1978-79[7] showed that (1) member states had responded positively to most of the board's recommendations made in 1977; (2) "...IGOSS support of the POLYMODE Experiment in the Atlantic Ocean was very successful both as

[7] IOC Scientific Advisory Board. (Draft) Review of IGOSS, February 1979.

a tool for final design of field experiments and for producing products providing up-to-date pictures of oceanographic conditions in the POLYMODE region"; and (3) the preliminary review of the marine (petroleum) pollution pilot project was sufficiently encouraging for the joint IOC/WMO Working Committee to recommend consideration of expanding the project in an operational marine pollution monitoring program.

In addition to the above, and perhaps more importantly, the decisions by the Eleventh Session[8] of the IOC Assembly in October and November 1979 and the Thirteenth Session[9] of the Executive Council in June 1980 to commit the IOC to a long-term, large-scale involvement in the World Climate Studies Program put a premium on systematic improvement of ocean monitoring capabilities. This gives the IGOSS program an urgency it did not have in 1976. On the other hand, there is a long way to go in improving these capabilities as demonstrated by the performance of IGOSS during the First GARP Global Experiment in 1979. While great advances have indeed been made, serious deficiencies still exist with respect to the scope of coverage and the speed and accuracy of reporting.[10]

The other two ocean services provided by IOC, namely, IODE and ITSU, have always received high marks within the commission. Both programs have been successful in large part because the needs to which they respond are sufficiently important to elicit strong national support from countries wealthy enough to provide the necessary infrastructure. In addition, IODE has been of considerable interest and value to developed and developing countries alike since it offers data and information upon request and provides a means of standardizing reported research results.

Conversely, IOC performance on technical assistance, training, and education in the marine sciences has been as disappointing as GIPME. Only meager resources have been made available to the IOC in this area, even though conflict between developed and developing countries has intensified. This conflict has been exacerbated by and within the Third United Nations Conference on the Law of the Sea with deleterious results for ocean-going academic oceanographers. In this context, the

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[8]IOC. Eleventh Session of the Assembly: Summary Report; Paris, - October 15-November 6, 1979: The World Climate Program, pp. 17-19; Annex III, pp. 10-19; Resolution XI-3, Annex II, pp. 4-6; Resolution XI-34, Annex II, p. 33. IGOSS, pp. 37-43; Resolution XI-19, Annex II, pp. 18-19.]

[9]IOC. Thirteenth Session of the Executive Council: Summary Report, Paris, June 23-28, 1980; IGOSS, Resolution EC-XIII.2, pp. 31-32; World Climate Program; Resolutions EC-XIII. 7-10, pp. 36-40.]

[10]WMO; IOC. A Critical Review of IGOSS Activities During the First GARP Global Experiment, Paris, April 1980, IOC-WMO/IGOSS-FE/DOC.13.]

IOC Working Committee on Training, Education, and Mutual Assistance has been an exercise in futility since its creation in 1973. It has simply never had the resources and commitments on which to build a viable program. And it is not at all clear that the establishment of the IOC Voluntary Assistance Program is indeed a substantive change for the better. It should be noted that previous attempts on this issue in the 1960s were equally futile. However, if, in view of the changed ocean regime, the required funding were made available to the Voluntary Assistance Program, this could make a major difference.

The major programmatic question that the current situation poses for the IOC as a whole is, How can it engage and satisfy the interests of both advanced maritime and developing countries? We have said (see p. 26) that the IOC can be a useful mechanism under three conditions. IOC involvement in the World Climate Studies Program clearly fits the first condition, namely, that the program concern a global problem. The study of climate is a high priority and cannot effectively be tackled in any other way that through global efforts. At the same time, any increase in IOC activities on climate studies may accentuate difficulties with WMO. It remains to be seen how these difficulties will be worked out. But this program should also result in increasing member states' commitment to IGOSS.

The Ocean Science in Relation to Living Resources Program meets the second condition, which concerns the problem of access for research. Like projects CINCWIO and ERFEN, this program combines the interests of developed and developing countries. The program, if carefully thought out, can engage the scientific interest and resources of advanced maritime countries. Simultaneously it can also address major management questions of interest primarily to developing countries. Thus, this program has the potential of helping to decrease the level of North/South conflict in the IOC.

These two programs, which were decided in 1979/80, create the possibility of increasing the utility of the IOC mechanisms to all constituencies in the short to medium term. In addition, there is recent interest in data as a commodity to be exchanged and in the role of IOC as a broker of marine scientific and technical information and services. The IOC would "sell" those products and the unique mechanisms it possesses to derive them. Governments would be the primary buyers; other intergovernmental organizations would be the secondary buyers. This approach is likely to appeal more to governments than to university-based research scientists, but presumably that is its primary objective.

ON U.S. PRIORITIES IN THE IOC AND POSSIBLE ALTERNATIVES

The basic questions to be addressed in this section are, What are U.S. interests relative to international oceanographic research and services? To what extent are these interests adversely affected by

the decline in the effectiveness of the IOC? Moreover, to what extent need these interests be pursued in an intergovermental setting? It is now self-evident that governments do not normally agree to organize programs internationally unless the same benefits cannot be derived elsewhere at less cost. At the same time, it does seem that occasionally there are significant domestic benefits to be derived from making international commitments and that these can be more important than the commitments themselves.

From the point of view of the working marine scientists, however, these benefits, especially in increased funding and logistical support for research, must be balanced against the costs of increased formalization in a multilateral setting. Given the changes in the global ocean regime as it affects marine scientific research, this is not a trivial question; the costs of multilateral commitments will not necessarily be less than those of bilateral commitments. Extended coastal state jurisdiction, as it affects marine science, will lead to increased formalization nationally and internationally as a result of the procedures for getting access to the exclusive economic zones of coastal states. Consequently, U.S. priorities in the IOC can no longer be addressed only in terms of the substantive scientific interests. They must also take into account political considerations in getting access to carry out research in the exclusive economic zones of other countries. Whether the IOC or an alternative mechanism is more likely to be effective in facilitating research under these conditions is a matter to be established in each case and should not be assumed.

The Department of State's Panel on International Programs and International Cooperation in Ocean Affairs has stated that U.S. interests with respect to ocean science and services are as follows:

- Improving our understanding of the physical, chemical, biological, and geological processes within the ocean.
- Improving our ability to observe and predict environmental conditions in both the atmosphere and the oceans.[11]

To these it is necessary to add the following:

- Minimizing the constraints on open scientific research in emerging exclusive economic zones in the world ocean.

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[11] The United States Policy Towards the Intergovernmental Oceanographic Commission (IOC); Recommendation Made to the Department of State by the Panel on International Programs and International Cooperation in Ocean Affairs (PIPICO), Unclassified, February 1977, p. 1.

- Trying to alleviate the intensity of the North/South confrontation over issues of ocean use by facilitating the expansion of marine scientific research capabilties among developing countries.

This statement of U.S. interest by itself does not yield any priorities, however, relative to specific programs of the IOC. In order to derive priorities, the eight criteria employed by the Scientific Advisory Board (see pp. 31-32) appear to be an effective set with one addition:

- Are there effective alternatives for deriving the same benefits outside of the IOC at less cost?

Within the category of ocean science, these IOC programs appear to satisfy the nine criteria:

Project ERFEN
CINCWIO
WESTPAC
IOCARIBE
GARP
    First GARP Global Experiment (FGGE)
    Climatic Changes and the Ocean (World Climate Studies Program)
Ocean Sciences in Relation to Living Resources

Within the category of ocean services, the following IOC programs satisfy the criteria:

IODE
ITSU
IGOSS (on the basis of its potential utility for the World Climate Studies Program)

With respect to Project ERFEN and CINCWIO, both would significantly enhance our knowledge of the upwelling phenomenon. Studies within CINCWIO would have the added virtue of dealing with the Somali current in the context of monsoonal changes in the Northern Indian Ocean. Both projects would contribute to the enhanced utilization of the ocean and its resources and could not be carried out under other auspices at less cost. Both provide a complementarity of interests for distant-water and coastal states so that a significant incentive exists for expanding technical assistance activities relative to each project.

In the case of GARP, knowledge of the role of the ocean in world climatic change is clearly of high priority. The large-scale program that exists combines governmental commitments in meteorology through the World Meteorological Organization (WMO). Oceanographers have complained that, until recently, the role of the ocean was not adequately handled in the existing structure, since WMO responds to a

different constituency. Because the problem is global, there must be some mechanism through which governmental commitment to oceanography in climate studies can be facilitated while also meeting the needs of both developed and developing countries. The IOC is that mechanism.

WESTPAC and IOCARIBE are special cases. Neither one deals with a single, clearly formulated scientific problem of importance. Both are regional programs of very broad scope and would not normally meet the test imposed by the nine criteria. In each case, however, the United States has major interests in the region and cooperative studies would not be possible now at less cost. With respect to WESTPAC, internal funding procedures within the USSR require the continuation of the IOC mechanism. On the other hand, if a new organization for the scientific investigation of the North Pacific were to be created, this might be a more effective mechanism than WESTPAC, at least on fisheries oceanography. With IOCARIBE, a mechanism exists, in an area of high priority, for pooling U.S. technical assistance activities in the Caribbean. The only alternative would be to employ a bilateral-cum-trilateral approach, which is likely to be significantly more costly in the long run. The region also needs a center to promote interaction among Caribbean marine scientists. IOCARIBE could perform this function, at least for governmental scientists.

This is not meant to imply that the rest of the IOC program is of no interest to the United States. Clearly there are projects that are useful though not of high priority. On the other hand, it is difficult to see any utility in continuing either CIM or the global planning aspects of GIPME apart from monitoring.

From the point of view of substantive U.S. oceanographic interest, only those programs that have met the test of high priority need to be coordinated within the IOC. Other, more advanced, problem-oriented investigations will continue to be coordinated by mechanisms outside the IOC, such as Project FAMOUS, MODE, POLYMODE, the Deep Sea Drilling Project (DSDP), and the like. Yet others may take the form of purely bilateral relationships between the United States and particular developed and developing countries. However, other countries have different interests within the organization and the United States should expect to contribute resources to some activities of lower priority as part of the cost of retaining a mechanism that still possesses some utility.

CHAPTER 2

EXISTING REGIONAL ARRANGEMENTS FOR MARINE SCIENCE

The coordination of international oceanographic research at the regional level has in general not been very successful, except for certain projects of limited duration and scope. The International Indian Ocean Expedition (IIOE), which eventually became the first of the international cooperative investigations of the Intergovernmental Oceanographic Commission (IOC), received high marks as a large-scale, multiship, multidisciplinary, multinational investigation of a specific geographic region; but subsequent investigations of this type have tended to occasion less acclaim partly because of lack of support from participating countries.

Several regional projects carried out under the auspices of the International Decade of Ocean Exploration (IDOE) have also been deemed successful. Among these is Estudio Regional del Fenomeno El Niño [Regional Study of the Phenomenon Known as El Niño] (ERFEN), which was eventually upgraded to the status of a project requiring an IOC working group. On a somewhat different level is the International Council for the Exploration of the Sea (ICES), which has been judged a continuing success. Its membership, however, is composed largely of developed countries with traditions of oceanographic research, and its budget, relative to the tasks it is assigned to perform, is considerably greater than those available to most regional marine science systems.

It is the purpose of this chapter to identify existing regional organizations associated with international oceanographic research both within and outside the U.N. system and to describe two of the more important bodies, IOCARIBE and ICES. Consideration will be given to emerging trends in regional marine science issues. There will also be a brief discussion of U.S. interests in current and potential regional arrangements for oceanographic research.

REGIONAL ARRANGEMENTS WITHIN THE U.N. SYSTEM

Intergovernmental Oceanographic Commission

The IOC's involvement in regional arrangements for research may be divided under four headings: (1) international cooperative investigations; (2) regional associations; (3) regional activities of the working committees; and (4) scientific projects of IDOE.

Once the initial phase of a regional project has been approved by the IOC Assembly, a working group may be created to oversee its activities. This happened in the case of the Studies on East Asia Tectonics and Resources (SEATAR) and of the investigations of El Niño (ERFEN). In time, a working group may be transformed into an international coordination group, as in the case of the Cooperative Investigations in the Mediterranean (CIM) and the Southern Oceans Survey.

In one case in which an international coordination group existed for a cooperative investigation, the investigation itself was followed by the creation of the only IOC regional association now in existence--the IOC Association for the Caribbean and Adjacent Regions (IOCARIBE). Founded in 1976, one year after the termination of CICAR, IOCARIBE was not intended to be a continuation of the former program, but rather a project-oriented body designed to oversee all IOC activities in the region and to coordinate those activities with the efforts of other groups. It was also envisaged as a catalyst for new cooperative marine science ventures. The rationale for the creation of IOCARIBE was that cooperative efforts in marine science in the Caribbean had already been developed through CICAR and other organizations and that a coordinating mechanism was needed to continue, and to build on, these efforts. IOCARIBE, like CICAR, is a time-limited project; seven years from its inception a review will determine whether it should continue.

IOCARIBE has a small secretariat, first located in Trinidad and Tobago[1] and then in Costa Rica, which provides for greater continuity than had been possible with the cooperative investigations. At the beginning of 1979 there were 18 members from the region plus Brazil and the USSR.[2] The first session of IOCARIBE was held in

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[1]Trinidad was the host country for the first two years of operation. IOCARIBE's regulations require that the secretariat be located in the country of residence of the chairman, who is elected biennially. In August 1978, Manuel Murillo of Costa Rica was elected chairman; the secretariat has moved to Costa Rica.

[2]France, the Netherlands, the United Kingdom, and the United States, as metropolitan powers in the Caribbean, are members of IOCARIBE. Nonmember states of the region include the Bahamas, Barbados, Dominica, El Salvador, Grenada, Honduras, and Saint Lucia.

Caracas in July 1976; the second session was in San Jose, Costa Rica, in August 1978.

During its first two years of operation, IOCARIBE was responsible for the covening of two workshops; one an Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects at Fort-de-France, Martinique, in November and December 1977; and the other, a Workshop on Environmental Geology of the Caribbean Coastal Area at Port of Spain, Trinidad and Tobago, in January 1978. From the Martinique workshop emerged recommendations for two cooperative projects. One was "Scientific studies for improvement of trap fishery management in the Lesser Antilles," and involved research on the oceanographic factors that regulate reproduction, growth, and recruitment of fish stocks; the second project, "Scientific studies in support of the management of the spiny lobster fisheries in Central America," had as its main objective stock assessment and the design of appropriate strategies for management of the fishery. The two projects were expected to start in 1980 at an estimated cost of approximately $3 million.

Two recommendations evolved from the Port of Spain workshop. The first involves the environmental geology of the Gulf of Paria area between Trinidad and Tobago and Venezuela; the other is a pilot study of the Caribbean coast of Costa Rica. The costs of the two projects have not been assessed.

It is the responsibility of the secretariat, in consultation with scientists of the region, to select project leaders for each of the four recommended projects. Each leader will then meet with experts in order to select researchers, define field and laboratory operations and methods, establish the research timetable, and propose detailed operational budgets.

In addition to its work on the scientific workshops, the IOCARIBE secretariat has been involved in a number of other cooperative marine science activities in the region. These include preparation of a Directory of Caribbean Marine Fisheries and Research Institutes and publication of the IOCARIBE Newsletter. Close contacts have been maintained with other agencies working in the Caribbean: (1) FAO's Western Central Atlantic Fisheries Commission (WECAF); (2) the UNDP-funded WECAF project; (3) UNEP and its Caribbean Action Plan; (4) the U.N. Ocean Economics and Technology Branch; (5) the Organization of American States; and (6) IOC's Working Committees for GIPME, TEMA, and IGOSS. In response to the IOC Assembly Resolution X-7, the IOCARIBE secretariat, in cooperation with the WECAF project and in consultation with UNEP, is developing a regional pollution program for the area. An IOCARIBE Regional Data Center has been established within the U.S. National Oceanographic Data Center. Plans are under way for a joint IOCARIBE/OETB/UNESCO/UNEP training seminar for management and development of the coastal area in the greater Caribbean region. There are also plans for IOCARIBE to implement a

regional MAPMOPP project on petroleum pollution monitoring, although the initiating costs come to US$93,000.

IOCARIBE's activities demonstrate a multiple approach to the issues of cooperation and coordination of marine science activities in the general Caribbean area. The concept of a regional association is gradually gaining recognition, and under IOCARIBE's aegis, proposals for cooperative scientific projects have been devised. The interactions among scientists and institutions of the region, which began with CICAR, have been continued and strengthened.

These achievements must be weighed against some problems. Research projects defined by the workshops have not been initiated; only a few of the project leaders and potential researchers have been designated. Funding for the projects is being sought by the secretariat, but few sources have been identified. Program budgets include both direct expenditures of funds, and indirect support, such as donations of research ship time, use of laboratory facilities, and provision of equipment. As IOCARIBE's Regional Secretary put it, "The most difficult financial barrier in the near future is to obtain money for direct programme expenses such as immediate needs for transport and support of project leadership groups and, eventually, their research and education personnel."[3] In other words, funding is not yet available for even the basic preparatory work for the recommended projects.

IOCARIBE faces a number of difficulties. There appears to be a lack of support, financial and otherwise, from its member states. There is the shortage of operational funds. The biennial financial summary to 31 July 1978 is shown in table 2-1. IOC has cautioned the IOCARIBE secretariat that more support is necessary from the member states if the association is to succeed. It is the inherent hope of IOC that the regional associations eventually become financially self-sustaining. Over the three-year period, 1978-81, IOC planned to supply no more than $15,000 in any one year for the support of the IOCARIBE secretariat.

There are other funding problems. Because of the requirement that the secretariat be located in the chairman's country of residence, the secretariat incurs expenses in moving from one host country to another. A related problem is the withdrawal of Dutch support for the associate regional secretary's position. Dr. Troost, late in 1978, was seconded from the IOCARIBE Secretariat to the UNESCO Division of Marine Science, and no replacement was designated.

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[3] IOCARIBE: Second Session of the Association, "Report of the Regional Secretary to the Association," IOC/IOCARIBE-II/16, 20 July 1978, p. 13.

TABLE 2-1
BIENNIAL FINANCIAL SUMMARY

Direct Support to IOCARIBE Secretariat
From 18 October 1976 to 31 July 1978
(prepared: 31 July 1978)

I. Office Support

(Support received for operational costs, i.e.: secretarial salaries, rent subsidy, furniture and equipment, materials and supplies, communications, miscellaneous)

A.	From IOC deposits to IOCARIBE bank account	US$16,523.33*
B.	From Trinidad and Tobago National Comm. Unesco	US$ 2,083.33
C.	From Trinidad and Tobago Ministry of Finance	US$ 4,000.00
D.	From Trinidad and Tobago Institute of Marine Affairs	$12,543.46
	T O T A L	US$35,150.12#

II. Member State Contributions

A.	From Government of Panama	US$ 1,000
B.	From Government of the United States	US$ 5.000**
	T O T A L	US$ 6,000

III. Salaries, IOCARIBE regional Secretaries

A. From the Government of the Netherlands to IOC (25 months of salary for Dr. Dirk G. Troost)

B. From the Government of the United States to IOC (17 months of salary for Dr. R. R. Lankford)

* IOCARIBE bank balance, 31 July 1978 = US$7,551.00

** Support of participant travel, Martinique Interdisciplinary Workshop.

\# The Biennial Financial Summary, as shown in Annex I of IOC/IOCARIBE-II/6 showed a total figure for Office Support of US$39,150.12. Either the addition was wrong, or one of the four items was incorrect.

Source: IOCARIBE: Second Session of the Association, "Report of the Regional Secretary to the Association," IOC/IOCARIBE-II/6, 20 July 1978, Annex I.

The shortage of marine science research facilities in the Caribbean area (other than those of the metropolitan countries) presents another problem. How willing are member countries to release scientists and divert funds from their own national programs? The delegates to the workshops and to the IOCARIBE meetings can only recommend that their governments support IOCARIBE projects.

The United States, which provides for the salary and travel expenses of the regional secretary, is reluctant to commit additional funds to IOCARIBE since it already pays more than $100 million a year toward the general United Nations budget.[4] The British and French have contributed virtually nothing to IOCARIBE, and, as noted earlier, support for the secretariat from the Netherlands has, at least for a time, been terminated. The USSR proposed that oceanographic research carried out in the Caribbean area by a Soviet research vessel be under IOCARIBE sponsorship, in return for which the Soviets would take on board scientists from the Caribbean countries and train them in scientific techniques.[5] The two member states in the Caribbean which presumably are best equipped to contribute meaningful support are Mexico and Venezuela. But Mexico has announced the termination of its Oceanographic Sorting Center (CPOM) as an IOCARIBE service facility; Venezuela, however, has made a contribution of US$50,000 to the IOC Trust Fund earmarked for IOCARIBE.

Other U.N. Agencies

Food and Agriculture Organization. Six regional marine fisheries organizations have been sponsored by FAO.[6] While it is not suggested that these units (whose memberships are composed largely of developing countries) are oriented toward basic oceanographic research, they have some potential for facilitating the development of research. One or more of the fisheries organizations might in time become a basic component of a new IOC regional association, much as WECAF has in the Caribbean. Second, under the aegis of FAO regional fisheries bodies, projects might be launched for oceanographic

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[4] An additional problem for IOCARIBE is the perception in the region that direct links to U.S. institutions operating under the National Sea Grant Program may be much more productive than participation in IOCARIBE.

[5] This proposal was not accepted at the IOCARIBE II meeting in August 1978.

[6] Regional Fisheries Advisory Commission for the Southeast Atlantic (CARPAS); Fishery Committee for the Eastern Central Atlantic Fisheries (CECAF); General Fisheries Council for the Mediterranean (GFCM); Indian Ocean Fishery Commission (IOFC); Indo-Pacific Fishery Commission (IPFC); Western Central Atlantic Fishery Commission (WECAF)

research in support of fisheries, along the lines of the Martinique workshop's recommendation on trap fishery management in the Lesser Antilles.

United Nations Environment Programme. For several years, UNEP has been involved in coordinated "action plans" for various regional seas. The first of these, the Mediterranean Action Plan, was begun in 1975, and is now well under way with seventeen coastal states of the region participating. Programs are now being developed for the Caribbean, the Persian/Arabian Gulf, the Gulf of Guinea, the East Asian seas, the Southeast Pacific, and the Southwest Pacific, particularly the area off the west coast of South America.[7]

Two aspects of the action plans are important in the near term for the Caribbean and in the long term, perhaps, for other IOC regional associations. First, the Mediterranean experience indicates that UNEP has sought, through action plans, to coordinate the efforts of marine science institutions and provide funds for their development. UNEP also has mounted a series of multi-agency scientific projects (MED POLS), which are aimed at addressing specific aspects of marine pollution. Although the related oceanographic research is more basic than applied, the MED POLS bring scientists together on specific projects and are backed by considerable funding from UNEP.

A second aspect of the action plans is that they virtually eclipse (at least for a time) other, less well funded operations. In the Caribbean, for example, the proposed UNEP/ECLA[8] Action Plan program is intended to be both well funded and comprehensive. If, as in the case of the Mediterranean, several millions of dollars are committed to the action plan by UNEP, and the regional marine research facilities are "organized" and utilized in UNEP's pollution studies, what effects would this have on IOCARIBE's activities? Admittedly, UNEP's programs are intended to be time-limited; after the initial UNEP funding, countries and agencies within and associated with the region are expected to fund ongoing activities. How the action plans will eventually affect a region's oceanographic research capabilities and interest is unclear.

United Nations Educational, Scientific, and Cultural Organization. Another agency of the U.N. with regional marine science interest is the UNESCO Division of Marine Sciences, which is responsible for assisting member states to attain high quality marine science programs and scientific infrastructure so they can participate

[7]There is also an action plan for the Red Sea, but in its development UNEP can play only an advisory role because the Arab coastal states refuse to include Israel within the plan.
[8]Economic Commission for Latin America.

in IOC programs as well as meet their other marine sciences needs. To these ends the division in the past supported regional planktonic sorting centers in Mexico, India, and Singapore. These centers are no longer funded by the division, which is now assisting UNESCO with the maintenance of Regional Offices for Science and Technology located in Nairobi, Cairo, Montevideo, Jakarta, and New Delhi. The last three offices have a marine specialist on their staffs.

Other U.N. Agencies. Several other U.N. agencies contribute indirectly to regional oceanographic research programs. Among these are WMO, IMCO, OETB, ECOSOC, and WHO. UNDP, which supports regional fisheries and pollution control efforts, does not at this time provide funding for regional oceanographic efforts, but this policy might change.

Regional Arrangements Outside the U.N. System

One of the most effective regional marine science organizations, whether within or outside the United Nations framework, is the International Council for the Exploration of the Sea (ICES). Established in 1902, the International Council now has eighteen members,[9] fourteen of them coastal states in the North Atlantic. Seven are members of the European Economic Community.

ICES is concerned with promoting marine research, particularly related to marine living resources. In addition, the council has advisory responsibilities to two fishery commissions and three pollution commissions.[10] The annual Statutory Meetings provide an important scientific forum for European marine scientists, as well as an opportunity for conducting the council's business.

In considering the relevance of ICES scientific programs to U.S. priorities in marine scientific research, several characteristics of the organization should be kept in mind. Although the statutory objectives are broad, the focus on fishery problems has been sharp. In recent years, increased attention has been paid to marine pollution while marine science per se has had much lower priority. Oceanographic programs tend to be closely linked to these applied interests. ICES contacts in its member states reflect these emphases,

[9]Present ICES members are Belgium, Canada, Denmark, Finland, France, German Democratic Republic, Federal Republic of Germany, Iceland, Ireland, Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom, U.S.S.R., and the United States.

[10]Fishery commissions advised by ICES are the North East Atlantic Fishery Commission (NEAFC) and the International Baltic Sea Fisheries Commission. Pollution commissions advised by ICES are the Oslo Commission and the Interim Paris and Helsinki Commissions.

being primarily with fishery laboratories rather than with universities or oceanographic institutions. For example, the major British oceanographic laboratory, the Institute of Ocean Sciences in Wormley, plays a minor role in ICES. Oceanographic activities of the Soviet Academy of Sciences and the French Centre Oceanologique de Bretagne are not represented. Some fields of marine science--e.g., geology and geophysics--are not represented, and major ocean studies in the North Atlantic--e.g., the MODE/POLYMODE studies of mesoscale eddies--are outside the purview of ICES.

Most members of ICES are from northern Europe and have common scientific traditions and common fishery and pollution problems in the North Sea or in the Baltic. However, two recent members, the United States and Canada, are removed from these practical problems and have only scientific interests in common. U.S. and Canadian scientists meet their needs for the exchange of scientific information in national or international (global) meetings and hence are reluctant to use the more limited forum offered by ICES. Neither country fishes or pollutes in the North Sea or the Baltic, so their interest in ICES management problems is limited. Nevertheless, the organization provides useful opportunities for scientific interchange and cooperative activities in certain applied fields as well as in certain areas of more fundamental research. Recent changes in the political environment within which ICES operates may lead to a broadening of these opportunities.

During the last few decades, ICES has devoted an increasing percentage of its efforts to fishery management problems in the eastern North Atlantic and in the North Sea and Baltic. A large number of working groups made annual assessments of various stocks and their recommendations on allowable catches were reviewed by the Liaison Committee (now the Advisory Committee on Fishery Management). These recommendations were then passed to the North East Atlantic Fishery Commission (to the International Baltic Sea Fisheries Commission in the case of the Baltic). The extension of national jurisdiction over fisheries and the emergence of a common fishery policy for members of the European Economic Commission has jeopardized the continuance of NEAFC and has called into question what has become the major activity of ICES.

Although the need for fishery advice will continue, it may be directed to different recipients. ICES has recognized this as well as other interests of its increased membership by reorganizing its structure and activities. The task of stock assessment is now carried out by the Advisory Committee on Fishery Management, thereby releasing the scientific committees to concentrate on more fundamental problems. The program of the annual Statutory Meetings is evolving toward increased scientific content with greater interdisciplinary interest. Thus the value of this scientific forum will increase for U.S. scientists, and the broader scientific scope should occasion

cooperative scientific activities more closely related to U.S. priorities than has been the case.

Other regional marine science organizations include the International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM). Founded at Monaco in 1919, ICSEM has the role of suggesting and coordinating programs of scientific research in the Mediterranean area. It is not a funding agency, although it publishes scientific data relating to projects that it has approved. Still another regional marine science body is ERFEN (Estudio Regional del Fenomeno El Niño), which is a monitoring program under the auspices of the CPPS (Comision Permanente del Pacifico Sur). Through this program, Ecuador, Peru, and Chile have taken part, jointly with WMO, in the IOC's investigations of El Niño.

Finally, the Organization of American States has recently embarked on a new program for marine science and resource development in Latin America, focusing on the coastal zone. The project includes "ecosystems research and resource mapping, renewable and non-renewable resources management; underutilized living and mineral resource development; socioeconomic analysis of resource development; recovery of degraded environment; and identification of alternative marine resource development possibilities."[11]

TRENDS IN REGIONAL MARINE SCIENCE

Several potential trends in regional marine science activities can be identified.

Regional oceanographic research efforts may increasingly tend toward "applied" rather than "basic" objectives. There are several reasons for this phenomenon. One is that a majority of the membership of the IOC are developing countries, and these countries' interests tend toward the applied aspects of oceanography. As oceanographic research methods become increasingly complex, and as the research itself grows increasingly expensive, the gap between the "haves" and the "have-nots" could widen.

Most of the U.N.'s regional marine activities are associated with tropical and subtropical waters, leaving to other organizations activities in the temperate and polar regions. With the termination of IDOE, the advanced maritime countries will continue to use other institutional mechanisms to coordinate regional efforts among themselves.

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[11] Francisco J. Palacio. "The Development of Marine Science in Latin America," Oceanus, vol. 23, no. 2 (Summer 1980), p. 47.

There will be emphasis on new "regions" as sites for oceanographic research efforts. New regions may be defined geographically, or in terms of specific oceanographic phenomena or processes. One of the more obvious is the Southern Ocean--a frontier region in which oceanographic research is both necessary and expensive. The North Atlantic and the North Pacific are proven areas for research. In the post-IDOE years, greater coordination of research by littoral maritime states would seem a logical development.

Advanced maritime countries will seek participation in regional research efforts in the interest of facilitating access to the waters of coastal developing countries. The Soviet Union and the United States have already demonstrated this trend by their interests in IOCARIBE and CINCWIO. The forms of participation and the direct or indirect support for coordinated projects are matters of conjecture, but they are well worth monitoring. A negative aspect of this trend is the possible evolution of "spheres of influence" of advanced maritime countries in certain marine regions of the developing world. What might eventually emerge would be a move toward restricting access to foreign research vessels in the exclusive economic zones of the area's coastal states, except for vessels of the favored advanced maritime country.

New regional patterns of oceanographic research capabilities will develop. Whether or not the "spheres of influence" concept comes to pass, there is the likelihood of new regional research capabilities developing, as countries become increasingly interested in marine research, and as development funds become available. The oil-rich Middle East countries are one case in point. Another could involve countries in the Southwest Atlantic, where Brazil, Argentina, and Uruguay might coordinate and expand their oceanographic research efforts.[12] Other areas of potential growth in marine research capabilities include the semi-enclosed seas adjoining the People's Republic of China.

One potential component of the new regional patterns would be the establishment and growth of regional marine science centers, as called for in the Draft Convention on the Law of the Sea. On the one hand, the science center concept is fraught with problems; for example, those states of a region, other than the one in which the center is located, may be reluctant to cooperate in support of the center. On the other hand, it can be argued that regional centers may be the most practical means for building up research capabilities in the developing world.

[12]For Argentina, such expansion might have meaning also with regard to the Antarctic waters.

U.S. INTERESTS IN REGIONAL ARRANGEMENTS

In addition to the four areas of U.S. interest in ocean sciences identified in chapter 1 (see p. 39), regional arrangements for marine research are an opportunity for the United States to provide training, education, and other forms of technical assistance to developing countries in the conduct of marine scientific research. These assistance activities cover a variety of subject areas but most often are related to fisheries conservation and management, pollution investigation and control, and protection and development of coastal areas. Where these regional arrangements include only advanced maritime countries as members, other interests appear to be served, in particular, the maintenance of a U.S. presence in certain regions of the world and opportunities to improve U.S. oceanographic research capabilities.

It is clear, however, that the performance record of marine scientific regional arrangements is often unsatisfactory where the attempt is to combine the interests and activities of developed and developing countries. Many reasons account for this but most relate to the absence of a large pool of trained indigenous marine scientists, weak infrastructure, and little commitment from governments of countries in the region. The United States had hoped that regionalization would provide a better focus for marine scientific research efforts and stimulate greater funding from both developed and developing countries. This has not happened, however, and the future of these experiments is uncertain.

CHAPTER 3

INTERNATIONAL NONGOVERNMENTAL ORGANIZATIONS

THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH*

During the last 25 years there has been a rapid escalation of interest in the oceans. In part, this manifested itself in a vigorous growth of national activity, but the very magnitude of the problems and the extent of effort required to study them led to the need for wider cooperation. In recognition of this need, the Scientific Committee on Oceanic Research was established by the Executive Board of the International Council of Scientific Unions (ICSU) in July 1957 for the purpose of "furthering international scientific activity in all branches of oceanic research." SCOR first met in Woods Hole in August 1957; since then, there have been 13 general meetings and 20 executive meetings.

Membership of SCOR now consists of 84 marine scientists nominated by scientific institutions and 11 scientists nominated by ICSU and by interested international scientific unions. Many other scientists are associated with SCOR through membership in its various working groups.

Many countries (34) have created national committees for oceanic research which are representative bodies of marine scientists appointed by national scientific institutions. These committees often serve to strengthen and coordinate marine science nationally as well as providing lines of communication between oceanographers and SCOR.

Most nongovernmental organizations concerned with some aspect of marine science are components of ICSU. Although SCOR is associated with a number of ICSU bodies, four are directly affiliated with SCOR, and their presiding officers are ex officio members of the SCOR Executive Committee; these are the International Association for the

*This section appeared previously in Ocean Yearbook 1 and is written by Warren S. Wooster. Reprinted from Ocean Yearbook 1 edited by Elisabeth Mann Borgese and Norton Ginsburg by permission of The University of Chicago Press. © 1978 by the University of Chicago.

Physical Sciences of the Ocean (IAPSO) of the International Union of Geodesy and Geophysics, the International Association of Biological Oceanography (IABO) of the International Union of Biological Sciences, the Commission for Marine Geology (CMG) of the International Union of Geological Science, and the International Association of Meteorology and Atmospheric Physics (IAMAP) of the International Union of Geodesy and Geophysics. These affiliations illustrate the unique interdisciplinary character of SCOR.

Of the intergovernmental organizations, SCOR's closest relations are with the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and its Intergovermental Oceanographic Commission (IOC), for both of which SCOR serves as a scientific advisory body. Another advisory body to IOC is the Advisory Committee on Marine Resources Research (ACMRR) of the Food and Agriculture Organization; SCOR and ACMRR have worked together in considering IOC problems of mutual interest. SCOR's efforts have also been joined on specific matters with those of the World Meteorological Organization and the International Council for the Exploration of the Sea.

The direct financial requirements of SCOR have been relatively small because its work is done by volunteers with the help of its national committees. Expenses are met from annual contributions from these committees and from contracts with UNESCO, IOC, etc.

The first major scientific project of SCOR was the International Indian Ocean Expedition, a multidisciplinary exploration of this large and relatively unknown region. Planning of the expedition began in late 1957, and SCOR played the major part in its organization and coordination until mid-1962 when this responsibility was transferred to the Intergovernmental Oceanographic Commission. The IIOE remains one of the largest and most comprehensive international oceanographic efforts ever attempted; the lessons learned and experience gained during the period have been used in the development of most subsequent cooperative expeditions.

During the past decade, SCOR activities have generally fallen into one of the following categories: scientific meetings, working groups, and advice to UNESCO/IOC.

Scientific Meetings

Soon after it was established, SCOR devoted its energies to the development of a world scientific meeting, which became the First International Oceanographic Congress (New York, 1959). The Second Congress (Moscow, 1966), although organized by UNESCO and IOC, was also based on a number of SCOR recommendations. The Joint Oceanographic Assembly (Tokyo, 1970) was the third in the series of world meetings, and the fourth was held in Edinburgh, 1976; both were organized by SCOR.

The sixth SCOR General Meeting (Halifax, 1963) included symposia on biogeochemistry, intercalibration, and standardization, and on a general scientific framework for world ocean study. Beginning in 1966, interdisciplinary symposia have become essential parts of the General Meetings, topics including variability in the ocean (Rome, 1966); scientific exploration of the South Pacific (La Jolla, 1968); and remote sensing, ocean monitoring, and the benthic boundary (Tokyo, 1970). The 1972 general meeting in Oban, Scotland was linked to the Second International Congress on the History of Oceanography, held in Edinburgh, and in 1974 the general meeting in Guayaquil, Ecuador was the occasion of an IOC workshop on the phenomenon of "El Niño."

Several more specialized scientific meetings have been organized in cooperation with other international organizations: hydrodynamics of plankton samplers (Sydney, 1966), micropaleontology of marine sediments (Cambridge, 1967), and geology of the east Atlantic continental margin (Cambridge, 1970). In the spring of 1971, a symposium on Indian Ocean biology and the International Indian Ocean Expedition was held in Kiel; in 1974 a symposium on the polar oceans was held in Montreal, and one on marine plankton and sediments was held in Kiel.

Working Groups

Members of working groups are selected by the Executive Committee. Often the groups are cosponsored by other interested international organizations. During each general meeting, the present status of each group is examined and decisions are reached on reconstitution or disbandment.

Many SCOR working groups have been concerned with problems of oceanographic methodology. Topics have included zooplankton sampling and laboratory methods, determination of photosynthetic pigments and other phytoplankton methods, measurements of photosynthetic radiant energy and estimation of primary production, methods of nutrient analysis, continuous current velocity measurements, and the measurement of deep-sea tides. One group has been concerned with the development of oceanographic tables and standards. Recommendations of these groups are published in the SCOR Proceedings or in one of the UNESCO series, Technical Papers in Marine Science and UNESCO Monographs on Oceanographic Methodology.

Another category of working groups deals with broader scientific questions such as air-sea interaction, micropaleontology of marine sediments, river inputs to ocean systems, east Atlantic continental margins, and the oceanographic basis of ocean monitoring and prediction systems. A group related to the last has examined problems of continuous monitoring in biological oceanography. Consideration also has been given to data exchange problems, particularly those concerning exchange and inventory of biological data.

There have also been several working groups that examined questions of science policy and ocean affairs. In cooperation with other organizations, a general scientific framework for the comprehensive study of the ocean was examined, consideration was given to implementation of U.N. resolutions on resources of the sea, and the scientific aspects of international ocean research were explored. All of these groups have given rise to special publications.

Advice to Intergovermental Bodies

In 1959, UNESCO abolished its own advisory committee and invited SCOR to provide scientific advice in the field of oceanography; in 1960 the IOC followed suit. Part of the cost of this activity has been met by UNESCO and IOC under annual contracts. Advice may be specifically requested by either UNESCO or IOC; on occasion, SCOR voluntarily presents the views of its members or national committees. Technical advice is often developed by working groups which have considered problems of importance to international cooperative expeditions, such as standardization and intercalibration of methods, data exchange, and the establishment of tables and standards.

The advisory activities of SCOR provide an opportunity for scientists to influence the programs and policies of the intergovernmental organizations with great potential for promoting marine science. By this means, scientists can help to ensure that these international programs have a sound technical basis and will serve to increase understanding of the ocean and its resources. Recently SCOR has been particularly concerned over the need to maintain freedom for scientific research on the oceans and has represented this view through ICSU to the U.N. Law of the Sea Conference.

Noteworthy Activities During 1976-77

Physical Oceanographic Studies

A number of SCOR working groups are concerned with studies of ocean circulation. WG 34, on internal dynamics of the ocean, has participated in planning of the international POLYMODE Experiment, to be held in the North Atlantic in 1977-78. An earlier set of oceanographic experiments in the equatorial Atlantic, organized by WG 43 as part of the GARP (Global Atmospheric Reserach Program) Atlantic Tropical Experiment, revealed hitherto unknown transient features of the equatorial circulation. Planning is also under way (by WG 47) for oceanographic programs during the First GARP Global Experiment; these are to take place in tropical regions of the Atlantic, Indian, and Pacific oceans.

Methods in physical oceanography are also receiving attention. Modern profiling devices to measure conductivity and temperature as functions of pressure (depth) and the methods for correcting and calculating other properties are being reviewed by WG 51, and an intercalibration exercise is being considered. Another group, WG 49, is concerned with mathematical modeling of oceanic processes; five issues of a newsletter on ocean modeling have been distributed in the last year [1976].

Still other groups are examining problems occurring in specific ocean regions that include not only physical, but also chemical, biological and, in some cases geological processes. A new group, WG 56, is being organized to look at the time and space variability of equatorial upwelling processes and to suggest appropriate lines of multidisciplinary inquiry. Another group, WG 57, has been established to look at physical processes, and their interaction with other kinds of processes, in studies of esturaries, coastal areas, and shelf seas.

Oceanography and Climate

It has been increasingly recognized that the key to understanding and eventually forecasting climatic changes lies in the surface layer of the ocean. Thus some of the activities discussed above are relevant to the study of climate. SCOR has recently established a Committee on Oceanography and GARP, which is intended to identify, stimulate, and coordinate oceanographic programs linked to GARP, and especially to the second GARP objective, achieving better understanding of the physical basis of climate. SCOR has associated with the Joint Organizing Committee of GARP in convening (in May 1977) a study conference on general circulation models of the ocean and their relation to climate. Two working groups are concerned with specific aspects of the problem. WG 55 is examining possible prediction schemes and indices for "El Niño," the large-scale atmospheric and oceanic perturbation off western South America that was accompanied in recent years by collapse of the anchoveta fishery. A new group, WG 58, will assess knowledge of, and required research for, the Arctic Ocean heat budget and the processes that control it.

Living Resources

Great interest has been shown in recent years in developing the harvest of krill and other living resources of the Southern Ocean. SCOR, together with other organizations (including the Scientific Committee on Antarctic Research), convened a conference on this subject in August 1976 and, through its WG 54, is giving further consideration to a proposed Biological Investigation of the Marine Antarctic System and Stocks (BIOMASS).

A new group, WG 60, is being established to review the status of mangrove ecosystem studies and to work with other agencies in appraising man's impact on these important tropical systems. The group will also deal with methodological problems. Other SCOR activities on biological methods include a study of methods for estimating micronekton abundance, particularly krill, squid, and juvenile stages of fish (WG 52), and a new group (WG 59) to suggest mathematical methods in marine ecology and in the treatment of biological data collections.

Pollution

While SCOR has concerned itself with promoting basic rather than applied research, several of its activities are more or less directly related to problems of marine pollution. Most direct is the continued study of pollution of the Baltic (WG 42), carried on in cooperation with the International Council for the Exploration of the Sea. SCOR participation in this effort facilitates the interaction of academic and fishery scientists within the region. Other groups are concerned more generally with processes whereby pollutants are introduced into the marine environment, either via the atmosphere (WG 44 on ocean-atmosphere materials exchange) or via rivers (WG 46 on river inputs to ocean systems).

Future Prospects

Intergovernmental action in the realm of ocean affairs has been increasingly complicated in recent years by political issues related to maritime jurisdiction. At the time of writing [1977], these issues have not yet been settled by the United Nations Conference on the Law of the Sea. It is to be hoped that the relevant intergovernmental bodies can eventually refocus on the scientific and technical aspects of ocean affairs. In the meantime, marine scientists have developed a variety of ways to promote international cooperation in the conduct of their investigations. Often informal arrangements are made among scientists and their institutions. Occasionally, international research projects are carried out within the framework of bilateral intergovernmental arrangements. In many cases, joint action on scientific problems of international interest can be facilitated by an organization such as SCOR. It seems likely that this mix of approaches will continue in the future and that SCOR will continue to have an important role to play.

(The following was written for this report by Warren S. Wooster and was not published in Ocean Yearbook 1.)

Utility of SCOR for U.S. Marine Scientific Research

SCOR is a mechanism that was created upon the initiative of U.S. scientists who have continued to play a leading role in its activities. The first major SCOR project, the International Indian Ocean Expedition (IIOE) was strongly supported by the United States from its origin and throughout its implementation. Since then, many of the SCOR working groups have been initially proposed in the United States, and U.S. scientists have been members of all such groups and have chaired a majority of them. From the point of view of participation, U.S. scientists clearly see SCOR as a most useful mechanism.

However, the mechanism is used selectively. For example, since IIOE, SCOR has only occasionally been used for the development and implementation of large field programs. Examples include the optical expedition organized aboard R/V Discoverer in 1970 and the development of oceanographic programs related to the GARP Atlantic Tropical Experiment (GATE) and the First GARP Global Experiment (FGGE). In another case, the POLYMODE Experiment, field work was organized outside of SCOR, but a SCOR working group was used in an attempt to broaden international participation.

From the operational point of view, SCOR has more often been used to organize methodological studies and intercalibration experiments (for example, the several intercalibrations of moored current meters carried out under WG 21). SCOR has also provided a useful mechanism for organizing assessments of scientific findings and their presentation in public symposia.

A look at some current SCOR activities illustrates the extent to which they support U.S. scientific interests. Books in preparation include manuals on coral reef and phytoplankton methods and a volume on the physical oceanography of coastal upwelling (based largely on the results of the U.S. CUEA project). A new definition of salinity and an equation of state for seawater have been circulated for review. An atlas of the results of the GATE oceanographic studies is being prepared. Reviews of ocean-atmosphere materials exchanges and river inputs to ocean systems are under way. Oceanographic programs in the equatorial Pacific and Indian oceans are being organized with major U.S. participation. Working groups are undertaking evaluations of the quality of conductivity-temperature-depth (CTD) measurements and of methods for estimating micronekton abundance. SCOR is cooperating with the Scientific Committee on Antarctic Research (SCAR) in the development of the BIOMASS investigation of the Antarctic marine ecosystem. Other groups are concerned with methods for predicting "El Niño," studies of coastal and estuarine regimes, determination of the Arctic Ocean heat budget, mathematical models in biological oceanography, mangrove ecosystems, sedimentation processes at continental margins, and the carbon budget

of the ocean. A new committee on climatic changes and the ocean is being established.

All of these projects are closely related to current ocean research interests in the United States, and U.S. scientists are deeply involved in their execution.

CHAPTER 4

BILATERAL AGREEMENTS ON MARINE SCIENTIFIC RESEARCH

Experience with formal bilateral agreements directly concerning marine research is relatively recent, apart from agreements establishing bilateral fishery commissions with regular staffs. In the case of oceanography, the use of formal bilateral agreements (in contrast to ad hoc, one-time, and private arrangements) began in the 1970s and involves primarily the most advanced maritime nations. Prior to the 1970s, the United States had bilateral arrangements with Canada and Mexico, but these were informal understandings regarding the mechanics of conducting research.

AGREEMENTS CONCERNING FISHERIES RESEARCH

Bilateral agreements regarding fisheries research are essentially a function of extended jurisdiction. Before 1958 when the first, initially modest, extensions of maritime jurisdiction occurred, there appear to have been no such agreements. But as coastal nations began to claim wider areas of control, even as moderate as the extension of the territorial sea from 3 to 12 miles, research in these areas came to be seen as valuable, and arrangements for access and coordination with other nations became increasingly important. Thus cooperative fisheries research increased with the growth in the perceived value of living marine resources.

Some obvious reasons probably explain why nations began to enter into these agreements. In the first phase of extending jurisdiction, from the early 1960s to mid-1970s, most fishing zones were much less than 200 miles wide and failed to include the migratory range of coastal stocks. Distant-water fishing states thus could continue fishing outside coastal jursidiction as well as securing permission to fish within. If a coastal state was to have accurate catch and effort statistics and stock assessments, it had to have the cooperation of the distant-water nations over the entire fishing area concerned. In exchange for allowing the distant-water fleets to enter within national jurisdiction (whether for fishing in certain areas or for transshipment operations or for entry into port), the fishing states agreed to cooperate in research concerning stocks wherever they fished

in the coastal region. This provided the coastal state with management data and benefited the fishing state as well, both directly and indirectly.

The earliest agreements relating to research were those between the neighboring states of the United States and Canada as they struggled with common fisheries problems affecting halibut and salmon in the North Pacific. These agreements led to the earliest fishery commissions and to the development of independent research staffs to carry out the necessary research. Other commissions were formed around the world but very few bilateral agreements existed for the coordination of fisheries research until after 1960 when fisheries zones began to be common. In the North Pacific, the first bilateral agreements on fisheries research were those concluded by the United States and Canada with the Soviet Union and Japan. In the mid-1970s, before the establishment of 200-mile fishing zones, there were nine ad hoc bilateral agreements in force in the eastern North Pacific, some providing for cooperation in fisheries research in addition to several other matters. Three agreements between the United States and the Soviet Union emphasized scientific research, the most important one concerning the northeastern part of the Pacific Ocean off the Pacific Coast of the United States. This agreement came into effect February 13, 1967, and in Paragraph 9 stated:

> Both Governments consider it desirable to expand fishery research in the northeastern part of the Pacific Ocean on species of common interest, both on a national basis and in the form of joint investigations. The competent agencies of the two Governments will arrange for the exchange of scientific data and results of research on the fisheries, for meetings of scientists and, when appropriate, for participation by scientists of each Government in investigations carried out on board research vessels of the other Government. Each Government will, within the scope of its domestic laws and regulations, facilitate entry into appropriate ports for research vessels of the other Government engaged in such joint research.

Pursuant to this arrangement, the two states have held annual (later biennial) meetings of scientists, alternating between Moscow and Seattle, to exchange views on the fisheries of the area. In addition, Soviet research vessels have been permitted access to the U.S. exclusive fishing zone. These research arrangements sometimes pose difficulties in implementation and on one occasion, U.S. misgivings about Soviet performance, coupled with locally intense dissatisfaction over the appearance of Soviet research vessels in the fishing zone, led to suspension of Soviet access under the agreement.

The 1971 agreement, which replaces the 1967 agreement as amended and extended, repeats the substance of Paragraph 9, now elevated to Paragraph 1, and adds detail. It states:

The competent agencies of both Governments shall ensure the following, at least on an annual basis.

a. An exchange of scientific and statistical data, published works and the results of fishery research;

b. Meetings of scientists and, in appropriate cases, the participation of the scientists of each Government in fishery research conducted on the research vessels of the other Government.

The record of accomplishment under these agreements is mixed. Participants do not believe that very much was accomplished from the scientific perspective, although some joint work was done and there were some positive scientific results. A main benefit was some improvement in statistics on Soviet fisheries, although even in this instance the improvement was only relative. Some believe a major gain was the opportunity to discover how the Soviet system of scientific inquiry really operated and to learn of the problems involved in working with Soviet scientists. Those problems include bureaucratic delays, inability to meet commitments such as scheduled cruises, exchanges of personnel and production of data, and the production of inadequate data.

Scientific meetings pursuant to other bilateral agreements were more productive than the US-Soviet agreements. Both the Japanese and Polish arrangements involved joint efforts that worked well and produced more adequate data. These agreements, as well as the US-Soviet agreements, had an impact on U.S. scientific activity in the sense that the United States redesigned its survey activities and altered its methodology.

The first bilateral fisheries research agreements in the Atlantic came in 1967 with the USSR and were soon followed by similar agreements with Poland and Romania. These agreements were similar to those in the Pacific and have been regarded as successful in terms of data exchange, objectivity and acceptability of scientific results, magnitude of joint efforts, and additions to scientific knowledge and understanding. This favorable record of research cooperation needs to be viewed in relation to the International Commission for the Northwest Atlantic Fisheries (ICNAF), a long-established multilateral fisheries organization in the Northwest Atlantic. Although research programs in this region were carried out on a bilateral basis, it is noteworthy that they were developed and reviewed on a multilateral basis using the ICNAF structure. Much coordination of otherwise bilateral activities actually occurred during ICNAF sessions. The existence of this familiar mechanism for multilateral cooperation has had a strongly favorable impact on the development and implementation of bilateral cooperation in research. Indeed the loss of ICNAF as a coordinating mechanism available to the United States (the U.S. withdrew from ICNAF in 1978 in compliance with the Fisheries

Conservation and Management Act of 1976) and its replacement by strictly bilateral activities is considered to have led to some degradation of quality in the scientific effort.

Despite the perceived loss of quality since 1977, cooperative research continues with some intensity. For the period from March 1977 to February 28, 1978, in the North Atlantic region off the United States, there were 19 joint cruises with various nations, including Poland, the German Democratic Republic, the Federal Republic of Germany, Japan, Spain, and the USSR for a total of 538 sea days, approximately 2,000 U.S. scientific man-days, and 2,000 stations. It is anticipated that U.S. involvement with other nations in 1979 in this region will be approximately 658 days of sea time.

In general, cooperation has been attended by few problems. Work with Poland and Romania is reported to present no difficulties whatsoever, while such difficulties as arise with the USSR appear to pertain to general political relationships rather than to marine science cooperation as such. Despite some hindrances, the joint report of cooperative fisheries research with the USSR in the North Atlantic for the decade 1967-77 records several scientific accomplishments.

In addition to bilateral fisheries agreements, the United States and the USSR have an Agreement on Cooperation in the Field of Environmental Protection, which entered into force in May 1972. Pursuant to this arrangement, the two nations conduct a Marine Mammal Project "to develop collaboration research on the biology, ecology and population dynamics of marine mammals of mutual interest to both nations that will contribute toward sound management and conservation of these animals."[1] In addition to exchanges of visits by scientists for laboratory work, field projects, and discussions, scientists from both parties have participated in joint work aboard each other's vessels in the North Pacific. The project convenes meetings of scientists and recently agreed to publish a compendium of papers on the results of the cooperative research under the program since its inception.

Beginning in 1975, bilateral agreements concerning fisheries began to increase noticeably around the world and a number of these contain provisions on research cooperation. It seems probable that, for reasons noted below, this increase in fisheries agreements is directly associated with the accepted widespread extension of national fishery jurisdiction to 200 nautical miles. A recent FAO publication explicitly makes this connection in listing about ninety "selected bilateral fishery agreements concluded as a result of the new regime

[1] The Marine Mammal Protection Act of 1972, Annual Report, April 1, 1977 to March 31, 1978, p. 15.

of the ocean."[2] While most of these agreements apparently deal only with conditions of access to fishery zones, the obligations of flag states, enforcement, and dispute settlement matters, twenty of them contain provisions concerning research. The United States is listed in the FAO study as party to two of these agreements but in fact is party to ten others which contain provisions on research, making a total of at least thirty such agreements out of one hundred. Probably others exist that have not come to attention.

Interestingly, nine developing states are in the group of about twenty-six that have concluded bilateral agreements on research. The agreements provide for such activities as joint scientific programs, meetings and consultations, planning, exchange or submission of data, and training programs. The FAO study contrasts agreements between developed states with those between a developed state (USSR) and developing states. The former call for mutual obligations, while "Agreements providing for joint research activities between a developed and a developing country usually describe in detail the contribution that will be made by the developing country."[3] Several Soviet agreements are cited in this connection. Other such agreements, however, do not fit this mold.

The bilateral agreements by the United States are called governing international fishery agreements (GIFAs), a term used in the legislation extending U.S. fishery jurisdiction. These agreements are perhaps anomalous because they are concluded by a developed state whose major interest is in its own coastal fisheries. Each agreement makes nearly identical provision for coordination of research efforts and for consultation about setting up a new multilateral institution for scientific research. The provisions for research concern stocks within the U.S. fishery zone and are especially important because, under law, the United States must make key catch determinations in accordance with the best available scientific evidence concerning such stocks.

Actions by the United States to implement these GIFA provisions include separate meetings of U.S. scientists with those from Korea, Japan, and the Soviet Union and indirect communications with Polish scientists. But convening a series of separate meetings is not a substantial improvement over previous bilateral arrangements. Invitations have been issued to all GIFA nations to meet as a group but it has not yet [as of this writing, 1977] been possible to find acceptable dates.

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[2] Carroz, J.E. and M.J. Savini. Bilateral Fishery Agreements - A review of bilateral fishery agreements concluded as a result of the new regime of the ocean. (FAO Fisheries Circular No. 709, April 1978) (Doc. No. FID/C709.)

[3] Ibid. p. 3

The motivation for the increase in bilateral agreements as fishing zones expanded is not hard to discern. The purpose in such agreements is simply to secure access to the fisheries of the zones; national legislation often makes such agreement a precondition for access. The research provisions in such agreements are explained by the self-interest of the fishing states in seeing that their coastal fishery management authorities get the best possible information for conservation and management decisions. Such information is likely to facilitate more accurate calculations of stock levels and thus of a potential surplus for foreign fishing. Moreover, evidence of a willingness to cooperate with the coastal state in fishery research may place the foreign fishing state in a more favorable position in the allocation of available surpluses. This latter consideration is in fact written into U.S. legislation and may account for the research by certain nations off U.S. coasts.

AGREEMENTS ON OCEANOGRAPHIC RESEARCH

Most agreements between the United States and other countries for coordinating oceanographic research are part of broad agreements or understandings addressed to science and technology. Sometimes, as with the United States and France, informal agreements are entered into by exchange of letters between executive agencies of the two governments. The United States currently is party to about twenty agreements on science and technology.

The two main bilateral relationships in the North Pacific concerning marine science, apart from the numerous fishery agreements, involve the United States with the USSR and Japan. The US-Soviet agreement deals only with the ocean while the US-Japanese agreement is an umbrella accord for science and technology.

The US-Soviet Agreement on Cooperation in Studies of the World Ocean was concluded and entered into force in June 1973 for a five-year period and has been renewed for a three-year period. The initial agreement was reached in pursuance of two agreements a year earlier concerning cooperation in scientific matters. The 1973 agreement enumerates some scientific areas in which cooperation was to occur and, some of the specific forms of cooperation. It also provides for cooperation and direct contact between entities within the two countries, the creation of a Joint Committee on Cooperation in World Ocean Studies to implement the agreement, and designation of an "Executive Agent" for each party to carry out the agreement.

The agreement has been in place for five years, and the record of cooperation and the relative benefits and costs have been such that the executive branch of the U.S. government has decided to agree to its extension. However, it is apparent from the available assessments that the balance of benefits, although positive from the U.S. perspective, has not been so pronounced in that direction that there

is particularly great enthusiasm for continuation. Public testimony by the Executive Agent for the U.S. side, the NOAA Administrator (Richard Frank), is almost devoid of affirmative evaluation. Instead, it cites numbers of cruises, studies, and joint activities of various kinds, as if this alone were to be understood as the basis for a positive evaluation, even in light of several negative features that were clearly labeled as such. This curious assessment seemed to make a special effort to avoid stressing benefits while candidly describing the difficulties in implementing the agreement. Perhaps the content of this statement reflects that the U.S. decision whether or not to renew was still in process at the time it was delivered.

Other public assessments were far more forthcoming in assessing benefits and disadvantages. The major advantages to the United States appeared to be (1) some increase in the capability to do "big science," primarily because of the usefulness of the added platforms (ships) made available by the Soviets; (2) the opportunity to become informed about the structure and operation of the Soviet scientific establishment; (3) some contribution to specific projects especially POLYMODE, the study of eddies and currents in the North Atlantic, and the International Program of Ocean Drilling.

The difficulties of cooperation in marine science with the USSR are identified by all concerned, but as frustrating as these are they are usually not offered as sufficient reason to terminate the cooperative ocean study agreement. The problems identified are much like those previously experienced in the much smaller scale cooperative activities involved under the US-USSR fisheries bilateral agreements mentioned above. They include the wholly different structure and approach to research in the two countries, most especially the severe difficulties caused by the centralization of decision making in the USSR compared to the more dispersed authority and flexibility in the U.S. system. Other difficulties were differences in technological capability, problems of logistics and communication (again due to the Soviet system of decision making, which fetters the individual scientists), restrictions on travel and publications, and a general unwillingness to interact outside formal arrangements (as indicated by refusals to permit the participation of third-country scientists).

US-Japanese relations in marine science cooperation take place pursuant to various programs begun in the early 1960s. Activities with at least some science content, albeit mostly applied to resource problems, occur under a variety of programs including the US-Japanese Conference on Natural Resources Development (UJNR), the US-Japanese Committee on Scientific Cooperation, and the US-Japanese Environment Agreement. Forms of cooperation include exchange of information and experts, various joint activities, and presentation of papers.

The US-French cooperative program in oceanography had its genesis in discussions in 1968 at working staff levels within the U.S. Marine Science Council and the French Centre National pour l'Exploitation des

Oceans (CNEXO) looking to informal cooperative arrangements in certain specific areas. Subsequently presidents de Gaulle and Nixon discussed programs of scientific cooperation and later discussions were also held between the U.S. Science Advisor and the French Minister for Industrial and Scientific Development, leading to later agreements or understandings at agency levels in the two governments. Because of their earlier discussions, the Marine Science Council and CNEXO were well prepared to spell out the terms of cooperation and they did so in early 1970. The first annual meeting on US-French cooperation in oceanography was convened in 1972. Over the years the program has grown to embrace specific objectives and projects concerning a wide range of research, including marine geology and geophysics, control of marine pollution, marine environmental research, data exchange, oceanographic instrumentation, buoy technology, shelf and coastal sediment dynamics, and aquaculture.

A major feature of this cooperative program is that there was and is no broad overriding agreement between the two parties but rather an exchange of letters between two principally concerned agencies and the designation of a lead agency in each nation as bearing primary responsibility for the activity. Under the stewardship of NOAA in the United States and CNEXO in France, and with the participation of other appropriate agencies, collaboration appears to be guided by agreement on clear objectives and on specific projects. There appear to be special efforts both to assess progress in older projects and to consider proposals for new ones.

CONCLUSION

What is to be learned from this experience with bilateral agreements? A primary lesson with respect to fisheries research arrangements is that they have been too numerous and burdensome. When the United States extended its fishing zone to 12 miles, it took the opportunity to improve its research base by including provisions for both expanded and coordinated research in agreements dealing with foreign access to the new zone. The trouble was that this resulted in a noticeably bothersome increase in the number of scientific meetings that had to be prepared for and conducted. In some instances it became clear that the results, though positive, were not worth the effort. The attitude on this is reflected in the dozen GIFAs concluded under the Fisheries Conservation and Management Act of 1976, all of which contain provision for a multilateral agreement on fisheries research.

Whether this inadequate balance of benefits and costs prevails with other nations' bilateral agreements is unknown. But so far as the United States is concerned, bilateral agreements do not appear to be a serious factor in marine research other than fisheries. We do not have many such agreements and it seems probable that their relative success is due mainly to the characteristics of the

participants and their interactions. Thus the difficulties confronting the US-Soviet agreements on marine research appear to relate to fundamental differences in decision-making structure in terms of decentralization of authority, flexibility in scheduling, ease of communication among scientists within a nation and with outsiders, and other factors bearing on individual choice and the openness of relationships. Such difficulties may not affect all US-Soviet science interactions, but it is obvious that they affected the ones examined here.

On the other hand, cultural and language differences may also be important. The US-Japanese agreement on science and technology does not seem to have made progress so far as the ocean is concerned even though the two parties have substantial overlapping or common interests. It is difficult to understand why this is so, but language problems might be a major contributing factor.

In contrast, the US-French connection seems to be particularly dynamic and productive. The records of the annual meetings reveal a very considerable array of cooperative projects or subject areas to which the participants devote systematic and well-coordinated attention. Each project or area has a lead agency within the governmental structure of each nation and a lead individual is specified. It is perhaps this means of accountability or of focusing attention that explains the appearance of action and movement toward accomplishment of specified goals. It may also be that agreements worked out by interested and involved working-level scientists are those with the best prospects of success. This US-French agreement is one concluded at the working level and its implementation is closely tied to such levels. It can also be speculated that both sides are very advanced in the subject area, and, being at a level of equality, their cooperative activities genuinely move them forward to important shared goals. It may be surmised that overall umbrella agreements concluded for high-level political purposes do not enjoy much prospect for success unless they are implemented and draw upon working level scientists or government personnel closely involved with scientific activities.

CHAPTER 5

INTERNATIONAL ASPECTS OF THE U.S. PROGRAM FOR THE INTERNATIONAL DECADE OF OCEAN EXPLORATION

The United States program for the International Decade of Ocean Exploration (IDOE) was the nation's major international marine science effort during the 1970s. The IDOE experience with international participation provides a useful basis for speculating on the kinds of domestic and international mechanisms needed to facilitate such oceanographic research in the future. This chapter reviews the international dimension of the U.S. IDOE program and, based on the experience of many of the individual projects, presents a number of of recommendations to enhance prospects for U.S. involvement in international oceanography during the 1980s.

THE IDOE EXPERIENCE

President Johnson's 1968 call for an international decade of ocean exploration provided a powerful impetus for international participation. Subsequent endorsements by the United Nations General Assembly and the Intergovernmental Oceanographic Commission reiterated the interests of the international community in long-term, collaborative efforts better to understand the oceans and their resources.

It was anticipated that the IDOE would require significant levels of international planning and coordination. These planning activities were to focus on the most promising geographic areas and lines of inquiry, set priorities, and agree on the sharing and distribution of effort. Data collection was to be standardized and the results were to be freely published. There was to be expanded activity by a large number of nations and greater coordination among the international organizations concerned with the oceans. In short, the planners saw the IDOE as a period of "intensified collaborative planning among nations and expansion of exploration capabilities by individual nations, followed by execution of national and international programs

of oceanic research and resources exploration so as to assemble a far more comprehensive knowledge of the sea in a reasonably short time."[1]

The anticipated success of the effort depended largely on the "extent to which various nations contribute their particular expertise and capabilities, assume a share of responsibility for the program, develop their manpower and facilities and disseminate to others the results of scientific and other discoveries."[2]

There were high expectations. In retrospect, they were perhaps too high. Few nations had major oceanographic programs. Even fewer were organized to respond rapidly to this vision of a global research effort. Although the traditional legal regime for ocean research had slowly started to erode during the formative years of the IDOE, it did not seriously impede the momentum of the program. The real difficulty was in inventing international cooperative approaches where none had existed in the past, in relying on personal contacts with foreign scientists, and in designing scientific projects with enough appeal to attract scientists from abroad.

The IDOE itself marked a major departure in the conduct of oceanographic research. Before 1969 when the U.S. role in the IDOE was assigned to the National Science Foundation, marine research had been built largely around the major oceanographic disciplines (biological, chemical, and physical oceanography, and geology and geophysics.) Although there were a few large-scale cooperative research efforts such as the International Indian Ocean Expedition, most of the research carried out during the 1950s and 1960s was done by individuals or small groups of scientists pursuing problems defined by their respective disciplines. The IDOE sought to complement this approach by supporting large-scale, long-term research, drawing on the skills and expertise of specialists from a variety of disciplines. In terms of participation by scientists and institutions, project duration and dollars spent, the IDOE was much larger and more complex than any single program that had preceded it. Table 5-1 shows some of these features.

Throughout the first eight years of its history, for example, IDOE provided $14 million to $20 million each year for between 14 and 17 major projects. This accounted for 11 to 16 percent of the total federal oceanographic research support during that period.

Despite some IDOE planners' preference for an applied research emphasis, administration of the program by National Science Foundation-based oceanographers virtually assured that projects would

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[1] Marine Science Affairs - A Year of Broadened Participation. The Third Report of the President to the Congress on Marine Resources and Engineering Development, January 1969, p.125.]

[2] Ibid. p. 126.]

TABLE 5-1 Some Characteristics of Major IDOE Projects

Class	Name	Cost[a]	Rate[b]	Life[c]	Institutions[d]
I	NORPAX	30.0[e]	2.1	14	12
I	MODE/POLYMODE	23.0	2.9	8	16
I	GEOSECS	22.5	2.5	9	11
I	CUEA	21.5	2.7	8	15
II	Manganese Nodules	12.0	1.1	11	10
II	Nazca Plate	9.0	1.5	6	3
II	CEPEX	9.0	1.1	8	5
II	CLIMAP	8.4	0.9	9	7
II	ISOS	7.5	1.2	6	7
II	Continental Margins	6.3	1.3	5	7
III	SES	5.0	0.7	7	8
III	Metallogenesis	4.8	0.8	6	6
III	Pollutant Transfer	4.5	0.9	5	9
III	SEAREX	4.5	0.9	5	6
III	Biological Effects Laboratory	4.3	1.1	4	8
III	PRIMA	4.0	0.8	5	5
IV	Pollutant Baselines	2.6	1.3	2	17
IV	CENOP	2.5	0.8	3	11
IV	Mid-Atlantic Ridge	1.5	0.5	3	4

[a]In millions of dollars, total for project.
[b]Annual spending rate, in millions of dollars per year.
[c]Estimated duration in years.
[d]Number of participating institutions.
[e]Including about $15 million from ONR.

SOURCE: NRC, 1979, p. 11.

emphasize basic research. International participation in the U.S. IDOE program was seen as an important adjunct to this country's projects. The basic considerations for involving foreign scientists were overall quality of the science, their likely contribution to the goals of the project, and contributions of resources like ship time and staging areas for equipment or laboratory facilities. At no time was the U.S. role treated as a foreign assistance program designed explicity to aid other countries in developing their oceanographic research capabilities.[3]

Considering this general encouragement of the project leaders developing international involvement, it is hardly surprising that there was no single prescribed format or approach shared by the projects. Each originated from a variety of scientific interests. Several projects had political origins but were built on established scientific contacts. A few had strictly political origins and were forced into patterns of international cooperation that were not always compatible with scientific interests. Others resulted from personal contacts and shared scientific interests.

[3]Those responsible for the National Science Foundation's marine research program clearly recognized the need to encourage development of oceanographic skills and capabilities in the developing countries. Funding was never sufficient, however, to pursue such a program.

The diversity of the projects makes it hard to reduce the IDOE experience to a few simple rules or guidelines. Nonetheless, there are several observations that are appropriate for future global ocean research programs.

First, every effort must be made to distinguish foreign policy objectives from scientific objectives in future international projects. There has been a trend over the past decade to use scientific agreements as instruments of foreign policy. Rarely, however, have administration officials consulted the affected agencies about the implications of these agreements for their science programs. No such commitments should be made without such consultation and without providing adequate funding to ensure the support of the agency and the long-term prospects for the project's success. Moreover, when science must be used to promote foreign policy goals, every effort must be made to segregate policy and administration from the actual conduct of the research. POLYMODE, the joint US-USSR project to study the statistics and dynamics of oceanic eddies, was largely successful in separating politics from management of the scientific program. Once the formal agreement, the US-USSR Cooperative Studies of the World Ocean, was signed in 1973, project planning essentially was left in the scientists' hands.

Second, somewhere in the federal oceanographic establishment there must be a place where international projects can be developed or used as the basis for agreements such as POLYMODE. The rationale for international participation in the IDOE is still valid even after the conclusion of the program. Oceanography is expensive and increasingly complex. One approach to these difficulties is to pool resources and scientific skills. The IDOE was aptly suited to this role because of its initial mandate and because it was able to attract many scientists with extensive international contacts.

A corollary to this point is that distant-water oceanography cannot be achieved easily without a firm, long-term commitment by the sponsoring agency to support this work. This includes not only a commitment to long-term funding, but also some display of sensitivity to the political implications of these joint scientific endeavors. Cancellation of the Controlled Ecosystems Pollution Experiment (CEPEX) by the National Science Board, the governing body for the National Science Foundation, illustrates the consequences of failing to consider these implications.

In response to IDOE's encouragement of international participation, as well as the scientific opportunities associated with CEPEX, scientists from Canada, Germany, Japan, and the United Kingdom took part in this project. Two weeks before the start of the 1979 field season, however, the National Science Board refused to renew funding for the project, or even to support a rational phasing out of the work, apparently for what members perceived as scientific deficiencies. No official explanation was provided to the foreign scientists planning

to join the project for the summer field season, or to the Canadian hosts. Not surprisingly, this insensitive handling of CEPEX by the National Science Board rankled the Canadians in particular, and does not provide an auspicious precedent for cooperative efforts of this kind in the future.

A third dimension involves adequate funding support by the sponsoring agency not simply for the project itself, but for the travel and contact necessary to lay the foundation for future collaborative efforts. This would appear to be self-evident. It is not. Those IDOE projects that were especially successful in attracting participation from abroad were based on personal contacts and shared professional interests developed years before the advent of the IDOE. Agencies with existing or potential international ocean research responsibilities must view travel abroad, scientific workshops, conferences, and professional presentations as investments in the future, not as luxuries. This support extends to nongovernmental organizations like SCOR and its parent national committees.

Fourth, whenever preliminary planning indicates that an oceanographic project will be of sufficient scope, duration, or regional significance, the sponsoring agencies, in collaboration with the Department of State, should seek the endorsement of appropriate international organizations. Those in the UNESCO family of organizations are especially important, such as SCOR, the IOC, and, for fisheries matters, the FAO.

Endorsement of most U.S. IDOE projects with substantial international aspects, such as the Eastern Atlantic Continental Margin project, the Coastal Upwelling Ecosystem Analysis (CUEA) project, and CEPEX, facilitated that work in two ways. First, the process of endorsement and participation in international meetings enabled scientists to identify and meet their counterparts in the interested countries. These contracts later proved extremely valuable in resolving problems such as vessel clearances and in expediting customs requirements.

Also, endorsement by an international organization provides important leverage for foreign scientists to persuade their own governments about the importance of national participation in these projects.

Fifth, in mounting explicitly international ocean research efforts, funding agencies must try to ensure sufficient funds so foreign scientists can participate in the planning and conduct of the projects. For the most part, IDOE support for foreign nationals was limited to the workshop and planning stages, though a number of projects budgeted funds for travel, data analysis, and joint publication. Although the outcome of the current law of the sea negotiations may make these additional costs inevitable, it is prudent

to acknowledge them now and begin to plan not only for the costs, but also for the logistical and communications problems likely to be associated with this comprehensive form of international participation.

Sixth, the form taken to nurture international participation should remain flexible. It should hinge on the scientific and foreign policy goals of the project. If the experience of the IDOE is any guide, there can be no single, prescribed approach to the conduct and management of future international ocean research efforts. In the Eastern Atlantic Continental Margin project, for example, representatives from developing countries participated primarily because of the personal efforts of Dr. K. O. Emery of the Woods Hole Oceanographic Institution. In JOINT-II, the coastal upwelling experiment off Peru, the project was facilitated by a scientific liaison officer housed for the field experiment's duration in Peru's Instituto del Mar del Peru (IMARPE). Scientific planning for POLYMODE was carried out by a joint organizing committee cochaired by an American and a Russian and composed of members from both countries.

Finally, there must be specialists within the agencies that sponsor global ocean research who are intimately familiar with the politics, history, and personalities of the international oceanographic community. Their express role should be to act as brokers between scientific project leaders, the domestic agencies (in particular the Department of State), and representatives of foreign government. Having this skill available in the IDOE office was an invaluable asset in resolving problems as diverse as vessel and customs clearance to locating sources of fuel for U.S. research vessels. To be most effective, however, these specialists must be flexible enough to develop personal contacts throughout the international oceanographic community and to work closely with project scientists. These kinds of responsibilities should not (and probably cannot) be tackled effectively by assigning a specialist from a separate section of an agency on an ad hoc basis.

REFERENCE

National Research Council (1979) The Continuing Quest: Large-Scale Science for the Future. Post-IDOE Planning Steering Committee, Ocean Sciences Board, Assembly of Mathematical and Physical Sciences. Washington, D.C.: National Academy of Sciences.

CHAPTER 6

POSSIBLE OUTCOMES OF UNCLOS III AND THEIR IMPLICATIONS FOR THE REGIME GOVERNING THE CONDUCT OF MARINE SCIENTIFIC RESEARCH

At the time of writing (January 1981), two possible outcomes of UNCLOS III seem likely: (1) A treaty completed in the near future, say 1982 or 1983, followed by signatures, the required number of ratifications over time, and entry into force between five and ten years after signature; (2) A completed treaty in the near future, followed by some signatures but without the necessary ratifications for entry into force. Both alternatives are possible with the U.S. choosing to sign but not ratify or choosing neither to sign nor ratify. The implications of such U.S. actions for the conduct of marine scientific research need to be assessed.

With or without a law of the sea treaty by 1983, general trends in the use of marine resources and national claims to offshore jurisdiction can be anticipated. Whether a conference text is ultimately voted, signed, and ratified, UNCLOS III has produced texts and a legislative history that delineate certain generally accepted rules. And those states that would have been willing to sign a treaty will probably choose to observe these rules even if there is no treaty.

In brief, the next decade will witness a continued increase in ocean use and ocean resource exploitation with the concomitant problems of crowding, ocean pollution, and conflicts between users. The proposed law of the sea treaty would do little to change this situation since: (a) it does not even address the principal sources of pollution (land-based activities); and (b) it does not address problems of multiple use conflicts. The bulk of ocean resource activities will be carried on within 200-mile zones under the regulation and control of national governments.

Conflicts will continue over the delineation of national boundaries as well as over the interaction of national and international uses of the zone and their impact on neighboring states. A treaty would do little to alter this since it cannot prescribe a universally applicable delimitation formula nor can it restrict national activities in the zone in the face of strong coastal state resistance.

Marine scientific research will have to develop new bilateral and multilateral mechanisms under the consent regime that will emerge. Marine science will be required to seek consent for research throughout the continental margin as well as within the 200-mile zones. Coastal states may attempt to limit publication of research results concerning areas of national jurisdiction.

Mining of manganese nodules in the Pacific Ocean will not begin until the late 1980s on early 1990s whether under an internationally negotiated regime or in accordance with national legislation. Given present and projected demand and supply for nodule minerals, there is no pressing need to undertake deep-sea mining before then.

Whether there is a complete treaty, a partial treaty, or no treaty, certain aspects of the present approach to ocean management are intrinsically unstable. Nations are attempting to regulate ocean space as if it were land by drawing arbitrary boundaries through waters that constitute an ecological whole. By the 1980s it will become increasingly evident to coastal states that they cannot successfully manage the resources of their coastal zones without reference to adjacent ocean areas.

Some of the activities of other coastal states, whether in adjacent zones or on the high seas, will undercut even the best of management schemes for conservation, environmental protection, or resources exploitation. When this fact becomes unavoidable, two trends will emerge: regional management and pressures for the expansion of coastal state jurisdiction. Where the economic zones of two or more states are adjacent, coastal states will be forced to adopt cooperative approaches for the management of some fisheries, offshore industries, and the like. Particularly in enclosed and semienclosed seas, the need for regional management of ocean resources will be unavoidable. Even as diverse and incompatible a group as the Mediterranean littoral states has come to the reluctant conclusion that their offshore pollution problems can be resolved only cooperatively.

The second and inconsistent trend will be toward expanded coastal state claims where offshore areas front on open (i.e., unclaimed) ocean. The high seas activities of flag states--whether for navigation, fishing, use of ocean thermal energy, or deep-sea mining--will have a potential impact on the coastal state's management of resources within its 200-mile zone. And even if there is no significant impact, the resources just beyond 200 miles will become tempting to coastal states as they consolidate their control over those within 200 miles. In the absence of agreement on a deep seabed treaty, there will be little to weigh against coastal state expansionism. If, for instance, a developed nation were to begin mining manganese nodules 250 miles off the Pacific coast of Latin America, the nearest coastal state will probably extend its jurisdiction to include the prospective site.

In the absence of forceful and concerted disapprobation, a logical end point of national moves would be the total carving up of ocean space into national areas with international cooperative efforts dictated by the circumstances of particular areas and uses. Because of the oceans' critical role in world transportation, a truly global international approach to shipping would be required. A similar approach to marine pollution might be useful because of the intermingling of ocean waters, but it would rest primarily on regional arrangements. Fishing would ultimately dictate cooperation on the basis of ecologically interdependent stocks with special management approaches for anadromous and highly migratory species. Offshore oil recovery does not per se require international management except where the common pool problem arises or where drilling activities pose environmental hazards for other states. None of these international or regional approaches to ocean management will be undertaken voluntarily or in the near future. Coastal states will be driven to cooperation only after strictly national approaches clearly prove inadequate. Thus, as in the case of Mediterranean pollution, we must expect to see near-crisis situations of pollution, overfishing, or navigational accidents before states are forced to resort to cooperative measures.

Apart from these general trends, however, special problems are created for the conduct of marine scientific research, as for other ocean uses, if the United States either signs but does not ratify a treaty or neither signs nor ratifies a treaty.

It is likely that any form of U.S. rejection of a Law of the Sea Treaty would stimulate similar action by others, particularly among the advanced maritime states and the Group of Landlocked and Geographically Disadvantaged States. In that event, the U.S. would have to bear the onus of preventing the consummation of a new ocean regime so arduously negotiated over such a long period of time. The consequence of this would be a significant increase in the salience of the issue globally and a concomitant increase in conflict between the U.S. and a large number of coastal states. United States marine scientific research would suffer seriously in this conflict because these coastal states will probably link U.S. ratification of the treaty to a host of other ocean-related and non-ocean-related issues in which the U.S. would be interested. In such a situation, it would be very difficult to conceive of clearances for U.S. vessels to work in foreign economic zones being easily granted.

Moreover, widespread rejection of a treaty stimulated by U.S. action would probably lead to more extreme clauses by coastal states with respect to their jurisdiction within, and perhaps beyond, 200 miles. Certainly the protections written into the treaty with respect to the promotion of research within the confines of carefully negotiated principles, obligations, and procedures designed to protect both coastal and researching states would be lost, to the detriment of the researching state. It is also probable that the standardization

of obligations on the researching state would be lost, thereby seriously increasing the level of uncertainty in negotiating clearances. In that event, coastal states are likely to demand adherence to obligations and conditions more onerous than those contained in the treaty.

Finally, rejection of a treaty would immediately destabilize the recent consensus on national boundaries in the ocean. While this may occur in the long run, given certain trends mentioned above, there are no benefits to be derived from stimulating a new round of negotiation in the short run.

But what if the United States signs and ratifies the treaty, yet the total number of ratifications is insufficient to allow entry into force? In that event, the critical question would be, Which states have ratified and which have not? If most of the major coastal states (developed and developing) of the world have ratified, then this would constitute a sufficient basis for a workable quasi-regime since the nations that use the oceans would be included. Since developing states with long coastlines, wide continental margins, and significant living and nonliving resources off their coasts gain considerably from a treaty, it is difficult to see any value for them in refusing to ratify. Some major maritime states, of course, are geographically disadvantaged and gain little from the new regime, but their displeasure is constrained by their need to maintain a certain level of order in the ocean and to protect their navigational interests.

If on the other hand, the ratifications received do not include the major coastal states of the world, then the regime will have broken down and the future will be difficult. In that event, is it likely that the United States would increase pressure on other states to sign and ratify to the extent of increasing the number of deliberate U.S. challenges to their claimed jurisdiction? Although a moderate increase in U.S. pressure could be expected, it would probably not increase to the level of systematic and deliberate challenges for two reasons. First, this would raise the ocean regime issue to a very high level of salience globally, thereby contaminating a wide range of issues important to the United States. Second, the successful implementation of such a policy would require a much higher level of internal bureaucratic consensus and effective coordination across several departments than is likely to be forthcoming.

CHAPTER 7

THE REGIME GOVERNING THE CONDUCT OF MARINE SCIENTIFIC RESEARCH AS DEFINED IN THE DRAFT CONVENTION ON THE LAW OF THE SEA*

The regime that emerged in the Draft Convention is without a doubt largely in favor of the coastal state and significantly burdensome to the researching state, though the latter retains certain benefits and protections, some of them significant, within 200 miles. Article 246 provides that coastal states have the right to "regulate, authorize and conduct" marine scientific research in their exclusive economic zone and on their continental shelf. Furthermore, marine scientific research undertaken in those two areas "shall be conducted with the consent of the coastal state." In connection with this, Article 296(2) specifically excepts these decisions or those suspending or terminating a research project in accordance with Article 253 from the applicability of the Settlement of Disputes provisions. It should be noted also that while a researching state can invoke a conciliation procedure in the event it alleges that the coastal state is not exercising its rights under Articles 246 and 253 in a manner compatible with the Convention, the conciliation commission "shall not call in question the exercise by the coastal state . . . of its discretion to withhold consent in accordance with paragraph 5 of Article 246."

Two significant benefits given to the researching state are that coastal states shall "in normal circumstances" grant their consent and that "normal circumstances" may exist in spite of the absence of diplomatic relations between the two parties. However, paragraph 5 of Article 246 specifies that the coastal state has the right of discretionary denial in four situations. These occur if the project:

(a) is of direct significance for the exploration and exploitation of natural resources, whether living or non-living;

*This chapter was taken from Miles, E. (1982) The future of U.S. distant-water oceanography in the new ocean regime. In Oceanography: The Present and Future, edited by P.G. Brewer. New York: Springer-Verlag. (In press). Reprinted here by permission.

(b) involves drilling into the continental shelf, the use of explosives or the introduction of harmful substances into the marine environment;

(c) involves the construction, operation or use of artificial islands, installations and structures referred to in articles 60 and 80;

(d) contains information communicated pursuant to article 248 regarding the nature and objectives of the project which is inaccurate or if the researching State . . . has outstanding obligations to the coastal State from a prior research project.

Another significant benefit to the researching state provided by the Draft Convention concerns research on the continental shelf beyond 200 miles. Article 246(6) stipulates that the right of discretionary denial affecting research on the continental shelf beyond 200 miles may not apply outside areas publicly designated by the coastal state as being "areas in which exploitation or detailed exploratory operations . . . are occurring or will occur within a reasonable period of time."

Articles 248 and 249 specify the set of obligations operative on the researching state and to which penalities for non-fulfillment may be attached. No less than six months (180 days) in advance of the expected starting date of the project, the researching state must provide the coastal state with a full description of:

a) the nature and objectives of the research project;

b) the method and means to be used, including name, tonnage, type and class of vessels and a description of scientific equipment;

c) the precise geographical areas in which the activities are to be conducted;

d) the expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate;

e) the name of the sponsoring institution, its director, and the person in charge of the research project; and

f) the extent to which it is considered that the coastal State should be able to participate or to be represented in the research project.

These requirements both extend the lead time for detailed planning of research projects[1] and, in paragraph (f), raise the possibility of increasing the costs of research to the researching state. The types of obligations which may increase costs are more specifically described in Article 249 and relate to participation of representatives of the coastal state in the research project. This may involve both travel and per diem costs during the planning phase and loss of ship space to the researching state by the need to accommodate representatives of the coastal state.[2] This may occasionally require a greater amount of ship operating time in a particular area than would normally be the case. Increased costs may also arise with respect to duplicating data and samples for the coastal state and with the need to assist the coastal state in their assessment or interpretation. The full list of additional obligations is reproduced below.

1. States and competent international organizations when undertaking marine scientific research in the exclusive economic zone or on the continental shelf of a coastal State shall comply with the following conditions:

    a) Ensure the rights of the coastal State, if it so desires, to participate or be represented in the research project, especially on board research vessels and other craft or scientific research installations, when practicable, without payment of any remuneration to the scientists of the coastal State and without obligation to contribute towards the costs of the research project;

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[1] It should be noted that in one sense the six-month lead time requirement will not have a major effect since scientists currently plan research projects a year or more in advance. The specific effect is that the details of such plans will have to be firm much earlier than previously in order for clearance requests to be submitted on time. It is the author's understanding that the U.S. Department of State is prepared to assist U.S. researching institutions by submitting for clearance requests which are not complete in all details with the proviso that additional information will be forwarded as it becomes available.

[2] Currently, all clearance requests submitted by the Department of State offer berths to foreign observers. This provision has been agreed to by the University National Oceanographic Laboratory System (UNOLS). In most cases so far, the host government has not sent observers. While travel costs are paid by the researching institution, these costs have not been significant when compared to total costs.

b) Provide the coastal State, at its request, with preliminary reports, as soon as practicable, and with the final results and conclusions after the completion of the research;

c) Undertake to provide access for the coastal State, at its request, to all data and samples derived from the research project and likewise to furnish it with data which may be copied and samples which may be divided without detriment to their scientific values;

d) If requested, provide the coastal State with an assessment of such data, samples, and research results or provide assistance in their assessment or interpretation;

e) Ensure, subject to paragraph 2, that the research results are made internationally available through appropriate national or international channels, as soon as feasible;

f) Inform the coastal State immediately of any major change in the research program;

g) Unless otherwise agreed, remove the scientific research installations or equipment once the research is completed.

Paragraph 2 of Article 249 is particularly important to researching states since it deals with the problem of controls on publication. The formulation is as follows:

> This article is without prejudice to the conditions established by the laws and regulations of the coastal State for the exercise of its discretion to grant or withhold consent pursuant to Article 246, paragraph 5, including requiring prior agreement for making internationally available the research results of a project of direct significance for the exploration and exploitation of natural resources.

This means that as a prior condition to granting consent, the coastal state may require restraints on publication for research of direct significance for the exploration and exploitation of natural resources. Presumably, it is the coastal state that makes such a determination. Furthermore, the cross-reference in Article 249, (1) (e) shown above, limits the obligation to make research results internationally available to possible coastal state restrictions as

specified in Article 249 (2).[3] This is a matter of grave concern for university-based oceanographers in the U.S. since most universities and granting agencies require open publication of research results.

Article 250 stipulates that all communications between the coastal and researching states concerning research projects "shall be made through appropriate official channels unless otherwise agreed." This means, first, that the request for consent process has been made completely formalized and that, in most cases, the agency to which the application must be addressed is the Ministry of Foreign Affairs of the coastal State in question via the U. S. Department of State. However, the words "unless otherwise agreed" leave the door open to less-formal arrangements.

The last two substantive provisions which shall be discussed are those dealing with the conditions for inferring implied consent (Article 252) and the conditions under which research projects can be suspended or terminated. The implied consent formulation is a benefit for the researching state. It reads:

> States or competent international organizations may proceed with a research project upon the expiry of six months from the date upon which the information required pursuant to Article 248 was provided to the coastal State unless within four months of the receipt of the communication containing such information the coastal State has informed the State or organization conducting the research that:
>
> (a) it has withheld its consent under the provisions of Article 246; or
>
> (b) the information given by the State or competent international organization in question regarding the nature or objectives of the research project does not conform to the manifestly evident facts; or
>
> (c) it requires supplementary information relevant to conditions and the information provided for under Articles 248 and 249; or

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[3] It should be noted that another interpretation of the effect of Article 249 (2) exists, to wit: Article 249 (2) serves to limit the exercise of coastal state authority as provided for in Art. 246 (1). Discretionary denial of consent by coastal state, therefore, is permitted only on the conditions specified in Article 246 (5). Whether this interpretation is persuasive remains to be seen.

(d) outstanding obligations exist with respect to a previous research project carried out by that State or organization, with regard to conditions established in Article 249.

However, it is necessary to point out that paragraph (c) provides the coastal state with a considerable capacity for delay in the event that, for other reasons, it does not wish to deny consent outright. Moreover, paragraph (d) makes each researching institution his brother's keeper, since outstanding obligations from one institution can be the cause of denying consent and suspending or terminating the research projects of others. The point here is that it is the researching state which undertakes the obligation and clearances for single institutions through formal channels in each case commit the whole state.[4]

With respect to suspension of marine scientific research activities (Article 253), the coastal state may exercise its right if: (a) the research activities are not being conducted in accordance with the information provided under Article 248 upon which consent was based; or (b) the research state fails to comply with the obligations specified in Article 249. The coastal state may terminate a research project if: (a) non-compliance with Article 248 amounts to a major change in the research project or the research activities; or (b) if situations leading to suspension have not been rectified within a reasonable period of time. On the other hand, Article 253 (5) also specifies that suspension shall be lifted and marine scientific research activities allowed to continue once the researching state or competent international organization has complied with the conditions required under Articles 248 and 249.

While these are not all the articles concerned with marine scientific research in the Draft Convention they are the most restrictive and therefore among the most important for researching states. The fact that marine scientific research remains relatively unregulated in the water column beyond 200 miles and in the international seabed area is also important. Changes in the world ocean regime, however, have come about through unilateral actions of coastal states as well as through decisions of UNCLOS III, and these must be assessed as well.

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[4] The implied consent provision may actually be useful in only a limited number of cases. For instance, when a coastal state (i.e., Ministry of Foreign Affairs) has problems in acquiring consent or even responses from other national governmental agencies whose approval is required, this provision will permit the researching institution to enter the zone even if the coastal state takes no action. Secondly, Article 252 will also be helpful when, for political reasons, the coastal state does not wish to grant formal approval even though it does not object to the research being conducted.

CHAPTER 8

TRENDS IN NATIONAL LEGISLATION AFFECTING MARINE SCIENTIFIC RESEARCH

In many areas of the world, coastal states have extended their jurisdiction over the conduct of marine scientific research within 200 nautical miles of their coasts.[1] Approximately 40 percent of U.S. oceanographic research is conducted within the area claimed.

This chapter summarizes which coastal nations claim jurisdiction over marine scientific research within their 200-mile zones, reviews certain pieces of national legislation and compares them with provisions in the Draft Convention on the Law of the Sea, and examines rules and regulations promulgated by various coastal states for marine scientific research.

SUMMARY OF 200-MILE NATIONAL MARITIME CLAIMS

As of February 1981, there were 135 coastal nations; 88 of these claim jurisdiction over a 200-mile zone.[2] Most of these 200-mile

[1] Office of the Geographer, Department of State, National Maritime Claims, 1979.

[2] The 88 states, in alphabetical order, are: Angola, Argentina, Australia, the Bahamas, Bangladesh, Barbados, Benin, Brazil, Burma, Canada, Cape Verde, Chile, Colombia, Comoros, Congo, Costa Rica, Cuba, Denmark, Djibouti, Dominican Republic, Ecuador, El Salvador, Federal Republic of Germany, France, German Democratic Republic, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Iceland, India, Ireland, Ivory Coast, Japan, Kampuchea, Kenya, Kiribati, Korean People's Democratic Republic, Liberia, Malaysia, Maldives, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Nauru, Netherlands, New Zealand, Nicaragua, Norway, Oman, Pakistan, Panama, Papua New Guinea, Peru, Philippines, Poland, Portugal, Republic of Korea, Sao Tome and Principe, Senegal, Seychelles, Sierre Leone, Solomon Islands, Somalia, South Africa, Soviet Union, Spain, Sri Lanka, Suriname, Sweden, Togo, Tongo, Tuvalu, Ukrainian SSR, United Arab Emirates, United Kingdom, United States, Uruguay, Vanuatu, Venezuela, Vietnam, and Yemen (Aden).

claims deal with resource jurisdiction but encompass a variety of regimes; i.e., a 200-mile territorial sea, a 200-mile fisheries zone, and a 200-mile economic zone. A 200-mile territorial sea is one in which the coastal state has full sovereignty subject only to the right of innocent passage. The 200-mile fisheries zones vary in their jurisdictional claims. One type of fisheries zone is simple extension of national fishery limits; e.g., U.K., Fishery Limits Act, 1976. Another type of jurisdiction specifically details management provisions of the fisheries, including catch allocation and access to foreign vessels; e.g., U.S. Fishery Conservation and Management Act, 1976. The third type of 200-mile fishery zone is one in which the coastal state not only asserts jurisdiction over fisheries activities but includes jurisdiction over scientific research and marine pollution as well. See Fishing Zones of Canada (Zones 4 and 5) Order, January 1, 1977, and the Fishing Zones of Canada (Zone 6) Order, March 1, 1977, both promulgated under the Territorial Sea and Fishing Zone Act of 16 July 1964 as amended by the Act of 1970. A 200-mile exclusive economic zone is one in which the coastal state claims sovereign rights over all of the resources of the zone and jurisdiction over research and marine pollution, e.g., Burma: Territorial Sea and Maritime Zones Law, 1977.

Because the number of 200-mile claims has greatly increased over the last two years, most of the source material is at best difficult to obtain. After reviewing pieces of national legislation or other available documents, it is estimated that out of the 88 coastal states, at least 69 specifically or indirectly claim jurisdiction over marine scientific research within their 200-mile zones. The breakdown is as follows: 41 states clearly claim jurisdiction over marine scientific research as stated in an actual law or decree. These states are: Argentina, the Bahamas, Barbados, Brazil, Burma, Cape Verde, Chile, Colombia, Cuba, Dominican Republic, Ecuador, Grenada, Guatemala, Guyana, India, Ivory Coast, Japan, Kenya, Maldives, Malaysia, Mauritania, Mauritius, Mexico, Morocco, Nauru, New Zealand, Norway, Pakistan, Peru, Portugal, Sao Tome and Principe, Seychelles, Solomon Islands, Spain, Sri Lanka, Suriname, Tuvalu, Uruguay, Venezuela, Vietnam, and Yemen.

Although not specifically stated in the legislation or other sources of documentation, 14 states claim a 200-mile territorial sea and, assuming the conventional rights of exclusive jurisdiction within the territorial sea, it can be inferred that these nations would exercise some jurisdiction over scientific research. These states are Argentina, Benin, Brazil, Congo, Ecuador, El Salvador, Ghana, Guinea, Liberia, Panama, Peru, Sierre Leone, Somalia, and Uruguay. An additional 19 states claim jurisdiction over "activities" related to fisheries or living and nonliving resources within their 200-mile zones. It can be inferred that the jurisdiction covers marine scientific research where it is related to the fisheries or other natural resources. These states are Angola, Bangladesh, Canada (fisheries research), Comoros, Costa Rica, France, German Democratic

Republic, Haiti, Honduras, Iceland (fisheries research), Netherlands (fisheries research), North Korea, Mozambique, Nicaragua, Poland (fisheries research), Senegal, Soviet Union (fisheries research), Togo, and United Arab Emirates. In the legislation of eight coastal nations, there is no mention of jurisdiction over scientific research. These nations are Australia, Denmark, Federal Republic of Germany, Ireland, Kiribati, Oman, South Africa, and United Kingdom. Only one coastal nation, however, explicitly excludes scientific research from its jurisdiction; this is the United States. Documentation was not available for ten coastal nations, each of which claims a 200-mile mile: Djibouti, Guinea Bissau, Kampuchea, South Korea, Papua New Guinea, Philippines, Sweden, Tongo, Ukrainian SSR, and Vanuatu.

NATIONAL REGULATION OF MARINE SCIENTIFIC RESEARCH

Burma[3]

On April 9, 1977, Burma's president signed into law the Territorial Sea and Maritime Zones Law, which has been approved by the People's Assembly. The law defines Burma's territorial sea, contiguous zone, continental shelf, and exclusive economic zone and sets forth the degree of control exercised over each area.

Chapter V, sections 17-20, of the Burmese law establishes an exclusive economic zone extending 200 miles from the normal baseline.

Article 18 defines the rights of the Burmese state in terms similar to the language of Article 56 of the Draft Convention on the Law of the Sea. Under paragraph (c) of this article, the Burmese state has exclusive jurisdiction to authorize, regulate, and control scientific research. This law is broader than the Draft Convention, because it permits the Burmese to control scientific research. The word "control" does not appear in either Part V or Part XIII of the Draft Convention.

Article 19 of Burma's law corresponds to Article 58 of the Draft Convention. Article 19 guarantees the rights of navigation and overflight to all states but is narrower than Article 58 because it fails to provide for the right to lay pipelines and cables. Moreover, Article 58 provides for the right to make any "other internationally lawful uses of the sea . . . compatible with the other provisions" of the Draft Convention.

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[3]PYITHU HLUTTAW Law No. 3 of April 1977. Reprinted in ST/LEG/SER. B/19, 13 June 1978, pp. 37-43.

Article 20 of Burma's law states that "no one shall conduct any activity in the exclusive economic zone in relation to exploration, exploitation or research, without the prior express permission of the Council of Ministers." This article is similar to the consent-regime of Part XIII and Article 62 of Part V of the Draft Convention. Burma's statute is less extensive than the provisions of the Draft Convention while still providing for a consent regime and the right of the Burmese to regulate, authorize, and control scientific research.

India[4]

Article 7 of India's Territorial Waters, Continental Shelf, Exclusive Economic Zone, and other Maritime Zones Act, 1976, established a 200-nautical-mile exclusive economic zone.

The rights and jurisdiction of India in the exclusive economic zone are outlined in Article 7, paragraph 4 of the act. In general, these follow rights and jurisdictions of the coastal state as specified in Article 56, paragraph 1, of the Draft Convention on the Law of the Sea.

Under Article 7, paragraph 4(c), India has "exclusive jurisdiction to authorize, regulate, and control scientific research." As in the case of Burma, this formulation exceeds Article 56 by including the right to "control" scientific research.

Paragraph 5 requires the prior consent of the Central Government in order to conduct research in the exclusive economic zone. In addition Article 7, paragraph 9, which corresponds to Article 58 of the Draft Convention provides that the right of other states to lay submarine cables and pipelines is expressly made subject "to the exercise of India of its rights."

Article 15, paragraph (f), empowers the government of India to make rules regarding the authorization, regulation, and control of the conduct of scientific research. Article 15 also permits the government to make rules that regulate "the conduct of any person in the exclusive economic zone."

Pakistan[5]

The Territorial Waters and Maritime Zones Act provides for an exclusive economic zone of 200 nautical miles. Article 6 outlines the

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[4]Territorial Waters, Continental Shelf, Exclusive Economic Zone, and other Maritime Zones Act of 1976, (Bill No. XXVIII of 1976). Reprinted in ST/LEG/SER. B/19, 13 June 1978, pp. 81-88.
[5]Territorial Waters and Maritime Zones Act, 1976. Reprinted in ST/LEG/SER. B/19, 13 June 1978, pp. 100-107.

exclusive economic zone provisions, which are similar to those enacted by India.

Under Article 6, paragraph 2(c), Pakistan has exclusive rights and jurisdiction to "authorize, regulate and control scientific research."

Article 6, paragraph 3 requires prior approval of the government before any research may be conducted. Article 14 of this act authorizes the government to make rules regarding the "authorization, regulation and control of the conduct of scientific research." As far as the conduct of scientific research is concerned, the exclusive economic zone is the functional equivalent of a territorial sea.

Sri Lanka[6]

Under the Maritime Zones Law No. 22 of 1976, the President of Sri Lanka issued a proclamation[7] establishing a 200-nautical-mile economic zone. Article 5, paragraphs 2 and 3, of the law specifies the rights and jurisdiction of Sri Lanka in the zone. These correspond for the most part to Article 56 of the Draft Convention on the Law of the Sea. Regarding scientific research, Sri Lanka has exclusive rights and jurisdiction to authorize, regulate, and control; this language is similar to that found in national legislation of India and Pakistan giving the coastal state much broader control over scientific research than the Draft Convention does.

Article 13 of Sri Lanka's law empowers the Minister to make regulations for the purpose of giving effect to provisions of the law. This article gives the Minister broad power to regulate within the economic zone, and it can be assumed that scientific research will be one of the activities regulated.

OTHER RULES GOVERNING MARINE RESEARCH

To date, most nations have not required foreign institutions and scientists to obtain clearances for the research they intend to conduct in claimed waters.

In 1978 the Department of State asked certain U.S. embassies to report on host country procedures for dealing with marine science

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[6]Maritime Zones Law No. 22 of 1976, Reprinted in ST/LEG/SER. B/19, 13 June 1978, pp. 130-135.

[7]Proclamation by the President of the Republic of Sri Lanka of 15 January 1977 in Pursuance of Maritime Zones Law No. 22 of 1976. Reprinted in ST/LEG/SER. B/19, 13 June 1978, pp. 125-137.

clearance requests.[8] Most of the 28 embassies responding stressed the need to submit the request at least 60 days before the proposed starting date for the research project and to invite host country scientists to participate in the research.[9] The embassy representatives also recommended that official channels be used for all clearance requests whether or not it is a national regulation to do so.

The embassy report from Argentina indicates that requests for research vessel clearances should be directed to the Argentine Foreign Office by the U.S. embassy. It was suggested that the clearance request be presented 180 days before the proposed research project and that one or two Argentine scientists be invited to participate in the cruise at issue. Although not mentioned in the embassy report, Argentina has published requirements for foreign institutions and scientists to obtain clearances for research in waters claimed under Law No. 20489. This law states, inter alia, "In some cases the Government may rule that an Argentinian expert be given authority to oversee and/or participate in the research." It is not clear what the word "oversee" means and, in particular, whether it is tantamount to "control" as used by Indian Ocean states.

The embassy report from India indicates that the best means of obtaining the research vessel clearance from the government of India is to sponsor a joint project between Indian and U.S. institutions. The report does not indicate requirements other than inviting Indian scientists to participate. In a July 1977 letter to Dr. Manik Talwani, then Director of the Lamont-Dougherty Geophysical Laboratory, Indian officials stated that a formal request for research vessel clearance must be sent through official channels to the government of India. Besides a full description of the project, the letter stated:

The Government of India will not permit the following:

(i) physical oceanographic observations of a grid closer than 30 mile intervals;
(ii) stationary time series observations for all physical oceanographic parameters except currents;
(iii) observations in ambient and ship generated noise level;
(iv) reverberations of observations particularly in shallow waters;

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[8] Notice to Research Vessel Operators #50, U.S. Department of State, June 12, 1978.

[9] Embassy reports for Argentina, Australia, Bahamas, Belize, Canada, Chile, Colombia, Cuba, Ecuador, Ethiopia, France, Greece, Honduras, India, Iraq, Italy, Japan, Libya, Mexico, Nicaragua, Oman, Panama, Saudi Arabia, Sudan, Trinidad and Tobago, Turkey, United Arab Emirates, and Venezuela.

(v) use of submersibles; and
(vi) observations on acoustic signal range limitations.

The letter went on to say:

(i) The Government of India will have access to all the original raw and processed data, samples, interpretations, and final results related to seabed and sub-soil of Exclusive Economic Zone and Continental Shelf of India;
(ii) The results of research and conclusions related to the area of Exclusive Economic Zone and Continental Shelf of India shall not be published or divulged to any third party without the prior consent of the Government of India;
(iii) The survey over the Exclusive Economic Zone and Continental Shelf will not allow participation of any third party without the prior consent of the Government of India.

These requirements exceed those in Article 249, of the Draft Convention on the Law of the Sea, which outlines duties of nations and organizations conducting marine research to comply with conditions of the Draft Convention and laws of coastal states.

Finally, the embassy report from Trinidad and Tobago specifies two additional prerequisites for approval from the government of Trinidad and Tobago. The first is that research data and results may be published only with the government's consent and, second, that all data and specimens are the property of Trinidad and Tobago. The publication requirement is now a state practice of Trinidad and Tobago.

In conclusion, more and more coastal states are extending their jurisdiction to 200 nautical miles. It appears that most of these coastal nations are claiming jurisdiction over scientific research. Although, for the most part, rules and regulations have not been promulgated, one should assume that the conditions outlined in the Draft Convention on the Law of the Sea will be minimum requirements.

CHAPTER 9

WITHIN A CRYSTAL BALL: POSSIBLE FUTURE DIRECTIONS OF MARINE SCIENCE AND THEIR INTERNATIONAL IMPLICATIONS

The world oceans have been free to the conduct of oceanography during most of oceanography's existence as an organized field of science. Ocean scientists have been constrained only by their own abilities and by the resources available for their use. Such freedom of scientific inquiry has resulted in major discoveries of the nature of, and the processes active in and about, the oceans. Our knowledge of ocean, seafloor, and atmosphere has resulted from investigations that have taken place during this period of free inquiry.

It has been during only the latter part of the twentieth century that political constraints have come to be a major factor in the scientific research of the oceans. With the establishment of the Continental Shelf Convention in the late 1950s, marine scientists felt one of the first infringements of their freedom to conduct research outside the limits of territorial seas. In spite of restrictions regarding sampling of the continental shelf, submarine geologists made enormous strides toward a better understanding of continental margins. Now, however, even the freedom that was enjoyed under the constraints of the Continental Shelf Convention appears to be endangered. As international political negotiations involving the oceans continue, it becomes increasingly clear that the freedom once enjoyed by ocean scientists will be limited seriously in the future. The effects of these limitations on the progress of science remain to be assessed.

To provide a foundation for an assessment of the effects of political constraints, this chapter outlines the directions ocean science may take in the future. Predictions of the future directions of ocean science are reviewed. These predictions come from the scientific community itself and are, like most predictions, subject to the influence of a great number of variables. Further, both the implications for and the involvement of future ocean science with international events are accented.

These predictions of future ocean science rely heavily on several recently prepared and published reports. These reports include The Continuing Quest: Large-Scale Ocean Science for the Future, a report prepared under the auspices of the Ocean Sciences Board of the

National Research Council (1979b) at the request of the National Science Foundation; Directions for Naval Oceanography: An Assessment of the Changing Environment of the Navy and its Impact on the Navy's Ocean Science and Engineering Program, a report prepared under the auspices of the National Research Council (1976) for the Office of the Oceanographer of the Navy; The Future of Scientific Ocean Drilling, a report by an ad hoc subcommittee of the JOIDES Executive Committee (1977); Continental Margins: Geological and Geophysical Research Needs and Problems, prepared under the auspices of the National Research Council (1979a); Shelf Sediment Dynamics: A National Overview, the report of a workshop held in Vail, Colorado, sponsored by the National Science Foundation, the Energy Research and Development Administration, the United States Geological Survey, and the National Oceanic and Atmospheric Administration (Gorsline and Swift 1977).

FUTURE DIRECTIONS OF OCEAN SCIENCE

Prediction is a risky game. A look to the past indicates that prediction of the course of science for any long period into the future is bound to be inaccurate. Like weather prediction, short-term prediction based on persistence does have some degree of validity. However, long-range forecasts, similar to those employed by climatologists, must of necessity be fairly general to have any validity. Prediction by persistence would indicate that in the immediate future we will be doing more of the same sorts of things, but doing them better.

In looking to the past, it becomes clear that persistence is not a particularly useful way to predict the future of ocean science, although is it probably the safest. As was pointed out in the Navy report, in evaluating the previous course of science, it becomes obvious that breakthroughs in ocean science have been the result of many different factors. These factors include the development of new instrumentation, application of knowledge from other fields to studies of the ocean, reassessment of existing data, understanding drawn from studies of previously little-known geographic areas, interdisciplinary approaches to problems previously considered only along disciplinary lines, extra or new efforts stimulated by socioeconomic pressures, and, finally, serendipity.

Because of the dangers inherent in relying too heavily on future predictions in ocean science, the following discussion pertains only to areas that appear ready for significant advances in knowledge. Both disciplinary and interdisciplinary approaches to ocean science are important. However, interdisciplinary approaches to certain problems may result in advances that might not come about through disciplinary studies of the same problems. The interdisciplinary approach to understanding of natural processes may have the highest potential for scientific return, although much is still to be learned through fundamental, disciplinary studies of the ocean.

Ocean science today is complex and expensive. In the United States most fundamental research is carried out at universities with funds provided by the federal government. Federal agencies, such as the National Oceanic and Atmospheric Administration and the United States Geological Survey, mainly carry out surveys and produce regional syntheses of various aspects of the ocean and the ocean floor. Industry, primarily the petroleum industry, focuses on the practical aspects of ocean science. Both industry and the federal agencies are driven primarily by the needs of society to use the ocean wisely. University ocean science is also driven by this social force but perhaps to a lesser degree.

The reports discussed here arose from the needs of federal agencies to respond to the long-term needs of the people. The predictions of each of the reports are summarized briefly.

Directions for Naval Oceanography

Recognizing that the Navy's role in the federal ocean science program had been steadily declining for some time, the Assistant Secretary of the Navy requested in the mid-1970s that the National Research Council review the Navy's oceanographic program in order to assist in planning a program in ocean science and engineering to meet future Navy needs. During the course of this review an assessment was made of needs for ocean science research for each of the Navy's major missions: surveillance, sea control and projection, strategic deterrence, and support functions. As this assessment evolved, it became clear that there were several general areas of needed research. It was recognized that a combination of disciplines probably would be more productive than individual disciplinary approaches to the problems. It was recommended that the Navy emphasize ocean science in a number of interdisciplinary areas:

Benthic boundary layer processes
Ocean variability monitoring as related to acoustic detection of submarines
Electromagnetic radiation
Prediction of variability and modeling of turbulence
Chemical variables in the marine environment
Biological communities, effect on and use in surveillance
Regional polar oceanography and southern ocean research
Shallow-water oceanography
The role of near-surface ocean processes in submarine detection

For each of the areas mentioned, a multidisciplinary approach involving the fundamental oceanographic disciplines should be employed. If the Navy is to continue to operate within the ocean environment, it will require detailed knowledge of ocean processes operating at all scales. The ultimate goal is one of predictability

based on the measurement of a few parameters. In order to maintain military advantage, the Navy will need to give high priority to the acquisition of knowledge and to the corresponding technology base for its future use of the ocean.

The Continuing Quest

Multiinvestigator, multiinstitutional research received some emphasis during the 1970s, partially as a result of the establishment in 1969 of the International Decade of Ocean Exploration (IDOE) by the National Science Foundation. Large-scale programs, often multidisciplinary, have been carried out with notable success. The National Science Foundation requested the National Academy of Sciences and the National Academy of Engineering to provide advice and guidance on the nature of programs to follow the IDOE. The product of the efforts of a great many ocean scientists is the report The Continuing Quest: Large-Scale Ocean Science for the Future. A portion of this report devotes itself to a statement of ocean science opportunities for the 1980s. These opportunities reflect both fundamental and problem-oriented research of value to society. Those opportunities that appear to be discipline oriented are listed in table 9-1.

TABLE 9-1 Opportunities in Ocean Science Disciplines

Physical Oceanography	Biological Oceanography
Estuarine/shelf dynamics	Climate variability and productivity
Continental shelf dynamics	Physical forcing or species succession
Shelf/ocean coupling	Biological interactions among species
Western boundary region dynamics	Trophic level coupling
Midocean (interior) dynamics	Community structure
Large-scale atmosphere/ocean coupling	Patchiness
	Recruitment
Marine Geology and Geophysics	
Characteristics and driving mechanisms of the deep lithosphere and asthenosphere	**Chemical Oceanography**
Evolution and variability of the ocean crust and upper mantle	Water-column fluxes and reactions
Structure and evolution of passive continental margins	Seafloor fluxes and reactions
Structure and evolution of convergent plate margins	Fluxes from the continent to the ocean
Diagenesis at depth	Transient tracer studies
The ocean's role in climate change over the past 150,000 years	Gas exchange studies
Climate over the past 5 million years	Tracer injection studies
Changing states of the ocean	

An examination of this table shows that a number of disciplines may focus on similar or related aspects of the ocean. It may also be obvious that similar temporal and spatial scales of the problems are also recognized by each discipline.

In addition to research within disciplines, it is also evident that during the past decade the interaction of disciplines has often resulted in particularly significant advances. The Continuing Quest manifests a recognition of the importance of the interdisciplinary approach and provides a number of examples of how various oceanographic disciplines can contribute to multidisciplinary and/or interdisciplinary studies. Examples of possible interdisciplinary research opportunities include estuarine and coastal studies, equatorial dynamics, the Southern Ocean as an ecosystem, and boundary layer processes. An example of the applications of the various oceanographic disciplines to estuarine and coastal studies is provided in table 9-2. The report goes on to provide several examples of possible research projects of interest to scientists from a variety of disciplines. They are as follows.

Coastal and Estuarine Problems

Fjord-type estuary experiment. This experiment would be intended to measure and provide a basis for modeling processes that control the transport of saline shelf water into the estuary and the vertical salt transport within the estuary.

Bar-built estuary experiments (physical). This experiment would determine those processes that government water and salt flux into shallow bar built estuaries, the time scales of their variations, and the manner in which small-scale mixing and advective processes adjust current and salinity (and density) fields within the estuary to boundary fluctuations in water and salt transport.

Bar-built estuary experiment (biological). For the same type of estuary this problem would focus on the influence of estuaries on recruitment of coastal and pelagic species and the effects of human activities and natural forces on such recruitment.

The fluxes of materials from the continent to the ocean. The focus here would be on the determination of the net fluxes of particulate and dissolved material, both organic and inorganic, to the ocean. Some accent would be given to modification of these materials during their transit though estuaries and coastal waters.

Local dynamics shelf experiment. This problem would address the dynamic processes which govern the wind driven and lower frequency transient motions over the continental shelf. Particular attention would be given to the description and parameterization of momentum flux in and through both surface and bottom boundary layers.

TABLE 9-2 Applications of Oceanographic Disciplines to Estuarine and Coastal Studies

Discipline	Estuarine–Coastal Processes	Shelf Processes	Shelf–Ocean Coupling
Physical oceanography	Salt intrusion (small-scale mixing, dispersion)	Freshwater extrusion (small-scale mixing, dispersion)	Subtidal shelf–ocean coupling (includes upwelling, warm-core rings, Calif. current, Equatorial Pac.)
	(Boundary-layer dynamics)	Boundary layer (surface and bottom dynamics)	Frontal mixing, stability, and dynamics
Chemical oceanography	→ Atmospheric Fluxes (Anthropogenic/Natural) →		
	River and estuarine (particulate and dissolved material) fluxes	Reef dynamics → Hydroseep	
	Chemical interactions and processes of sediment accumulation →		Climatic indicators ↔ Shelf–ocean fluxes
Geological oceanography	Sediment sources and sinks, diagenesis and sediment transport → (Bottom boundary layer, turbidity currents, small-scale mixing by internal waves, canyons, mass sediment properties)		
	← Paleoclimatic sedimentary and geomorphology processes (includes anoxic deposits and varved deposits)		
Geophysics	← Geological structures →		
Biological oceanography	Larval contributions to recruitment →	Nutrient supply, primary and secondary production →	Pelagic and benthic populations

SOURCE: National Research Council (1979b, p. 42).

Open Ocean Problems

Gulf stream studies. Primary and secondary sources of energy and the mesoscale eddy circulation would be studied.

Sverdrup experiment. This problem focuses on the dynamics of subtropical gyres. An attempt would be made to obtain a quantitative description of the actual mean circulation in this area of the ocean.

A transient tracer study. Transient tracers include tritium, carbon-14, krypton-85, and several freon compounds. The rates of formation of deep water and the penetration of anthropogenic materials into the ocean could be assessed from a program of long-term measurement of the oceanic distribution of such tracers.

Past climatic change. Using techniques similar to those employed during the CLIMAP program, the detailed climatic history based on deep sea sediments during the past 5 million years would be assessed.

Equatorial dynamics. This study emphasizes the interaction between ocean and atmosphere, transmission of low- and high-frequency signals in the equatorial wave guide, and their interaction with the circulation of the eastern boundary region.

Equatorial ecosystem dynamics. Here an attempt would be made to link physical oceanographic and atmospheric parameters to changes in productivity of the ecosystem of this region.

Southern Ocean

Southern Ocean dynamics. The focus here would be on the overall momentum and energy balance of the Antarctic circumpolar current and the role of bottom topography in establishing this balance. The large-scale air-sea interaction in the Antarctic circumpolar current system would be studied.

Southern Ocean ecosystem dynamics. The possible value of krill as a fishery dictates the practical importance of knowing the factors involved in the ecosystem of the Southern Ocean. How the ecosystem is maintained and renewed, the role physical factors play in the system, would be investigated.

Seafloor Sediments

Benthic boundary flux studies. Questions to be addressed include the following. How do the processes of particle formation, transport, and dissolution operate and what are their variations in time and space? What is the nature and rate of chemical reactions and fluxes

across the ocean floor boundary? What are the physical and chemical processes that effect this area of the ocean?

Geotechnical properties of marine sediments. Attention is directed to early diagenesis, alteration of organic composition and clay mineralogy, lithification, and cemetation.

Deep Seabed

Deep lithosphere and asthenosphere studies. What are the processes affecting the evolution of the deep oceanic lithosphere and asthenosphere?

Seawater-rock Interactions. What is the nature of the interaction between geothermally heated seawater and basaltic crust?

The areas of investigation listed above are cited as examples of problems that are of interest to the scientific community and whose solution would provide fundamental knowledge (which undoubtedly would open the door to more complicated problems). These problems were accented in the hope that some consolidation of individual (fragmented) efforts in the study of important regions and processes could be brought about. Also, the scientific problems provide targets for obtaining additional scientific information that is needed (urgently?) for the prediction, management, or control of human activities related to the ocean.

The Future of Scientific Ocean Drilling

Possibly the single most successful program in the history of earth science has been the Deep Sea Drilling Project. This project of drilling beneath the ocean bottom has provided samples and knowledge of the sea floor which have been extremely useful in confirming hypotheses of plate tectonics, ocean bottom dynamics, paleontology, and past climates. In looking to the future, the Executive Committee of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) brought together a group to assess the present state of the Deep Sea Drilling Project and to assess future needs involving drilling into the ocean floor. The committee recognized that the deep ocean drill is a tool and that the program should not be continued in order to keep the tool in operation, but rather should be extended only as long as it provides exciting new scientific knowledge. In attempting to place the deep drill in its proper context, the commitee recommended continued drilling only if "adequate funding is assured for scientific studies for broad scale problem definition, small scale site examination and preparation, sample analysis, and interpretation and synthesis as well as well logging for each hole drilled."

If funds become available for a program of continental margin drilling, the report says that drilling in passive margins should focus on the North Atlantic, where there are excellent examples of two categories of passive margins: mature margins (e.g., the margin off the east coast of the United States) and sediment-starved margins on both sides of the North Atlantic. The purpose of drilling passive margins would be to relate the structural evolution, rifting, and early sedimentation to the nature of the ocean-continent boundary and to the early history of subsidence. Such drilling would assist in the testing and improvement of existing models of passive margin formation and development.

Likewise, the objectives of drilling into active continental margins are to clarify processes of subduction, both in areas involving trenches and island arcs, and of the origin and development of back arc basins. Areas of priority for drilling in active margins would include the middle America trench and South Philippine Sea, the Kurile-Okhotsk-Japan area, the Northern Philippine Sea, and the Caribbean, New Hebrides, Tonga, and Peru-Chile areas.

In focusing on problems involving the deep ocean crust, scientific problems involving interpretation of heat flow and magnetic anomalies, hydrothermal processes, petrological differentiation, and the general nature of the deep ocean crust would be addressed. Holes would be located in the open ocean to provide information on these processes.

In addressing problems involving the paleoenvironment of the ocean, attention would be directed to the transition from stagnant to well-oxygenated oceanographic conditions and to the transition from a warm to a cold ocean. The South Atlantic and the paleoceanography of that region would receive most attention. Specific problems to be addressed include the conditions of black shale formation during the early Cretaceous, modification of the ocean basin during the widening of the South Atlantic, opening of the Drake Passage during the Tertiary times, establishment of the flow of cold bottom water through the South Atlantic, and the role of the aseismic ridges (Rio Grande Rise and Walvis Ridge).

Shelf Sediment Dynamics: A National Overview

At a workshop held in 1976, scientists examined the nature of continental shelves, the processes and agents operating on shelves, the definition of appropriate subfields for research, and the criteria that define research problems with respect to sediments of the continental shelves. Shelf dynamics research involves not only morphology, but transport processes, studies of material, identification of sources of sediments and their sinks. Included are other attributes of the continental shelf environment involving (1) the air-sea interface or surface boundary layer, (2) the main shelf water body, and (3) the bottom boundary layer.

Specific areas of research identified for future emphasis include problems of bed load transport, suspended sediment dynamics, processes and conditions of the shore interface and offshore slope, bottom boundary layer stresses, flow fields generated by winds, tides, and density variations, sedimentary structures and bed forms, large-scale topographic features, such as submarine canyons and valleys, geotechnical properties of the substrate, biological parameters, mass budgets and carbonate shelves. Because the topics of this workshop stressed fundamental processes, it can be assumed that research could be carried out on shelves wherever such processes operate. Clearly, areas of different dynamic properties (high energy versus low energy) and different chemical environments should be addressed (terrigenous shelves versus carbonate shelves). Both passive and active continental shelves would be involved.

INTERNATIONAL ASPECTS OF FUTURE SCIENCE

Based on the assessments in the reports above, one may assume that scientific efforts in the future will be characterized more and more by interdisciplinary approaches to problems, by the use of increasingly sophisticated equipment, and in many instances will be done by teams of scientists. This is not to say that the individual principal investigator will be excluded, but the overall character of oceanography will continue to turn in the direction of the team approach to the solution of scientific problems. If present activities can be used as an indicator of trends for the next decade, we will see increased activity in the southern oceans and possibly in the Arctic Ocean, more activity in equatorial regions, and increased drilling activity in marginal areas involving both active and passive continental margins and back arc basins.

Nonscientific factors that will constrain the ability of ocean scientists to achieve their objectives include economic forces and international and national political actions. Rapidly escalating costs may severely affect relatively expensive activities, such as the Deep Sea Drilling Project. High costs may also prohibit the operation of vessels in distant areas and may seriously restrict complex scientific investigations by teams of scientists in remote regions of the world. Beween 1972 and the time of this writing (1979), the total drilling subcontract costs of the Deep Sea Drilling Project have increased from about $6.0 million to $10.2 million. At the same time, the cost of operating ordinary research vessels has increased dramatically. Small coastal vessels that operated at an annual cost of about $250,000 in 1975 increased to $337,000 per year in 1979. One manifestation of this increase in ship costs has been that scientists shift the conduct of their research from larger to smaller vessels, which are comparatively cheaper to operate. The increased costs cited above may not be due totally to inflation, but inflation is definitely a major factor in the increases. If the trends of the past several years are not reversed, financial factors may prohibit the conduct of

much valuable ocean research. Effort must be made to counter these trends and to demonstrate the value of ocean research to the future well-being of the peoples of the world.

Extensions of coastal state jurisdiction have led oceanographic institutions to engage in more technical assistance programs, both formal and informal. Such programs have provided ship time to scientists of nations in whose waters our scientists wish to operate, provided seminars in foreign countries and brought foreign scientists on U.S. cruises, and brought scientists from developing nations to the United States for research. All of these activities incur costs that must be added to the price of doing science in the waters of other coastal nations. At the same time, it has become more and more expensive for U.S. scientists to travel to remote areas of the world to engage in scientifc research. Both domestic inflation and the declining value of the dollar in the foreign market become increasingly important to the conduct of science in foreign areas.

Extensions of jurisdiction by coastal states will create problems for the scientists wishing to carry out studies in the Southern Ocean, in equatorial areas, and along the continental margins. Optimism, lack of concern, or a misunderstanding of the jurisdictional problems on the part of ocean scientists may be inferred from their assessment of where science should go in the future. In making their predictions, scientists have not constrained their thinking on the basis of exclusive economic zones. Although aware of some of the jurisdictional problems involving coastal states, many scientists are confident that the proposed research activities can be carried out with the cooperation and collaboration of their international collegues. The implications of their predictions of the future directions of science include the need to consider seriously mechanisms that will permit work within the exclusive economic zones of other nations.

There are a number of possible mechanisms for enabling research in foreign waters. International bilateral agreements of both long and short term and of large amd small scope lead the list. Scientist-to-scientist technology transfer programs (exchange of data and samples as well as assistance in their analysis) may be advantageous or even required. Transfer of equipment and formal training programs for both professional and technical personnel may be necessary. The participation of foreign scientists in U.S. research cruises already takes place. It may be advantageous for U.S. scientists to organize symposia and workshops in foreign countries to explain the value of specific research programs and, subsequently, the importance of the results of the research. American scientists must be alert to opportunities to engage in such technical assistance programs.

The extension of coastal state jurisdiction can be expected to affect ocean science in high latitudes, low latitudes, and along continental margins. Research in polar and subpolar waters may encounter problems of national jurisdiction anywhere, but particularly

where these waters occur within the 200-mile extended economic zone of the Soviet Union, Canada, Norway, Chile, and Argentina. Research in tropical areas will encounter difficulties off Africa, South America, and Southeast Asia; generally any research along continental margins will be constrained by the desire of coastal states to control the waters over the margins. All types of ocean research may encounter political problems of this nature. However, it is likely that biological research and geological and geophysical research will feel the burden most heavily because of the possible relation to fisheries exploitation and mineral extraction, respectively.

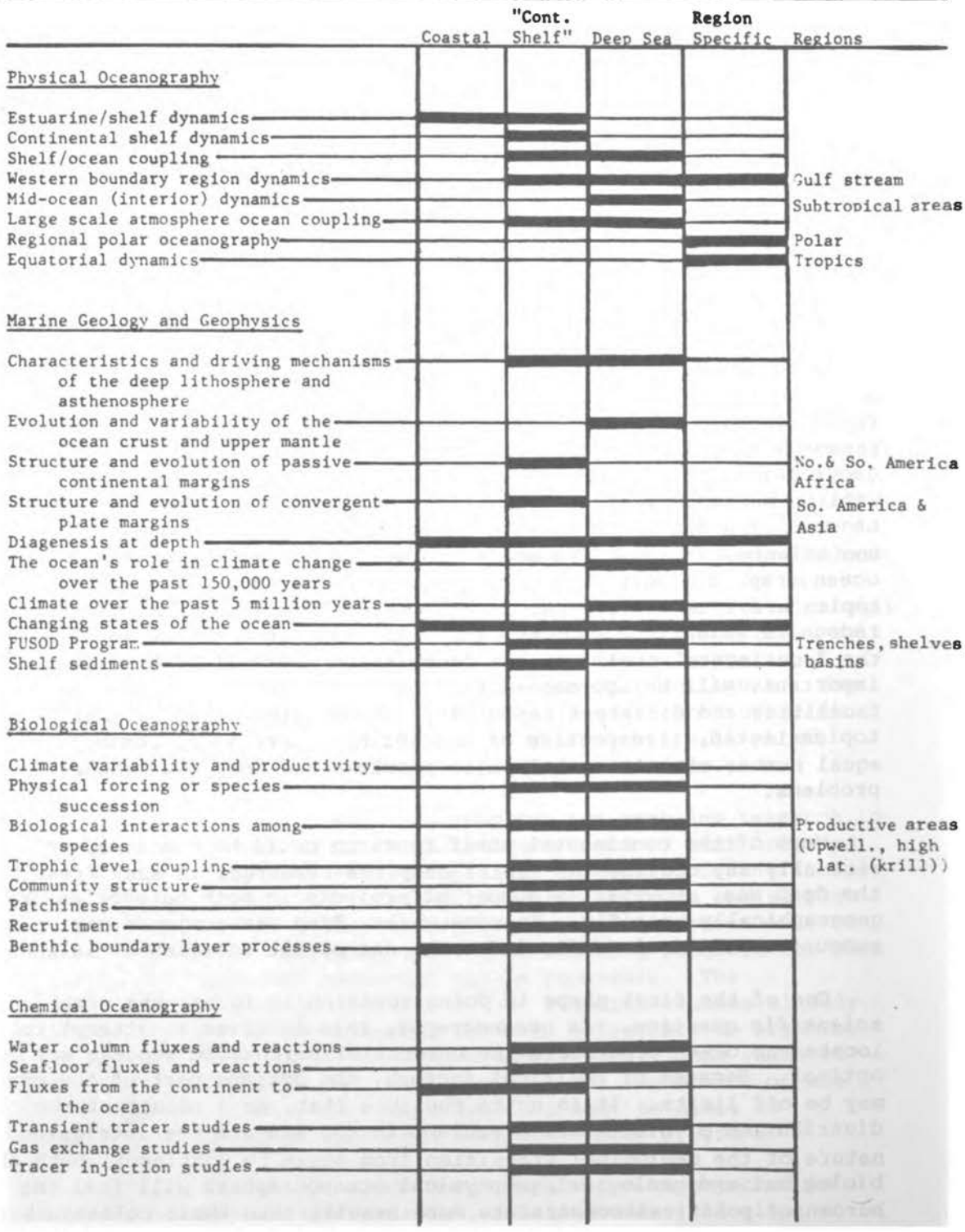
SUMMARY

Of the many oceanographic questions that have been posed for the future, most can be thought of as elements of major programs. Some of these topics are listed in table 9-3 together with the areas of the ocean in which they might be investigated. In many cases, the research could be done almost anywhere. In a number of cases, the research is geographically specific and is focused on solving a geographically peculiar problem. In the future, much ocean science will be multidisciplinary or interdisciplinary, but there will always be much of a disciplinary nature to learn. For this reason and for convenience, table 9-3 is organized according to traditional oceanographic disciplines, even though many of the listed research topics are interdisciplinary. The table shows that oceanographers recognize scientific problems that will best be resolved in areas of the "continental shelf" or the "deep sea." Coastal problems, although important, will be approached by other scientists requiring different facilities and different resources. It may also be noted that of the topics listed, irrespective of discipline, there is approximately an equal number of continental shelf problems and deep sea research problems.

Much of the continental shelf research could be conducted on virtually any continental shelf; deep sea research, in many areas of the deep sea. However, a number of projects in both categories are geographically specific. In some cases, deep sea projects may encounter political difficulties because of the location of islands.

One of the first steps in doing research is to ask the proper scientific question. In oceanography, this involves an attempt to locate the ocean area where the chances of scientific success are optimal. Because of political factors, the optimum part of the ocean may be off limits. It is quite possible that, as a result of the distribution of biological organisms in the sea and the intriguing nature of the geological transition from ocean to continent, both the biological and geological/geophysical oceanographers will feel the burden of political constraints more heavily than their colleagues in chemical and physical oceanography. There can be little doubt, however, that all oceanographers will feel the impact of the evolving complexities of international ocean politics.

TABLE 9-3 Areas of Interest for Oceanographic Research, by Discipline



REFERENCES

Ad Hoc Subcommittee of the JOIDES [Joint Oceanographic Institutions for Deep Earth Sampling] Executive Committee (1977) The Future of Scientific Ocean Drilling. JOIDES Office, University of Washington.

Gorsline, D.S. and D.J.P. Swift (1977) Shelf Sediment Dynamics: A National Overview. Available from the Office of the International Decade of Ocean Exploration, the National Science Foundation, Washington, D.C.

National Research Council (1976) Directions for Naval Oceanography: An Assessment of the Changing Environment of the Navy and its Impact on the Navy's Ocean Science and Engineering Program. The unclassified version of a report (same name) by the Steering Group for the Review and Analysis of the Navy Oceanographic Program, Marine Board, Assembly of Engineering; and Ocean Sciences Board, Assembly of Mathematical and Physical Sciences, National Research Council. Alexandria, Va.: Office of the Oceanographer, Department of the Navy.

National Research Council (1979a) Continental Margins: Geological and Geophysical Research Needs and Problems. Ad Hoc Panel to Investigate the Geological and Geophysical Research Needs and Problems of Continental Margins, Ocean Sciences Board, Assembly of Mathematical and Physical Sciences. Washington, D.C.: National Academy of Sciences.

National Research Council (1976b) The Continuing Quest: Large-Scale Science for the Future. Post-IDOE Planning Steering Committee, Ocean Sciences Board, Assembly of Mathematical and Physical Sciences. Washington, D.C.: National Academy of Sciences.

CHAPTER 10

NATIONAL ARRANGEMENTS TO FACILITATE AND COORDINATE FUTURE MARINE SCIENCE PROGRAMS

FUNDING TO COVER NEW COSTS

The prospective legal regime for marine scientific research embodied in the Draft Convention on the Law of the Sea will increase the cost of U.S. research programs off the shores of other countries. There will be financial costs as well as other, less tangible costs. Because the case-by-case implementation of the Draft Convention cannot be foreseen, it is impossible to set precise figures on what the new financial burdens will be. One can only sketch the general categories of new costs that will arise from its implementation. In considering how the costs can be met, it is useful to evaluate the benefits and to determine the beneficiaries of the new regulations.

The most visible new costs of scientific research off the coasts of other nations are financial and are of three types.[1]

1. Costs related to research projects--travel, data and sample exchange, routine assessment costs, participation of foreign nationals in the research project, preparation and publication of special reports, removal of equipment.

2. Costs related to ship operation--port calls, additional operational costs for increased ship time and various communications, transportation and subsistence for foreign participants.

3. Costs of cooperating and assistance--discussions between U.S. scientists and the coastal state scientists, training programs, technical assistance, possible additional scientific projects requested by the coastal state, assessments of data after completion of project.

[1] Proceedings of a Workshop on Procedures for Marine Scientific Activities in a Changing Environment, January 9-11, 1978. Ocean Policy Committee, Commission on International Relations, National Research Council and University National Oceanographic Laboratory System. Washington, D.C.: National Academy of Sciences, 1978, p. 9.

These new costs will fall initially on the scientific research institutions but will ultimately be borne by the U.S. government and the taxpayer unless foreign governments can be persuaded to make some contribution.

Certain other costs are more difficult to anticipate and evaluate. First, there will be costs of the research opportunities forgone if resources are diverted to meet the new financial costs. The resources directed to meet new regulatory and legal requirements could thus be diverted from research itself unless overall levels of funding are raised to meet these new requirements. Second, there is the cost entailed in the loss of the principle and practice of free inquiry per se. Where scientists confront time-consuming procedures and the prospect of ultimate exclusion from a particular area even if the appropriate procedures are observed, they may be expected to turn their energies to other areas and subjects offering better prospects for completing research programs. Thus the new regime could limit scientific inquiry or direct it onto paths that would otherwise have been given lower priority. A related problem is one in which the quality of researchers might be impaired where restrictions on access limit the opportunity for comparative research.

A final category of costs is the political consequences of the new regime, namely the friction or ill will that may be expected when governments are faced with the task of interpreting the Draft Convention on the Law of the Sea (e.g., its requirement to assist the coastal state to assess data and samples) or determining where the draft convention applies (e.g., continental shelf boundary). As with financial burdens, society at large will ultimately pay for the political and social costs of the new regime for scientific research.

Benefits, like costs, may be expected under a regime based on the Draft Convention but, like costs, they cannot be anticipated with any certainty nor can they be readily quantified. From the point of view of the researching institution and scientists, benefits may be in the form of contacts that would not otherwise develop. That is, assuming that the researching institution undertakes an intensive program of contacts and negotiation, it may develop relationships that are scientifically fruitful in the planned program and in future projects. Moreover, it is possible that the participation of foreign scientists in research programs may be mutually beneficial, depending of course on the experience and abilities of the particular scientists.

The principal benefits envisaged under the Draft Convention on the Law of the Sea are the transfer of scientific expertise and information to the coastal state. Developing coastal states are likely to be particularly interested in securing this benefit through rigorous implementation of provisions for participation, sharing of data and samples, and assistance in assessing research findings. Insofar as the transfer of scientific expertise contributes to the process of development, the coastal state benefits and, it may be argued, so does the international community.

This sketch of likely costs and benefits raises several questions as to how the increased costs are to be allocated. In the first place, the present level of funding (with allowance for inflation) might be maintained by reducing the amount of research done and using the remaining funds to cover the costs of foreign participation, new data-sharing requirements, and so forth.

A second course would be to maintain the current level of research by increased funding to cover the new costs. The expanded funding could come either from technical assistance allocations or from research budgets. The argument for using aid funds is based on the fact that the principal benefits to be expected are in the areas of training and technical assistance. If, on the other hand, research funds were to be increased to meet the new costs, it would have to be decided which parts of the research budget would be increased and by what amounts. In general, the diffuse nature of the international and political benefits from scientific research and the impact of the new requirements suggest that U.S. and foreign governments should seek to meet the new costs while maintaining and, where necessary, expanding the level of marine scientific research.

U.S. GOVERNMENT ORGANIZATION TO FACILITATE ACCESS

The Draft Convention on the Law of the Sea establishes significant new requirements for marine scientific research. Under these requirements, the U.S. government would be called on to play a major role in facilitating U.S. research in the 200-mile economic zones and on the continental margins of coastal states. The new requirements may be grouped into two principal categories: (a) the need to provide information and facilitate communication, and (b) the need to comply with formal procedures in order to obtain research clearances.

In the area of information and communication, the U.S. Department of State will be called on to serve as a gatherer and disseminator of information relevant to obtaining access to foreign waters. This will include information on the laws and regulations of the U.S. and foreign governments regarding marine research as well as information on the experience of previous researchers operating in certain areas off the shores of coastal states. The State Department will need the assistance of the National Science Foundation and the University National Oceanographic Laboratory System (UNOLS) in collecting and updating the necessary information.

The State Department will also play a central role in following the formal procedures set out in the Draft Convention for obtaining clearances from foreign ministries for offshore research. Given its channels of communication to foreign governments, the State Department remains the best-placed agency to carry out this function. With the specified procedures and the increase of 200-mile claims affecting marine science research, the State Department's volume of requests for

access will grow. The State Department will not only be handling a greater volume of claims but will also be expected to follow a more tightly organized set of procedures in dealing with foreign governments. In addition to supplying the information required by the coastal state, the State Department will be expected to document the fulfillment of obligations before, during, and after the cruise. The fulfillment of obligations will become an important factor because noncompliance by one vessel or institution is likely to impair the access of other vessels and institutions. In this regard, UNOLS can play a useful role in assisting U.S. officials to monitor compliance with research obligations. UNOLS institutions can also play a useful role in providing data and developing contacts with foreign scientists who are supportive of official efforts to negotiate access.

To promote U.S. access to newly claimed coastal areas, a number of suggestions have been made by scientists and administrators in anticipation of future difficulties under the new regime. In the case of State Department procedures for seeking clearances, several problems might be addressed. As State has transmitted its request through U.S. embassies overseas, the role of the local U.S. science attachés has become important. Where the embassies have had a science attaché with some continuity, requests have been expedited by the contacts he or she has developed in the foreign capital. In the absence of local science attachés to monitor a request, Washington should provide a deadline for the application and should periodically ask the embassy to follow up on the request.

Other tasks to be addressed by the State Department include (a) consolidating all requests for research to be conducted in a certain offshore area in a given period of time; (b) negotiating standing clearances for all UNOLS ships in foreign waters where research is frequently conducted; and (c) developing cooperative research programs in the appropriate international organizations.

By consolidating requests for projects to be conducted in a coastal state's waters in a given period of time, the State Department would have to negotiate only a single request for access through the revelant foreign ministry. This would require some major changes in the way U.S. oceanographic institutions now conduct research. At present, some U.S institutions do not even combine their own individual research projects in the waters of a coastal state into a single request. In the future, U.S. oceanographic institutions and UNOLS could undertake the task of combining research projects in a given area into a single package proposal. This would require an uncharacteristic degree of planning. The NSF would have an important role to play in promoting such consolidated planning. To this end, it would have to let researchers know well in advance just how much support they could expect for a given period of time. This is especially important as research money gets tighter. On the basis of this information, the oceanographic institutions could then plan and coordinate their future programs and submit their combined requests in time to meet the

deadline stipulated by the coastal state. For these reasons this alternative would pose severe problems of implementation.

An even less cumbersome course of action, albeit initially more difficult, would be the negotiation of standing clearances with coastal states in whose waters U.S. scientists have traditionally worked (e.g., Mexico, Canada, Jamaica, Iceland). Clearly, for such a negotiation to be successful, U.S. institutions would have to inform the coastal state of anticipated cruises and carefully observe all coastal state requirements and regulations. The ties between U.S. and foreign scientists could be valuable in facilitating the negotiation for such standing clearances. On the other hand, this approach would present both logistic and political problems. Logistically, it would be difficult to get from all institutions, long enough in advance, complete and detailed information on all cruises. Politically, the coastal state would prefer to treat the package as a composite of individual projects, thereby approving some and disapproving others.

A final means of facilitating marine scientific research is through cooperative research programs conducted under intergovernmental organizations. U.S. representatives to these bodies would need to be sensitive to whether international sponsorship would provide access that would otherwise be unavailable, and they would need to work closely with oceanographic institutions in fostering such research. In addition, the research projects undertaken will have had to provide discernible benefits to others, especially developing coastal states, to make a mutually profitable exchange possible. This alternative should be evaluated more fully.

Several of the science-related trends generated by extensions in coastal state jurisdiction require significant improvement in long-range planning as well as in inter-institutional coordination of research cruises. These requirements pose major problems of adaptation for U.S. distant-water oceanographers because they imply a mode of operation vastly different from what currently exists and highly uncongenial to marine scientists. Let us summarize the jobs to be done and consider some possible national approaches for meeting these challenges.

It has been suggested that the U.S. distant-water oceanographic community will have to develop a self-policing capability to assist the Department of State to monitor compliance of different researching institutions with the obligations imposed by the Draft Convention. This is so because the Draft Convention puts the obligations on the researching state--not on each separate institution. Consequently, each researching institution within a given state becomes its brother's keeper and there will be a premium on preserving the collective performance reputation. U.S. distant-water oceanographers must avoid the perception that stringent coastal state regulation is the only means of getting them to fulfill their obligations.

Second, it has been suggested that U.S. distant-water oceanographers should develop the capability to negotiate relatively informal arrangements with coastal states. This is permitted by the draft convention but obviously there must be real incentives for coastal states to adopt this route rather than the formal, intergovernmental route. These informal arrangements would permit the exchange of interests and activities between the researching institution and the coastal states. They would promote an emphasis on primarily scientific interests of both parties, provide insulation against contamination by external political conflicts, and permit the pooling of assistance to the coastal state on other than a per vessel, per trip, per institution basis, which makes sense for neither party.

At the same time, it must be acknowledged that this mode of operation would be very difficult to create and manage. It would require adequate funding, imaginative leadership, and a procedure for pooling expertise so that the whole is greater than the sum of the parts. The difficulty here is that developing coastal states often have specifically coastal and applied interests that cannot really be satisfied by U.S. distant-water research institutions. Since the coastal and distant-water oceanographers in the United States make up separate communities, some "horse trading" will be necessary and this may contribute to an increase in the cost of operations.

Nationally, there are two potential candidates for the type of organization proposed. These are UNOLS and the Joint Oceanographic Institution (JOI), Inc. With respect to assisting the Department of State in the monitoring of obligations, UNOLS would seem to be the more appropriate mechanism since it includes all academic and government researching institutions as members and has considerable experience with coordination of ship scheduling, reporting, and the like. JOI, Inc., on the other hand, is restrictive in its membership by including only the big ships of the academic fleet. The major drawback with UNOLS with respect to monitoring obligations is that it has no control over the government fleet, and the performance of NOAA and Navy will affect the academic institutions as well as vice versa.

With regard to the negotiation of umbrella arrangements, however, JOI, Inc., would seem to be the more appropriate mechanism because this is a problem faced primarily by the distant-water oceanographers and because JOI, Inc., has a tighter and more developed management infrastructure than UNOLS. The initial drawbacks relate to its exclusivity of membership and its sole focus on deep-sea drilling. The Governing Board, therefore, would need to consider whether the organization should broaden its focus and include as members major distant-water institutions, like Duke University, that are not involved in deep-sea drilling activities.

The problem in transforming the organization so radically is that there will be only a limited need for the capability to negotiate umbrella arrangements. This mode should be considered only when

demand for access to a region is high and continuous. Over the last ten years this has been true only with Mexico and the Caribbean. For all other regions, demand has been light and episodic and individual institutions will have to continue to make their own arrangements.

CHAPTER 11

INTERNATIONAL ARRANGEMENTS TO FACILITATE AND COORDINATE FUTURE MARINE SCIENCE PROGRAMS

International mechanisms for management of marine scientific research are either intergovernmental or nongovernmental and operate at different levels: global, regional, multilateral (nonregional), and bilateral. The clearest examples of pure nongovernmental mechanisms occur at the global and bilateral levels. Given the scale of operations required for funding and logistic and diplomatic support of regional and multilateral (nonregional) activities, these levels usually involve mixed intergovernmental and nongovernmental operations. It is expected that the new ocean regime, as it affects the conduct of marine scientific research, will increase the scope and frequency of governmental participation in international arrangements. Accordingly, it is useful to try to summarize the conditions that should guide the approach to establishing international cooperative programs in marine scientific research.

GLOBAL

Nongovernmental

The Scientific Committee on Oceanic Research (SCOR) will and should continue to be the primary mechanism that facilitates contact among working scientists in a regular but informal way. This does not mean that SCOR will increasingly be the source of development and implementation of large field programs in the new ocean regime. As chapter 3 makes clear, this mechanism historically has been used selectively for this purpose.

SCOR ought to remain available for use, when necessary, for informal coordination of research activities among institutions of different countries, for development of methodological studies and intercalibration experiments, and for assessment and presentation of scientific findings. In fact, the utility of SCOR remains as varied

and as high in 1979 as was suggested in the early years of its existence.[1]

Intergovernmental

The global intergovernmental mechanism, namely, the Intergovernmental Oceanographic Commission, should be chosen only when at least one of the following conditions is present:

- The scientific problem to be investigated is clearly a global problem and cannot usefully be investigated on a lesser scale.
- Political problems make access to particular marine regions difficult and the ad hoc mode of coordination infeasible. In these contexts, it is assumed that the work will be on less-than-global problems and that alternative regional umbrellas are either not available or are inappropriate.
- Internal funding procedures in a major maritime country allow new funds to be committed more easily if the IOC is seen to be the sponsor.

[1] A broadly based international organization can be helpful. . . in several ways. It can serve as a sounding board to emphasize the economic and social importance of greater knowledge of the oceans and thereby assist marine scientists in different countries to obtain support for their work. By arranging wide dissemination of ship operating schedules, it can help scientists to participate in cruises or to obtain desired data and collections. By pointing out areas and kinds of observations where work needs to be done, it can encourage more efficient use of research vessels. It can facilitate the exchange of techniques, personnel, samples, and data. By sponsoring or encouraging discussions of ocean research problems at national and international scientific meetings, it can help enlist scientists from other fields. It can arrange for coordinated work at sea by research vessels and shore observations of different countries in attacking problems where a wide network of observations is needed. It can serve as a mechanism for the standardization and intercalibration of techniques and instruments, and can arrange for the introduction of techniques newly developed in one country or laboratory to other scientific groups elsewhere in the world. (Report of the Special Committee on Oceanic Research (SCOR) on the 2nd Meeting at Paris, 26-27 September 1958. Mimeo, n.d., pp. 1-2.)

REGIONAL

At the regional level, mechanisms are predominantly intergovernmental. They exist under the following circumstances:

1. Where there are nations that have advanced, symmetrically distributed capabilities in marine science research with a focus primarily on applied investigations related to resources and marine pollution; e.g., the International Council for the Exploration of the Sea (ICES).

2. Where global organizations in the U.N. system, e.g., IOC, FAO, and UNEP, attempt to operate regional programs as means to respond more effectively to the interests of their diverse constituencies. The emphasis in each case is again applied and the predominant interests are those of the developing countries.

3. Where, in marine regions of high scientific interest to one or more advanced countries, arrangements are made to facilitate the exchange of marine technical assistance for access to exclusive economic zones for research.

The regional level, while more diverse than the global level in the research management forms to which it gives rise, is still quite restricted and may be very expensive, especially in terms of transaction costs. Although ICES is the only current example of a type (1) mechanism, another may be created in the future in the North Pacific. The prerequisites of this type of organization make it an unlikely candidate for wide replication, but it is of special interest to the United States.

Type (2) mechanisms are the most common, but because historically they have been starved for resources, most are paper activities or organizations. They compete unsuccessfully with more direct forms of assistance in which control and benefits are seen to be greater for the donor.

There are no type (3) mechanisms now in existence, though some of type (2), e.g., IOCARIBE and Projects CINCWIO and ERFEN, could carry out type (3) functions.

The type (3) coordinating mechanism is made desirable by the changes in the ocean regime. Because it will be very costly, such a method for coordinating research will be limited in application. Furthermore, it would impose some unwelcome changes on U.S. marine scientists in the way they organize themselves and conduct research. First, because the type (3) arrangement will be difficult to negotiate and expensive to maintain, it would require that U.S. marine scientists choose one or two areas of the world, outside the United States, of highest interest to them. Second, it would demand that

they establish national organizations to derive economies of effort in which differently specialized research institutions are called upon to provide different kinds of assistance to coastal states in a region. However, the interests of the coastal state may differ substantially from U.S. scientific interests so that some means must be found for balancing the contributions made by differently specialized research institutions.

MULTILATERIAL (NONREGIONAL)

As indicated previously, some of the most advanced work in oceanography today is conducted multilaterally through nongovernmental and intergovernmental means. The process seems to work in the following way:

- Working scientists in one or more developed countries become interested in a problem or set of problems of high theoretical significance and for which solutions are foreseeable.

- They interact in various arenas with other scientists and simultaneously search for governmental commitment of funding and logistic and diplomatic support.

- Government agencies respond according to their research objectives. Occasionally, certain benefits, unrelated to the research itself are also seen to be possible.

- Once the commitment is obtained, scientists set up ad hoc mechanisms for managing these large-scale, problem-oriented investigations.

This process suggests the following preconditions for multilateral coordination of marine research:

- Scientists in countries with advanced oceanographic research capabilities should agree on the choice of a large-scale problem that promises major theoretical advances in oceanography.

- Governments should be sufficiently interested in these problems to commit funds to support scientist-to-scientist contact, planning, logistic requirements, and execution of research.

- Research arrangements should be kept relatively informal and the research agenda should be effectively insulated from external political conflicts.

The costs of operating in this mode are high. Unlike research at the regional level, however, multilateral research is not primarily applied research.

BILATERAL

The bilateral category contains various types of agreements, not all of which will be of much use under the new ocean regime. For example, several intergovernmental agreements between the United States and other developed countries are primarily government-inspired for reasons not necessarily related to the research itself. From the point of view of the research program, this approach is not often the most efficient. The most efficient mechanisms are in fact nongovernmental bilateral agreements that grow out of contacts developed between scientists in the Scientific Committee on Oceanic Research, for example. However, the increased formalization of the research process may constrain this mode of operation in the future.

As a result of the governing international fishery agreements (GIFAs) required by the U.S. Fisheries Conservation and Management Act (FCMA), a number of countries fishing in the U.S. zone now engage in valuable joint research projects. The incentive here, of course, is that such participation is supposed to be taken into account when allocations of the surplus are made. Such a direct benefit will be hard to come by for nondirected research programs, although research related to a coastal state's management needs could be made an added incentive.

There are also examples of intergovernmental agreements between the United States and particular developing countries. These, too, are usually driven by considerations external to the research effort, most often defense or "good relations." As a result of the new ocean regime, it is expected that these agreements can be used as a way to exchange assistance for access in a few special cases. Such agreements might take the form of "framework" agreements in which a variety of specific research programs are carried out over time. This kind of arrangement can work if both parties have either identical or complementary research interests in a variety of possible research projects.

From the perspective of marine scientific research, informal arrangements are preferable. Formal bilateral agreements should be used as sparingly as the regional approaches described above and for the same reasons; that is, the area must be important scientifically, and demand for access must be high and continuing. Additionally, government-to-government arrangements should be sought only if political problems between the two countries preclude informal arrangements for research. If political problems are not major but it is impossible to get the necessary funding to respond to the interests and priorities of the coastal state without a governmental commitment, then a formal bilateral agreement should be sought.

Changes in the ocean regime will add significantly to the costs of marine research. These changes occur just at the time when inflation in the cost of food, fuel, and labor has already begun to exert significant adverse effects on distant-water oceanography. In addition to these financial costs, there will be the cost of extended time for planning, and getting clearance for, particular research projects. The research process, therefore, will be increasingly formalized, both internationally and nationally, and all of these costs will have to be calculated case by case in determining which mechanisms might be appropriate.

ACRONYMS AND ABBREVIATIONS

BOMEX	Barbados Oceanographic and Meteorological Experiment
CARPAS	Comision Asesora Regional de Pesca el Atlantico Sud-Occidental
CECAF	Committee for the Eastern Central Atlantic Fisheries
CEPEX	Controlled Ecosystems Pollution Experiment
CICAR	Cooprative Investigation of the Caribbean and Adjacent Regions
CINCWIO	Cooperative Investigation in the North and Central Western Indian Ocean
CIM	Cooperative Investigations in the Mediterranean
CNEXO	Centre National pour l'Exploitation des Oceans
CSK	Cooperative Study of the Kuroshio
CUEA	Coastal Upwelling Ecosystem Analysis
ERFEN	Estudio Regional del Fenomeno El Niño
FAMOUS	French-American Mid Ocean Undersea Study
GARP	Global Atmospheric Research Program
GATE	GARP Atlantic Tropical Experiment
GIPME	Global Investigations of Pollution in the Marine Environment
ICES	International Council for the Exploration of the Sea
ICNAF	International Commission for the Northwest Atlantic Fisheries
IDOE	International Decade of Ocean Exploration
IGOSS	Integrated Global Ocean Station System
IIOE	International Indian Ocean Expedition
IMCO	Inter-Governmental Maritime Consultative Organization
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Association for the Caribbean and Adjacent Regions
IODE	International Oceanic Data Exchange
ITSU	Tsunami Warning System for the Atlantic
JOIDES	Joint Oceanographic Institutions for Deep Earth Sampling
LEPOR	Long-Term and Expanded Program of Oceanic Research
MODE	Mid Ocean Dynamics Experiment
NODC	National Oceanographic Data Center
ODAS	Ocean Data Acquisition Systems
OETB	Ocean Economics and Technology Branch
POLYMODE	Joint US-USSR Mid Ocean Dynamics Experiment
SCOR	Scientific Committee on Oceanic Research
SEATAR	Studies on East Asia Tectonics and Resources
TEMA	Training, Education, and Mutual Assistance
UNCLOS III	Third United Nations Conference on the Law of the Sea
UNOLS	University National Oceanographic Laboratory System
WECAF	Western Central Atlantic Fishery Commission
WESTPAC	Working Group for the Western Pacific
WMO	World Meteorological Organization

United States Interests and Needs in the Coordination of International Oceanographic Research
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