MARINE SCIENCE AFFAIRS

—A Year of Transition

THE FIRST REPORT OF THE PRESIDENT TO THE CONGRESS ON MARINE RESOURCES AND ENGINEERING DEVELOPMENT

February 1967

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WASHINGTON, D.C., *March 1967.*

To the Congress of the United States:

I am pleased to report on the marine science activities of the Federal Government.

The resources of the oceans can help us meet many of the challenges that face our Nation and the world today.

> The vast food reserves of the sea must be developed to help end the tragic cycle of famine and despair.
>
> The continuing pollution and erosion of our seashores, bays, estuaries, and Great Lakes must be arrested and reversed to safeguard the health of our people and to protect the resources of the sea.
>
> The influence of oceans on the environment must be understood so that we may improve the long-term forecasting of storms, weather, and sea conditions; protect life and property in coastal areas; and improve the prediction of rainfall in the interior.
>
> The wealth of the ocean floor must be freed for the benefit of all people.
>
> Finally, the seas must be used as pathways to improved international understanding and cooperation.

The great potential of the seas has not gone unnoticed. During the past 6 years, we have invested increasingly in the development of marine scientific and technical manpower, ships, and facilities. The quality of our research fleet, deep sea vessels, and laboratories is unsurpassed. The small but growing corps of highly trained specialists provides a strong creative base for our marine science and technology.

The 89th Congress also responded to the challenge of the oceans by enacting—

> The Marine Resources and Engineering Development Act which provides a stronger policy and organization framework and gives new momentum to our marine science activities;
>
> The Sea Grant College and Program Act, which will improve our capabilities for training and research in marine sciences and engineering; and
>
> The act authorizing pilot plants for the production of fish protein as a usable source of food.

The new National Council on Marine Resources and Engineering Development, chaired by the Vice President, has made significant progress in carrying out its responsibilities for planning and coordinating the Nation's marine science activities. In consultation with the President's Science Advisory Committee, the National Academy of

Sciences and other agencies of the Federal Government, the Council has reviewed our current work and has identified the areas in which action should be taken.

We must—

Launch a pilot program to assist the protein-deficient countries of the world in increasing their capacity for using the fish resources of the seas;

Implement the Sea Grant College and Program Act to strengthen oceanographic engineering, expand applied research, and improve technical information activities;

Accelerate studies to improve the collection, storage, retrieval, and dissemination of oceanographic data;

Expand ocean observation systems to improve near-shore weather prediction services, and study ways to make more accurate long-range predictions of precipitation levels and drought conditions;

Study the Chesapeake Bay to determine the effects of estuarine pollution on shellfish, health, recreation, and beauty, and to provide a basis for remedial measures;

Explore offshore solid mineral deposits;

Improve technology and engineering for work at great ocean depths; and

Equip a new Coast Guard ship to conduct oceanographic research in sub-Arctic waters.

Details of these programs are set forth in the accompanying report of the National Council on Marine Resources and Engineering Development.

I have this year recommended to the Congress a 13-percent increase—from $409 to $462 million—in appropriations to support marine science activities. These funds will permit us to expand our efforts to understand the sea and develop its vast resources. They will enhance the capabilities of local government, universities, and private industry to join in this vital enterprise. They will enable us to support the important new efforts recommended by the National Council on Marine Resources and Engineering Development.

I urge the Congress to provide the necessary funds to support these important efforts.

In January, I appointed 19 distinguished Americans, including four Members of Congress, to serve as members and advisers of the Commission on Marine Science, Engineering, and Resources. This Commission will complement the activities of the National Council on Marine Resources and Engineering Development, by providing impartial insights into the strengths and weaknesses of our marine science programs.

The Commission will be called upon to identify still more opportunities for a concerted public and private effort—to develop the resources of the sea through a creative and cooperative partnership of Government, industry, and the academic community.

The depth of the sea is a new environment for man's exploration and development, just as crossing the West was a challenge in centuries past.

We shall encounter that environment with the same conviction and pioneering spirit that propelled ships from the Old to the New World.

We shall bring to the challenge of the ocean depths—as we have brought to the challenge of outer space—a determination to work with all nations to develop the seas for the benefit of mankind.

LYNDON B. JOHNSON.

THE WHITE HOUSE.

DEAR MR. PRESIDENT:

I am pleased to forward to you the first report of the National Council on Marine Resources and Engineering Development, entitled "Marine Science Affairs—A Year of Transition."

This report describes current and proposed Federal programs within the scope of the Marine Resources and Engineering Development Act, and presents the rationale and funding requirements of $462 million for the next fiscal year.

The report also contains the Council's initial findings and recommendations to utilize scientific knowledge of the seas and the Great Lakes more effectively to meet national goals. These recommendations were prepared after reviewing proposals from your Science Advisory Committee, Federal agencies, and others, and after evaluating the content and balance of current efforts. A consensus was obtained in defining nine areas that immediately deserve special emphasis in designating agencies' responsibilities and in strengthening coordination for programs that increasingly cross agency lines.

In short, this report sets forth a perspective to show how a more deliberate study and use of our marine environment may make this country and the world a better place in which to live. It also sets the stage for new opportunities to approach the major questions of world order, starvation and urban development, and for looking ahead to marine science contributions to help resolve problems in the decades to come.

Sincerely,

Hubert H. Humphrey

VICE PRESIDENT

THE PRESIDENT,
The White House,
Washington, D.C.

A Report to the President From the National Council on Marine Resources and Engineering Development, February 1967

Chairman:

Hubert H. Humphrey, the Vice President.

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Stewart L. Udall, the Secretary of the Interior.
Alexander B. Trowbridge, Acting Secretary of Commerce.
John W. Gardner, the Secretary of Health, Education, and Welfare.
Alan S. Boyd, the Secretary of Transportation.
Glenn T. Seaborg, Chairman, Atomic Energy Commission.
Leland J. Haworth, Director, National Science Foundation.

Observers:

James E. Webb, Administrator, National Aeronautics and Space Administration.
S. Dillon Ripley, Secretary, Smithsonian Institution.
William S. Gaud, Administrator, Agency for International Development.
Charles L. Schultze, Director, Bureau of the Budget.
Gardner Ackley, Chairman, Council of Economic Advisers.
Donald F. Hornig, Director, Office of Science and Technology.

Executive Secretary:

Edward Wenk, Jr.

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INTRODUCTION

A New National Policy

For marine sciences, the year 1966 was a significant turning point. Through the Marine Resources and Engineering Development Act, the 89th Congress developed, and the President approved, a new national policy to intensify the study of the sea, and to convert to practical reality its inherent promise for man's benefit.

This national policy is unprecedented in its breadth. It continues the quest for scientific knowledge of the marine environment. It also marks a significant transition toward strengthening ocean engineering and stimulating new ocean technologies:

—to contribute to national security;
—to enhance commerce and transportation;
—to rehabilitate domestic fisheries and increase the harvest from the sea;
—to develop seashore resources and to reduce pollution of the Great Lakes, bays, estuaries, and nearshore waters;
—to improve forecasting of weather and ocean conditions;
—to supplement continental sources of oil, gas, and minerals;
—to promote international understanding and cooperation through the use of the oceans.

The Marine Resources and Engineering Development Act, Public Law 89–454, calls on the President to develop a comprehensive, long-range, and coordinated national program in marine science, with the assistance of a National Council on Marine Resources and Engineering Development, and an advisory Commission on Marine Science, Engineering, and Resources.

The Council is composed of the Vice President, who serves as Chairman, five members of the Cabinet and three heads of other Federal agencies. It has statutory responsibility to advise and assist the President in policy planning and coordination of the marine science programs of eleven Federal agencies.

First Council Report

This initial report by the Marine Sciences Council to the President communicates some new steps taken to meet the needs and opportunities in the ocean, and thus to accelerate marine sciences toward objectives laid down by law. It outlines the Council's interpretation of the policy and purposes of the Act, and defines and describes the scope of this aggregate of activities whose statutory terms of reference extend the coverage beyond what previously had been designated the Federal Government's "National Oceanographic Program."

The report discusses nine priority efforts or emphases in marine sciences recommended by the Council to the President in response to his request for initial proposals by this January. The resulting decisions are reflected in the President's budget for fiscal year 1968, now before Congress. To place these priority efforts in the perspective of ongoing efforts, the report also discusses marine science activities of the Government as a whole and tabulates funding estimates for all agencies in considerable detail.

Areas for special attention were chosen after screening proposals from numerous public and private sources, considering public needs to which marine science could contribute and the many continuing efforts that could be effectively mobilized around a smaller number of explicit goals. The Council thus evaluated current Federal marine science activities, identified initial priorities, clarified agency responsibilities, and endeavored to strengthen coordination of multiagency programs.

Categories of Public Need

As the new scope of marine science affairs was studied and defined, categories were established to reflect more clearly the end purpose of Federal expenditures in marine science and technology. Accordingly, the President's estimate of funds required in this area by all Federal agencies for fiscal year 1968 is delineated in this report by purpose.

Many of the goals and programs were found by the Council to cut across agency lines. The report discusses actions to designate a lead agency to take responsibility in developing certain areas and in providing Government-wide leadership.

The report concludes with a brief commentary on next steps by the Council through its long-range studies to identify potential benefits of marine science activities, appropriate goals of the Federal Government, and resources needed for their accomplishment; to review ongoing activities and develop a comprehensive program. These functions anticipate an independent set of recommendations to be submitted by the Commission on Marine Science, Engineering, and Resources to the President, through the Council, and to the Congress, for an adequate program to meet national needs and a Government organizational plan.

Limitations

While the Council has selected some programs for special emphasis in fiscal year 1968, the limitations of time since its creation have not permitted more than a beginning on its total job. The many continuing Federal activities have not been fully surveyed or evaluated. Not all of the policy issues and relationships between marine activities and corresponding land activities have been explored. The balance between various Federal programs and functions has not been fully analyzed. A comprehensive program is now only in its formative stage.

This report, however, reflects steps taken by the Marine Sciences Council following enactment of the Marine Resources and Engineering Development Act on June 17, 1966.

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Chapter I

MARINE SCIENCES AND NATIONAL GOALS

The Oceans and Society

Marine science is a term employed in Public Law 89–454 to designate scientific research, engineering, and technological development related to the marine environment. The marine environment is considered to include the oceans, the Continental Shelf of the United States and its territories, the Great Lakes, and their resources.

Marine science affairs cannot be considered in isolation. Research and development activities in the oceans must be related to similar activities on land. So, too, must man's exploration and exploitation of the oceans' resources. Marine science goals, policies, programs, and activities must therefore be examined in two ways: as they relate to the unity they derive from the marine environment, and as they contribute to major goals of society and the Nation. It is in this second context—the relatively unfulfilled promise of the sea to contribute to human needs—that recent effort became increasingly motivated to deal with major issues of world peace, starvation, and general welfare; the requirements and problems of a growing and increasingly urbanized population; and the protection of our environment and seashore resources from unnecessary degradation.

Recognizing the importance of the oceans to society, the Federal Government began in the late 1950's to increase its rate of investment to strengthen the Nation's capabilities in marine research and engineering. Concurrently, the business and academic communities and the States began to extend their interests in offshore activities such as intensified petroleum and gas exploration, application of aerospace technology, development of new fisheries, and efforts to preserve coastal areas. These combined efforts have strengthened the extent of our understanding of the oceans, the availability and sophistication of our instrumentation, laboratories, ships, deep submergence vehicles, and other data-collecting platforms, and our ocean science and engineering manpower base.

Indeed, we have progressed significantly during the 1960's, but the total marine sciences enterprise—both public and private—is still small, representing only about three percent of the Nation's total technical effort.

This effort is spread over many scientific and engineering disciplines and many technologies; it involves a wide diversity of institutions. The participants include twenty-four bureaus in eleven Federal departments and agencies, thirty-three subcommittees of the Congress, and numerous State, regional, and international organizations. In the private sector, participants include universities and maritime, chemical, electronics, aerospace, mineral, oil, fishing, recreational, and other industries. One of the purposes of the Marine Resources and Engineering Development Act of 1966 is to foster a coherent sense of direction and purpose in any expanded program through a creative and cooperative partnership of Government, business, and the academic and scientific communities.

National Policies and Objectives

To mobilize the Nation's marine science activities, the Marine Resources and Engineering Development Act of 1966 declares it to be the policy of the United States "to develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind to assist in:

—protection of health and property,
—enhancement of commerce, transportation, and national security,
—rehabilitation of our commercial fisheries, and
—increased utilization of these and other resources."

This mandate of the Congress and the President further identifies eight objectives related to these goals. Specifically, the marine science activities of the United States should "contribute to the following objectives:

—The accelerated development of the resources of the marine environment.

—The expansion of human knowledge of the marine environment.

—The encouragement of private investment enterprise in exploration, technological development, marine commerce, and economic utilization of the resources of the marine environment.

—The preservation of the role of the United States as a leader in marine science and resource development.

—The advancement of education and training in marine science.

—The development and improvement of the capabilities, performance, use, and efficiency of vehicles, equipment, and instruments for use in exploration, research, surveys, and the recovery of resources, and the transmission of energy in the marine environment.

—The effective utilization of the scientific and engineering resources of the Nation, with close cooperation among all interested agencies, public and private, in order to avoid unnecessary duplication of effort, facilities, and equipment, or waste.

—The cooperation by the United States with other nations and groups of nations and international organizations in marine science activities when such cooperation is in the national interest."

Congress has singled out international cooperation for particular emphasis. The seas offer unique opportunities to enhance scientific exchange and to promote understanding between nations in all sectors—among the scientists, the universities, the Federal Government, and industry.

In short, the Act calls on the marine science communities to contribute to fulfillment of our national policies. The bountiful resources of the sea can help solve man's increasing need for food, water, minerals, and energy. A vigorous and imaginative program of marine research, development, and exploitation is consequently anticipated on a significantly larger scale than formerly as an integral part of the economic, political, and social fiber of our nation and other Nations.

Chapter II

MOBILIZING FEDERAL RESOURCES

The Federal Role

In view of the diversity of broad economic, social, and political goals that can be served by the sea, and the traditional role of the Federal Government in promoting our national interest, the 1966 Act anticipates that the Government will continue its past interest in marine sciences. Federal leadership is necessary, for example, to insure that marine science activities:

—sustain a naval science and technology to meet national security needs;
—support foreign policy objectives by fostering international agreements, understanding and cooperation, and by supporting technical assistance to developing nations on the principle of self-help;
—enhance capabilities for describing and predicting the state of the oceans and the weather and provide services to marine interests;
—explore and foster exploitation of fish, minerals, and energy resources by mapping, by appropriate development of technological capabilities, by formulation of means for public and private collaboration, and by encouragement of private investment;
—aid abatement and prevention of pollution and assist in the conservation and improved utilization of recreational, esthetic, and economic resources of our sea coast and Great Lakes;
—protect life and property at sea, and along the coast;
—nourish basic knowledge and develop scientific facilities and manpower.

At the same time, the Government recognizes that the vitality of our industrial organizations and the creativity of our scientists have been major factors in our progress toward better understanding and use of the seas. Indeed, the bulk of Federal funds devoted to marine efforts has been expended through grants and contracts with private industrial and academic organizations. The States have also become increasingly involved in studying and preserving our coasts and in insuring rational exploitation of coastal resources.

With the broadening and deepening interest in marine activities—national and international—the articulation of key Federal policies and programs should aid all interested parties to develop their independent activities and relationships against a backdrop of national purposes and directions.

Federal Activities

Previous legislation has provided for marine science functions and services to be undertaken in eleven Federal agencies, related to the core mission of each. This distribution by agency, shown in Table I, indicates both the breadth and the complexity of involvement. This pattern also highlights the importance of coordination in Federal programs.

Appendices to this report contain program and funding details of the individual agencies. The chapters dealing with new areas for emphasis, however, treat activities on a Government-wide basis so as to show both individual and collective efforts to serve a common set of national goals.

Coordinating Federal Programs

To meet the need for a coordinated Federal effort, the Interagency Committee on Oceanography (ICO) of the Federal Council on Science and Technology has, since 1959, brought together programs of Government agencies into the framework of a National Oceanographic Program. The ICO published annual summaries of agency activities and other oceanographic reports.[1] Specialized panels developed international programs, an interagency buoy program, and information as to instrumentation and equipment, manpower, engineering, surveys, research, and ships.

During the past several years, a sense of urgency has been felt in the Congress and the Executive Branch to strengthen this multiagency Federal effort, to intensify momentum and improve overall effectiveness. This has come about through the recognition of the undersea threat to our national security; the emerging significance of science and technology as instruments of world affairs; and increased international interest in the exploitation of marine resources. Our lack of knowledge of the sea—together with the development of new tools for exploring its secrets—has further underscored this urgency.

During the past five years, a number of new laws have been enacted in the marine sciences area. As shown in Table II, these new laws strengthen existing statutory authority in the present family of Federal agencies, without establishing any new operating entities. However, the 1966 Marine Science Act goes beyond this: in the past eight

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[1] These include: "National Oceanographic Program for Fiscal Year 1967"; "Ship Operating Schedules for FY 1967"; "University Curricula in Oceanography—Academic Year 1965–66"; "Aquatic Sciences in the Great Lakes Area"; "Oceanic Research in Foreign Waters"; and "Scientific and Technical Personnel in Oceanography."

Table I.—*Federal agencies having marine science activities*

Agency	*Missions*
Department of Defense:	All phases of oceanography relating to national security.
Navy, Army Corps of Engineers, Advanced Research Projects Agency.	Undersea technology.
	Statutory Civilian Responsibilities:
	Great Lakes, river, harbor, coastal and ocean charting and forecasting.
	Great Lakes, river, harbor, coastal development, restoration, and preservation.
Department of State	United States' participation in international organizations.
	Support of International Fisheries Commissions.
Agency for International Development	Foreign assistance.
Department of Commerce:	Environmental prediction and description.
Environmental Sciences Services Administration,	Charting and mapping coastal and deep-ocean waters.
Martime Administration	Central responsibility for air/sea interaction program.
	Research on shipbuilding and ship operations.
	Marine transportation systems.
Department of the Interior:	Management, conservation, and development of marine natural resources.
Geological Survey, Federal Water Pollution Control Administration, Bureau of Commercial Fisheries, Bureau of Sport Fisheries and Wildlife, Bureau of Mines, Bureau of Land Management, National Park Service, Bureau of Outdoor Recreation, Office of Saline Water.	Measurement and enforcement of water quality standards.
	Preservation and development of coastal areas.
	Identification and development of technology for evaluation of mineral resources.

Table I.—*Federal agencies having marine science activities*—Continued

Agency	*Missions*
Department of Transportation:	Safety at sea.
Coast Guard	Delineation and prediction of ice masses.
	Oceanographic services.
Department of Health, Education, and Welfare:	Relation of marine organisms to health and pollution.
Public Health Service, Office of Education	Marine science and engineering education—fellowships, grants.
Atomic Energy Commission	Effects of radioactivity in the marine environment.
	Development of marine nuclear technology.
National Science Foundation	Basic and academic oceanography.
	Graduate and undergraduate training in marine science and engineering.
	Sea-Grant program.
Smithsonian Institution	Identification, classification, and ecology of marine organisms; investigations of the geophysical factors of oceanic environment.
National Aeronautics and Space Administration	Feasibility, design, and engineering of spacecraft and sensors for ocean observations.

years, it has become clear that existing oceanographic activities should be unified at the Presidential level; the Marine Sciences Act establishes this unity.

TABLE II.—*Selected recent Federal legislation related to marine sciences*

Public Law 86–409 (April 15, 1961)—removed geographical limitations on operations of the Coast and Geodetic Survey.

Public Law 87–396 (October 5, 1961)—expanded the functions of the Coast Guard to include oceanographic research.

Public Law 87–626 (September 5, 1962)—extends the authority of the Secretary of the Interior to activities of the Geological Survey beyond the national domain.

Public Law 88–309 (May 20, 1964)—fostered research and development to promote commercial fisheries through a program of Federal-State cooperative research.

Public Law 88–606 (September 19, 1964)—established Public Land Law Review Commission, whose scope included mineral resources of outer Continental Shelf.

Public Law 89–99 (July 30, 1965)—exempted oceanographic research vessels from application of certain inspection laws.

Public Law 89–298 (October 27, 1965)—Rivers and Harbors Act provided for study of water utilization and control of Chesapeake Bay and construction of a large scale model for this purpose.

Public Law 89–454 (June 17, 1966)—Marine Resources and Engineering Development Act of 1966 established a national policy to advance marine sciences and created a cabinet level council and advisory commission.

Public Law 89–658 (October 14, 1966)—established a contiguous fishing zone beyond the territorial sea of the United States.

Public Law 89–688 (October 15, 1966)—National Sea Grant College and Programs Act of 1966 authorized grants to institutions to operate programs of applied research, training and education, and information dissemination.

Public Law 89–701 (November 2, 1966)—authorized practicable and economic means for the production of fish-protein concentrate.

Public Law 89–753 (November 3, 1966)—Clean Water Restoration Act of 1966 provided for Federal assistance to and cooperation with groups developing water quality control and pollution abatement programs.

Marine Sciences Council and Advisory Commission

To implement the Marine Sciences Act, a National Council on Marine Resources and Engineering Development was created as a new policy planning and coordinating arm of the President. The Vice President was designated to serve as Chairman of the Marine Sciences Council, and the following officials to serve as members:

Secretary of State.
Secretary of the Navy.
Secretary of the Interior.
Secretary of Commerce.
Chairman of the Atomic Energy Commission.
Director of the National Science Foundation.
Secretary of Health, Education, and Welfare.
Secretary of Transportation.[2]

[2] With the transfer of the Coast Guard to the Department of Transportation, the Secretary of Transportation replaces the Secretary of the Treasury. PL 89–670.

To insure that broad Government interests are represented on the Council, the following observers were subsequently appointed by the Chairman:

Administrator of the National Aeronautics and Space Administration.

Secretary of the Smithsonian Institution.

Administrator of the Agency for International Development.

Director of the Bureau of the Budget.

Chairman of the Council of Economic Advisers.

Director of the Office of Science and Technology.

The principal responsibility of the Marine Sciences Council is to assist the President in planning and reviewing Federal marine science activities. The President, with the advice and assistance of the Council, was specifically directed "to:

—survey all significant marine science activities;

—develop a comprehensive program of marine science activities * * * to be conducted by departments and agencies * * * independently or in cooperation with such non-Federal organizations as States, institutions and industry;

—designate and fix responsibility for the conduct of the foregoing marine science activities by departments and agencies * * *;

—insure cooperation and resolve differences arising among departments and agencies * * *;

—undertake a comprehensive study * * * of the legal problems arising out of the management, use, development, recovery, and control of the resources of the marine environment;

—establish long-range studies of the potential benefits to the U.S. economy, security, health, and welfare to be gained from marine resources, engineering, and science, and the costs involved in obtaining such benefits; and

—review annually all marine science activities conducted by departments and agencies * * *."

The President has also requested the Council to prepare for him a report, required by law to be submitted to the Congress annually, that describes and evaluates Federal activities and accomplishments in marine science, sets forth recommendations for legislation, and contains an estimate of funding requirements of each Federal agency for marine science activities during the succeeding year.

To complement the role of the Council, the Act provides for an independent advisory Commission on Marine Science, Engineering, and Resources. The Commission is made up of fifteen members from Federal and State Governments, industry, laboratories, and other marine science institutions. Four members of Congress serve as advisers to the Commission. All members and advisers are appointed by the President.

Specifically, the Commission is charged to:

—"Review the known and contemplated needs for natural resources from the marine environment to maintain our expanding national economy.

—Review the surveys, applied research programs, and ocean engineering projects required to obtain the needed resources from the marine environment.

—Review the existing national research programs to insure realistic and adequate support for basic oceanographic research that will enhance human welfare and scientific knowledge.

—Review the existing oceanographic and ocean engineering programs, including education and technical training, to determine which programs are required to advance our national oceanographic competence, and stature, and which are not adequately supported.

—Analyze the findings of the above reviews, including the economic factors involved, and recommend an adequate national marine science program that will meet the present and future national needs without unnecessary duplication of effort.

—Recommend a Governmental organization plan with estimated cost."

The Commission was appointed January 9, 1967.[3] It shall submit to the President, via the Council, and to the Congress a report of its findings and recommendations not later than eighteen months after its establishment.

While the Act provides a framework of policy guidance of unlimited duration, the Marine Sciences Council is an interim body pending recommendations as to the best organizational structure required to implement the Act. Its statutory authority expires 120 days after the Commission renders its report.

Council Activities

Soon after the President signed Public Law 89–454 into law, he requested the Vice President to activate the Marine Sciences Council. The first meeting was held August 17, 1966, and four other sessions

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[3] Dr. Julius Adams Stratton, Ford Foundation (chairman); Prof. Richard A. Geyer, Texas A. & M. University (vice chairman); Dr. David Adams, Department of Commercial and Sport Fisheries, State of North Carolina; Dr. Carl Auerbach, University of Minnesota; Mr. Jacob Blaustein, Standard Oil Company; Prof. James Crutchfield, University of Washington; Mr. Leon Jaworski, attorney; Dr. John A. Knauss, University of Rhode Island; Mr. John H. Perry, Perry Publications; Mr. Taylor A. Pryor, Sea Life, Inc.; Mr. George Reedy, Struthers Research and Development Corp.; Dr. George H. Sullivan, Northrop Space Corporation; the Honorable Robert H. B. Baldwin, Under Secretary of Navy; the Honorable Frank C. Di Luzio, Assistant Secretary of Interior for Water Pollution Control; the Honorable Robert M. White, Environmental Science Services Administration; the Honorable Norris Cotton, U.S. Senator; the Honorable Alton Lennon, U.S. Representative; the Honorable Warren G. Magnuson, U.S. Senator; the Honorable Charles A. Mosher, U.S. Representative.

have since been convened. An Executive Secretary was appointed by the President and sworn in at the first Council meeting. A full time professional staff, provided for in the legislation, is being assembled. The staff is composed of specialists in ocean sciences, engineering, national security affairs, economics, foreign affairs, and public administration. It maintains working relations with the Congress, key officials of the Executive Office of the President, Federal and State agencies, industry, the academic community, and professional societies to insure that considerations affecting all marine science interests are brought to the attention of the Council.

The Marine Sciences Council is not an operating agency. Its purpose is to assist the President in identifying Government-wide goals, in developing alternative strategies for their achievement, in identifying issues, and in reaching an informed decision. Helping the operating agencies to do their jobs is a prime objective of the Council, but the agencies must rely on their own budgetary resources to carry out programs called for in their organic legislation. When missions are the statutory responsibility of more than one agency, the Council may serve the Government-wide interest by recommending one agency assume responsibility for planning, guiding, and coordinating a multi-agency program. Each participating agency, however, retains management and budgetary responsibility for its element of the program.

The Interagency Committee on Oceanography has been supporting the activities of the Council as an essential mechanism for compiling and disseminating information about the many detailed aspects of the various agency programs. ICO panels are being realigned and new Council panels established to reflect the enlarged program and to be of more assistance to the designated lead agencies and the Council.

The National Academy of Sciences' Committee on Oceanography continues to serve as a source of scientific advice on oceanographic matters. For ten years, the committee has helped chart the course of Federal marine science activities, and it issued a landmark report in 1959 and is preparing another. The National Academy of Engineering's Committee on Ocean Engineering, as well as other offices of the two academies, together with numerous professional and industrial societies, also provide marine sciences advice to Government agencies and the Council.

Chapter III

NEW INITIATIVES AND AREAS OF INCREASED EMPHASIS

Defining and Classifying Marine Science and Technology Programs

The Marine Resources and Engineering Development Act requires budget estimates for the succeeding fiscal year from each Federal department and agency that conducts programs in marine science and technology. To collect such data and to improve its utility, it was necessary to define the overall scope and classify constituent programs. Since 1959, the Federal budget has identified the Government's "National Oceanographic Program" by agency and by such functions as oceanographic research, surveys, facilities, manpower, and closely related engineering development.

As a consequence of the broadened scope of marine science and technology defined by the Marine Sciences Act, other resources and engineering programs must now be considered, in addition to the original oceanographic component. Additions include certain classified naval programs; ship and vehicle research; additional technological developments related to such subjects as fish, marine minerals, and energy resources; and seashore land use and recreation.

Federal agencies have now identified programs within the scope of marine science, engineering, technology, or resources development as follows:

TABLE III.—*Program plan of Federal agencies for marine sciences and technology*

[In millions of dollars]

Agency	1966 actual	1967 estimate	1968 estimate
Department of Defense	174.9	235.8	258.7
Department of the Interior	56.5	71.2	72.3
National Science Foundation	[1] 47.7	29.0	40.1
Department of Commerce	25.0	32.5	36.0
Department of Transportation	8.1	10.8	24.6
Atomic Energy Commission	8.3	13.7	15.8
Department of State	5.0	5.1	5.4
Department of Health, Education, and Welfare	5.4	7.0	4.8
Agency for International Development	.1	2.0	2.0
Smithsonian Institution	1.5	1.6	1.8
National Aeronautics and Space Administration	.9	.4	.8
Total	333.4	409.1	462.3

[1] Includes Project Mohole which was discontinued in fiscal year 1967.

A more detailed explanation of these estimates is given in Part Two, Tables A–1, 2, and 3, where they have been classified by purpose and function.

These activities have been summarized by the participating agencies in terms of recognized national economic, political, or social purposes as follows:

TABLE IV.—*Federal marine science programs by major purpose*

	Fiscal year 1968 program estimate (in millions)
National security	$191.6
Fisheries development and sea food technology	49.2
Transportation	27.8
Recreation	13.6
Pollution abatement and control	9.5
International cooperation and collaboration	7.4
Minerals, chemicals, water, and energy resources	5.8
Health	4.2
Shore and harbor stabilization and protection	1.7
Multipurpose activities:	
Oceanographic research	73.2
Mapping, charting, and geodesy	39.1
Ocean environmental observation and prediction services	21.1
General purpose engineering	10.5
Education	5.5
Data centers	2.1
Total	462.3

For purposes of comparison of new and old definitions of scope, the "National Oceanographic Program" component is estimated at approximately $208 and $229 million for fiscal years 1966 and 1967 respectively, and proposals for fiscal year 1968 amount to approximately $278 million. Details are set forth in Table V.

The distribution of Federal marine science and technology funding in terms of the percentage planned in fiscal year 1968 for each major purpose is shown in Figure 1.

This distribution of funding is also represented by the functional relationships shown in Figure 2. The total activity may be considered in three stages. The first two stages constitute a general purpose base of academic research, manpower training and education, general purpose ships, environmental data acquisition, facilities, and instruments which provide a reservoir of information and techniques. The third stage, which is functionally dependent on the first two, includes applied research, mission-oriented development, and other marine technology programs to provide for public needs such as national defense and resource exploitation. In this third stage, each activity directed to a specific goal is represented by a separate bar in Figure 2.

Table V.—*The "National Oceanographic Program," a component of Federal Marine Sciences and Technology*

[Program Plan estimated in millions of dollars]

	Fiscal year 1966	Fiscal year 1967	Fiscal year 1968
BY AGENCY			
Defense	98.0	123.0	137.9
Commerce	19.5	20.7	27.7
Interior	23.4	27.3	28.6
National Science Foundation	47.7	29.0	40.1
Atomic Energy Commission	8.3	13.7	15.8
Health, Education, and Welfare	3.1	5.8	4.0
Transportation	5.2	6.0	20.1
Smithsonian Institution	1.5	1.6	1.8
State	.5	.5	.7
National Aeronautics and Space Administration	.4	.9	.8
Total	207.6	228.5	277.5
BY FUNCTION			
Research	94.2	99.2	121.7
Surveys	42.6	48.3	56.9
Engineering	40.1	48.7	64.5
Instrumentation	9.9	8.6	14.1
Ship construction	15.6	15.5	12.0
Services	1.8	2.4	3.1
Facilities	3.4	5.8	5.2
Total	207.6	228.5	277.5

These three stages differ in one other respect—the motivation for funding. The two stages in the base are supported as a national policy to maintain an innovative capability adequate to meet both present and future national needs. This base can be considered part of the long-term investment capital of the Nation. General purpose research includes a substantial academic research component. This is of special importance and has received Council study to be sure that its growth is consistent with both needs for additional knowledge and the new opportunities for research associated with increasing graduate student interest in ocean-oriented programs.

Funding of marine science efforts for public needs, the third stage, depends largely on the user requirements in terms of anticipated payoff, even though such a cost-benefit assessment deals in part with intangibles. Funding for each category of development in the vertical bars is developed separately, depending on the relative importance of the different goals and on the opportunities available in various programs. This expected potential to contribute to public needs is determined by the President and the Congress in the budget and appropriation process.

Trends in the Federal Program

Past programs have been characterized by substantial marine science efforts for national security objectives such as strategic, undersea, and

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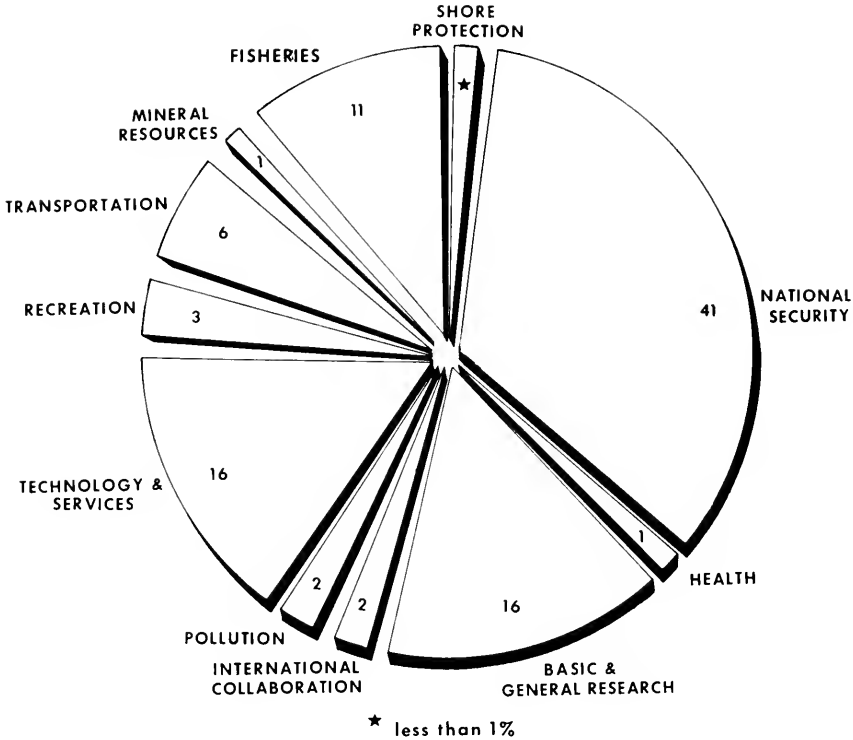

FIGURE 1.—*The Marine Science and Technology Dollar.*

amphibious warfare. The contribution of marine sciences to defense of the Nation continues to be substantial. Over fifty percent of all Federal funding for marine sciences is budgeted by the Department of Defense. In the past, such Defense expenditures have provided a significant part of the technological base now available for both civilian and military purposes.

In fiscal year 1968, civilian activities will increase more rapidly than defense activities, reflecting the increasing emphasis on utilizing marine sciences to meet industrial, economic, and social goals. This civilian growth will not be at the expense of military effort, however, because each activity will continue to be judged on its own merits and military growth will continue in response to defense requirements.

Marine science is now in an early stage of transition from a primary concentration on research to a more comprehensive and productive ocean technology. The program in fiscal year 1968 indicates, as shown in the following breakdown by function, that the Government will continue to nourish a base of oceanographic research, essential for further new applications, increased performance, and cost reductions.

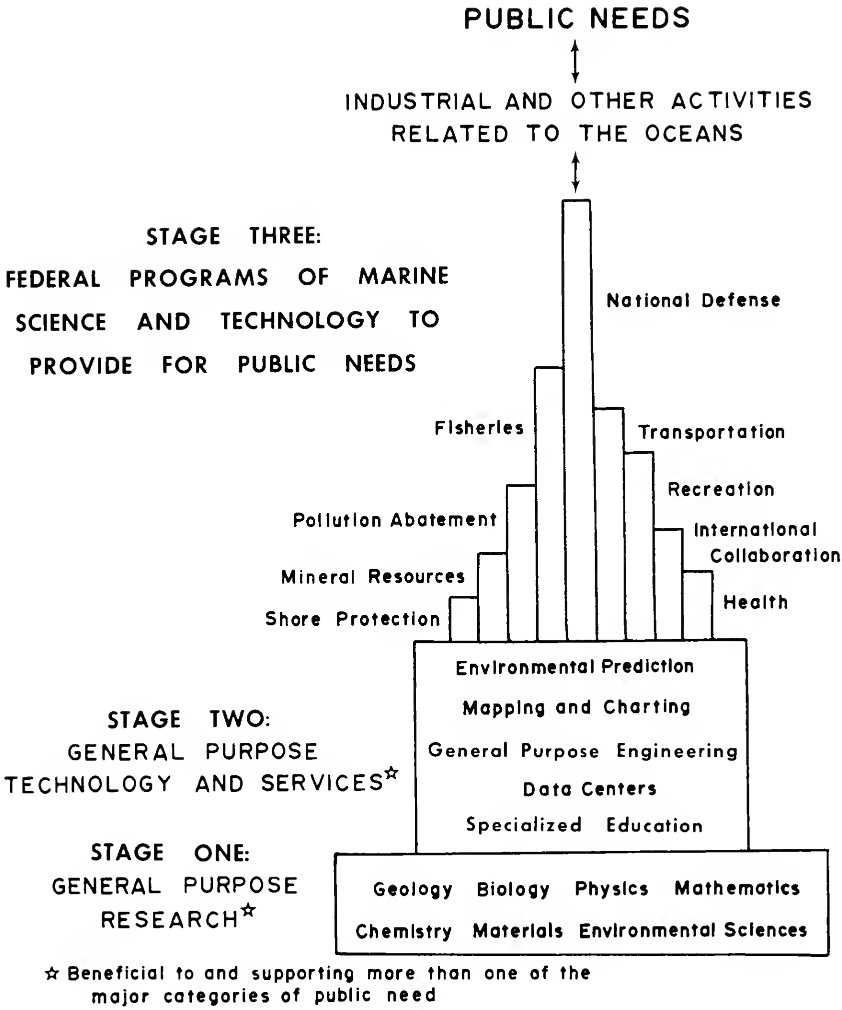

FIGURE 2.—*Functional Relationships of Marine Science and Technology.*

(This current tabulation includes only Federal funds. Not included are expenditures for marine science and technology by the States, academic institutions, and industry.)

(Program plan in millions of dollars)

Function	1966	1967	1968
Research	122.3	121.5	138.1
Development	72.4	103.1	124.6
Investment (ships, facilities, and major equipment)	46.8	66.8	72.0
Operations and services	91.9	117.7	127.6
Total	333.4	409.1	462.3

Statistics on State and private funding are now being collected by the Council because encouragement of non-Federal investment is a matter of special concern in order that all activities be mutually reinforcing. When economic incentives are promising, American private enterprise takes the initiative. When profits are too long deferred or risks too high (relative to alternative possible ventures), private investment is inhibited. With better understanding of the total Federal/non-Federal enterprise, appropriate Federal steps can be developed for sound private investment in exploration, technological development, marine commerce, and economic utilization of marine resources.

A similar objective appears with regard to the States. Local and regional interests and problems—related especially to development of seashore resources—are so varied that local initiatives should be encouraged to study problems, to develop solutions, and to make thoughtful use of local resources. Here also, the Federal Government may take the lead to foster a creative partnership with the several States in marine science affairs.

Council Analysis of Federal Programs

At the July 13, 1966, commissioning of the ESSA ship *Oceanographer*, the President requested his Marine Sciences Council to review the report, "Effective Use of the Sea," which had just been released by his Science Advisory Committee, and to develop initial recommendations by the following January. Accordingly, the Council analyzed ongoing efforts to identify gaps or lack of balance. It then concentrated on selecting priority areas, developing action programs, designating agency responsibilities, and formulating means for interagency collaboration in conformity with statutory marine science objectives and policy.

Prompt action was desirable because budget planning for fiscal year 1968 was well underway. Unless analyses were completed in time to identify program changes for the 1968 budget cycle, the direct impact of Council actions on programs requiring financial support would almost surely have been delayed a full year.

In addition to analyzing the more than 100 recommendations included in the report of the President's Science Advisory Committee, the Council staff carefully considered suggestions of the Interagency Committee on Oceanography and the National Academy of Sciences' Committee on Oceanography, as well as recommendations submitted by individual Government agencies related to new possibilities in the marine sciences programs. The Council then selected nine programs for priority attention and made recommendations to the President accordingly. Eight of the programs require additional fiscal year 1968 financing in the amount of $40.5 million. In addition, the Council lent support to a ninth new initiative toward international cooperation which at this time requires no additional funding.

These priority programs have the following common characteristics:

—The objectives contribute to broad national goals such as pollution abatement and the war on hunger.
—The priorities present a consensus of the senior Government officials responsible for marine science affairs, most of whom report directly to the President.
—With identification of major goals, small investments will produce multiplier effects by deploying existing capabilities more effectively.
—Means for implementation are immediately available and the benefits clear.
—A lead agency is designated whenever possible. Development of project details and funding is made the responsibility of the agency having jurisdiction.
—The Council assumes responsibility to assure effective implementation, and to assist in budget defense.

The Council recommendations for nine priority projects were presented to and approved by the President. Their components are included in the fiscal year 1968 agency budgets submitted to Congress January 24, 1967.

New Initiatives and Areas of Increased Emphasis

Of the $53 million increase in funding recommended for fiscal year 1968, approximately $41 million (Table VI) represents program areas selected by the Council for priority or increased emphasis. These are discussed later in greater detail. The remaining $12 million constitutes necessary growth in other vital programs, proposed by agencies to meet their commitments and justified in the normal course of program and budget review.

The nine priority programs include five actions that are essentially new—even though built on a foundation of past accomplishment or existing capability—and four which are selected from continuing activities that deserve sharpened emphasis, reorientation of goals, or consolidation of multiagency efforts into a more unified approach.

1. *International Cooperation.*—Additional efforts are now being devoted to examining the marine sciences activities of other nations, identifying and seeking opportunities for international cooperation, and fostering an international outlook for promoting the peaceful uses of the oceans.

The resources gap between rich and poor nations draws attention to the oceans as an arena for increased cooperation in economic devel-

TABLE VI.—*New initiatives and areas of increased emphasis*

	Financing agency	Fiscal year 1968 (millions)
Food from the sea	Agency for International Development	$1.8
	Bureau of Commercial Fisheries	2.1
Sea grant programs	National Science Foundation	4 0
Comprehensive estuary study	Army (Corps of Engineers)	.4
Ocean-related environmental prediction	Commerce	2.5
Assessment of Continental Shelf minerals	Interior	.6
Data systems study	Several agencies	.7
Deep-ocean recovery and submergence systems, and deep-ocean technology.	Navy	[1] 16.4
Ship for research near polar regions	United States Coast Guard	12.0
Total		40.5

[1] Includes $5.5 for deep-ocean technology and $10.9 for increased efforts in deep submergence systems.

opment. The traditional "freedom of the seas," multinational scientific expeditions, and other programs of international organizations all attest to existing cooperation between seagoing nations. The Department of State, working with Council staff and other offices of the Executive Office and with many agencies, is examining the opportunities the oceans offer for increased international cooperation in the Nation's interest.

2. *Food From the Sea.*—The food-from-the-sea program offers a new opportunity for the United States to provide world leadership through a long-range program to exploit the oceans as a relatively untapped source of protein for the undernourished. First steps involve overseas demonstration projects utilizing fish protein concentrate. The Agency for International Development has been designated the lead agency; the Bureau of Commercial Fisheries will develop the necessary technology. Other Federal agencies will assist, especially those whose ships can collect data of value in locating fish stocks. The annual cost of the program during fiscal years 1967 and 1968 will be about $4 million.

3. *Sea Grant Programs.*—The recent Sea Grant College and Programs Act, Public Law 89–688, aimed at education, training, applied research, and information transfer, will be implemented immediately.

More college graduates and technicians are needed to apply marine science to practical uses, including a stronger orientation to ocean engineering and multidisciplinary approaches to marine science affairs, and to providing a point where Federal, State, academic, and industrial interests may focus on local problems.

The National Science Foundation, with policy guidance from the Council, will administer the program. The initial cost of the program is estimated to be $1 million in fiscal year 1967; $4 million is proposed in fiscal year 1968.

4. *Data Systems Study.*—Collection, storage, and dissemination of vast quantities of oceanographic data require improvement. A major study will be undertaken of data requirements and modern data-handling systems.

The Council staff, working with the many Federal agencies and non-Federal producers and consumers of marine data, will guide the study. It will be started in fiscal year 1967 with Council funding of $75,000, then completed in fiscal year 1968 at a cost of $625,000 provided by the participating agencies.

5. *Estuary Study.*—Problems of estuarine pollution are increasing, with serious effects on fish, shellfish, health, recreation, and beauty. An interagency study will be initiated leading to a long-range program of research, first utilizing the Chesapeake Bay as a model.

A Corps of Engineers hydraulic model of the Chesapeake Bay is already authorized and will serve as a focal point for a multiagency, multidisciplinary approach closely correlated with pollution studies of the Federal Water Pollution Control Administration and other units of the Department of the Interior; the Department of Health, Education, and Welfare; the Smithsonian Institution; and other agencies of the Federal and State Governments.

6. *Surveys of Mineral Resources.*—Planning, surveys, and survey methodology, all related to the mineral resources of the Continental Shelf, will be accelerated to identify potential new mineral sources and to develop a pilot plan to meet long-term needs as land sources become more expensive. Expenditures in fiscal year 1968 will be increased by $600,000. The Department of the Interior, working with the Departments of Commerce and Navy, and other agencies, through the Council, will be responsible for the project.

7. *Ocean Observation and Prediction.*—Planning has begun to strengthen ocean-based observation networks that lag behind land-based systems and yet are critically needed to:

—study the effects of the marine environment on weather and especially to study how to predict droughts;

—improve prediction of near-shore weather and severe storms to protect life and property of shore communities and industries;

—predict the state of the oceans to protect life and property and support resource exploitation.

The Environmental Science Services Administration's portion of these program will require about a $2.5 million increase in fiscal year 1968; Navy will continue its ongoing program; the Coast Guard and other agencies will contribute to the programs.

8. *Deep Ocean Technology.*—The loss of the *Thresher* and the recent loss of an unarmed H-bomb off Spain emphasize the national impor-

tance of an expanded capability for search and recovery systems in the deep ocean. A new program to develop deep-ocean technology will be initiated which with the current Navy effort in deep submergence will strengthen the future capability for recovery of lost equipment and provide a deep ocean engineering capability.

The priority program will be implemented by the Navy with fiscal year 1968 costs of $16.4 million devoted to development of key components and additional work in the Navy's deep submergence program.

9. *Subpolar Oceanographic Research.*—A replacement Coast Guard ship, previously authorized for the International Ice Patrol, will be especially designed and constructed so that it can expand oceanographic research in high latitudes. Construction of the ship will begin in fiscal year 1968 at a cost of $12 million.

Chapter IV

INTERNATIONAL COOPERATION IN THE NATIONAL INTEREST

U.S. Policy and International Cooperation

Intensified use of the sea, now projected worldwide, could very well stimulate national rivalries and conflicts that could arrest the development of marine resources and defeat the very purpose of our national policy. We thus emphasize international collaboration in the exploration and use of the seas and their resources and the opportunity to utilize the seas to advance world peace, understanding, and economic development at home and abroad. Such steps anticipate strengthening communications and institutions at all levels, intergovernmental, scientific, and industrial.

The Marine Resources and Engineering Development Act declares that our marine science program should contribute to cooperation "with other nations and groups of nations and international organizations * * * when such cooperation is in the national interest." The Act also directs the Council, under foreign policy guidance of the President, to coördinate a program of international cooperation.

The President clearly stated his support for international participation in marine science activities at the commissioning of the *Oceanographer* on July 13, 1966, when he said: "Truly great accomplishments in oceanography will require the cooperation of all the maritime nations of the world. Today, I send our voice out from this platform calling for such cooperation, requesting it, and urging it. * * * The sea—in the words of Longfellow, 'divides and yet unites mankind.' "

The Council has given high priority to determining how the seas can serve as a medium for increased international cooperation, and is supporting, for example, the following activities:

(1) A U.S. initiative at the 1966 United Nations General Assembly calling for an examination of international marine science activities:

(2) A pilot U.S. program to assist the less developed nations to use food from the sea;

(3) A survey of marine science activities of other nations and of opportunities for cooperation;

(4) Studies to identify possible legal or political problems and to develop a framework of principles to further foreign policy objectives; and

(5) Scientist-to-scientist exchanges, including multinational use of research ships.

Expanding Opportunities for Scientific Cooperation

Scientist-to-scientist communication in oceanography has successfully brought people and nations together from all corners of the world. International oceanographic projects following the International Geophysical Year have involved experts from as many as 46 countries and have resulted in lasting contacts among scientists throughout the world. Examples of such programs are the International Indian Ocean Expedition, the International Cooperative Investigations of the Tropical Atlantic, the cooperative study of the Kuroshio, and the International Biological Program. The Scientific Committee on Oceanic Research of the International Council of Scientific Unions is one of the principal nongovernmental organizations concerned with these and other marine research activities.

The Second International Oceanographic Congress in Moscow and the Eleventh Pacific Science Congress in Tokyo highlighted the many convocations on marine sciences in 1966. The Moscow Congress provided an unusual opportunity for American and other Western scientists to visit Soviet laboratories and to meet hundreds of Soviet specialists who had not previously attended international meetings.

Research ships of U.S. Government agencies and private institutions operate in waters throughout the world, and foreign scientists frequently participate in these cruises. The forthcoming global scientific expedition by the *Oceanographer* (Figure 3) will afford many opportunities for useful scientific investigations and cooperation and will demonstrate our desire to work with all nations in using new technology to improve our understanding of the oceans.

As a matter of policy, the Government encourages exchanges of American and foreign scientists and port calls. This has been exemplified most recently by a call at San Francisco in January 1967 by the Soviet oceanographic ship *Mikhail Lomonosov* and the expected calls of the *Oceanographer* at Odessa and other foreign ports this year.

Cooperation in Using Marine Resources

International cooperation can enhance the effective and rational use of marine resources. Bilateral and multilateral fishing conventions and agreements have been concluded to insure that some stocks will not be depleted. The Convention on the Continental Shelf promotes the development of the economic productivity of petroleum, gas, and solid minerals.

FIGURE 3.—*Environmental Science Services Administration Survey Ship "Oceanographer."*

The 1958 and 1960 Law of the Sea Conferences, conducted under U.N. auspices, were landmarks in the development of the legal code governing the use of the seas and their resources. Four conventions have since come into force:

Convention on Fishing and Conservation of the Living Resources of the High Seas.
Convention on the High Seas.
Convention on the Continental Shelf.
Convention on the Territorial Sea and the Contiguous Zone.

While these conventions provide a basis for resolving a major part of the conflicts among nations, they have not attempted to cover all contingencies. As advancements in technology place the sea's resources within the grasp of more nations, the principles enunciated—and omitted—in these conventions take on added significance. Moreover, to regulate the use of marine resources in a manner which will insure their wise disposition requires an understanding of the oceanic environment and a forecast of man's interaction with his natural environment. No one nation can explore the seas alone. All nations will benefit; all should contribute.

The Increasing Role of the United Nations

Since the founding of the United Nations, this country has played a leading role in mobilizing international interest in preserving and promoting peace through this world forum. The international character of oceanic activities is reflected in the increasing interest in marine activities of many United Nations agencies, such as the United Nations Food and Agriculture Organization and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization.

At the 1966 United Nations General Asembly, U.S. initiatives resulted in the adoption of a resolution requesting the Secretary General to survey international cooperative activities related to marine science, technology, and marine resources. This two-year survey will examine the mechanisms for preventing duplication and for increasing coordination among international organizations concerned with marine activities. In some respects, this study on an international scale is analogous to those leading to the recent Marine Sciences Act on a national scale.

In 1966, the General Assembly endorsed a proposal of the United Nations Committee on Outer Space for a group of experts to examine the international requirements for navigation satellites. The accurate positioning of oceanographic stations is an important aspect of any cooperative ship-survey program, and the potential of navigation satellites to improve the precision of station locations was demonstrated by several U.S. oceanographic ships equipped with the Navy-developed receiving equipment.

Our support of the activities of the many United Nations agencies concerned with marine activities, and our initiatives to promote cooperation through these agencies are becoming more important. The Intergovernmental Oceanographic Commission, for example, is playing an increasingly active role in promoting international expeditions, data exchanges, radio frequency allocations for oceanographic research activities, and an international tsunami warning system in the Pacific Ocean. The World Meteorological Organization coordinates the exchange of marine weather data between nations and is in the process of developing the World Weather Watch. Other international organizations concerned with marine sciences are indicated in Table VII.

Polar Exploration

Antarctica remains a symbol of successful cooperation among countries having potentially conflicting political interests and a model of international arrangements for the benefit of all nations. The experience of Antarctic cooperation deserves study to determine whether it can be extrapolated to areas of the seas beyond polar regions.

Our Arctic Research Laboratory in Alaska continues to welcome scientists of other countries. Oceanographic data collected from ice stations and contiguous land stations are routinely made available to the other countries of the Arctic. Also, the International Ice Patrol, through research and observation, makes data available to reduce navigation hazards in the North Atlantic.

Our understanding of the Arctic basin, however, is still in its infancy. The oceanographic research capability to be included in the new Coast Guard ship will be a significant step in enhancing our investigations of near-Arctic waters. As we improve our capabilities to operate in the Arctic, we look forward to collaboration with other polar countries for we have much to learn from their extensive experience.

International Use of the Great Lakes

We have worked with Canada for many years to preserve one of our greatest inland resources, the Great Lakes. Many countries of the world use the Great Lakes as a trade artery. Millions of Americans and Canadians rely on the lakes for water supply, recreational activities, fishery products, transportation, and electric power generation. At the same time, industries and municipalities often use the Great Lakes as a convenient dumping ground for waste products.

The American-Canadian International Joint Commission is devoting considerable attention to pollution and to the maintenance of water levels. Through the efforts of the Great Lakes Fishery Commission, the sea lamprey population has been reduced by 90 percent in Lake Superior; treatments were recently completed in Lake Michigan and are well underway in Lake Huron. The U.S. Geological Survey is planning a collaborative project with Canada in connection with the International Hydrological Decade to study the physical dynamics of one of the Great Lakes.

Table VIII indicates the Federal agencies supporting research in the Great Lakes.

Bilateral and Multilateral Foreign Assistance

Coastal fishing and other maritime activities play a significant role in the economies of most coastal nations of the world. Technical assistance programs can help the lesser developed of these countries, particularly if the programs incorporate the principle of self-help. Also, the programs must be formulated within the context of the overall needs and directions of the country's economy, for harbors without boats, fishery products without marketing mechanisms, and scientists without laboratories make little sense.

On a limited bilateral basis, we have provided precision equipment and specialists for harbor surveys in Latin America and aided on-the-job training for local specialists. We have similarly supported harbor improvement, navigation, and desalting projects.

TABLE VII.—*Selected list of international organizations concerned with research and development activities in the marine environment*

Oceanic research	Fisheries interests	Offshore oil and minerals interests
U.N. agencies:		
UNESCO.	Food and Agriculture Organization.	ECAFE-Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas.
International Oceanographic Commission.	UNICEF.	
International Atomic Energy Agency.	Protein Advisory Group (WHO, FAO, UNICEF).	
World Meteorological Organization.	Advisory Committee on Application of Science and Technology to Development (ECOSOC).	
International Telecommunication Union.	Advisory Committee on Marine Resources Research (FAO).	
Intergovernmental Maritime Consultative Organization.	World Health Organization.	
Intergovernmental:		
International Hydrographic Bureau.	International Commission for Northwest Atlantic Fisheries.	
International Council for the Exploration of the Seas.	International North Pacific Fur Seal Commission.	
NATO Subcommittee on Oceanography.	North-East Atlantic Fisheries Commission.	
International Joint Commission (United States, Canada).	Japan-U.S.S.R. Fisheries Commission.	
International Ice Patrol.	Indo-Pacific Fisheries Council.	
OECD Committee for Research Cooperation.	Regional Fisheries Council for the Southwest Atlantic.	
International Commission for the Scientific Exploration of the Mediterranean Sea.	International Pacific Salmon Fisheries Commission.	
	International North Pacific Fisheries Commission.	
	International Pacific Halibut Commission.	
	Inter-American Tropical Tuna Commission.	
	International Whaling Commission.	
	Great Lakes Fishery Commission.	

Nongovernmental: International Council of Scientific Unions: International Union of Geodesy and Geophysics: International Association of Physical Oceanography. International Association of Meteorology and Atmospheric Physics. International Union of Biological Sciences. International Union of Geological Sciences. International Geographical Union. Scientific Committee on Oceanic Research. Scientific Committee on Antarctic Research. Special Committee for the International Biological Program. Pacific Science Association. International Union for the Conservation of Nature and Natural Resources. International Limnological Society. Mediterranean Association for Marine Biology and Oceanography. Association of Island Marine Laboratories of the Caribbean.	International Shrimp Council. International Association of Fish Meal Manufacturers. Eastern Pacific Oceanic Conference.	Petroleum Equipment Suppliers. International Gas Union. Permanent Council of the World Petroleum Congress. Society of Exploration Geophysicists.

TABLE VIII.—*Federal Marine Science Activities in the Great Lakes*

	Estimated fiscal year 1968 program (millions)
Department of Defense	$2.8
Department of the Interior	2.6
Department of State	1.1
Department of Transportation	.2
National Science Foundation	.2
Department of Commerce	[1]
Total	7.0

[1] Less than $50,000.

Multilateral aid arrangements in the marine field are limited to date and, like our bilateral programs, have emphasized development of coastal facilities. The world banking consortiums and the United Nations development program have supported some projects. UNESCO and the Food and Agriculture Organization have provided fellowships and other devices for study and training by foreign marine scientists and technicians in many countries.

The Organization for Economic Cooperation and Development has become increasingly interested in raising the capabilities of the less developed countries in the marine sciences. Also, NATO has established a strong oceanographic capability at the research center in Italy and has an annual exercise in environmental prediction.

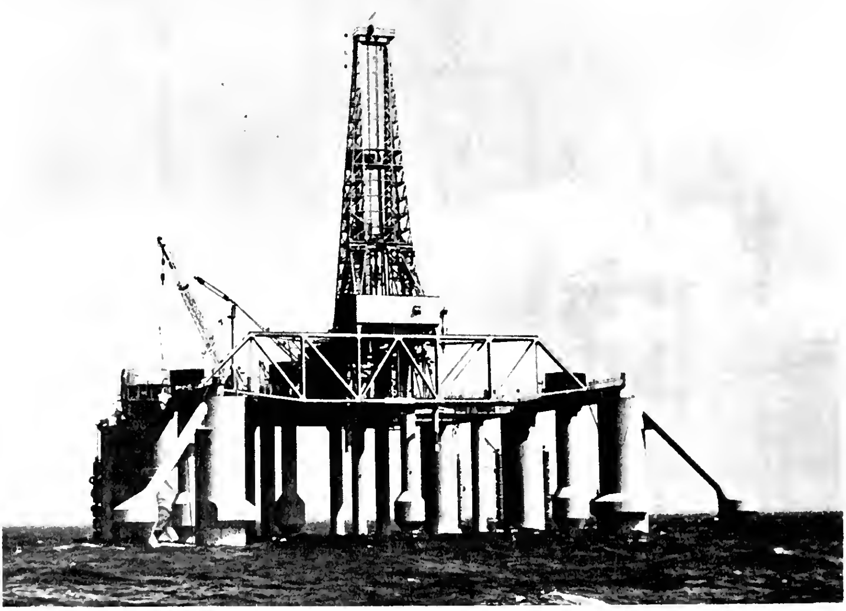

FIGURE 4.—*American Drilling Rig Prospecting in Foreign Waters.*

This nation will intensify its examination of opportunities for these programs.

American Commercial Interests Abroad

American firms continue to develop interests in offshore areas of foreign countries. Oil and gas exploration activities in the North Sea, off the African coasts, and in the Persian Gulf, involve American companies operating under arrangements worked out with the riparian governments. An example of a U.S. drilling rig operating in the North Sea is shown in Figure 4. Similarly, American firms are interested in solid-mineral deposits under foreign waters, including mineral deposits near Australia and tin deposits in Southeast Asia. American firms are also heavily involved in fisheries ventures throughout the world, often supporting the development of new local industries. These commercial arrangements represent international cooperation at still another level with benefits accruing to both the American firms and the host countries.

Protecting Order in the World Community

Lasting peace is our goal and international cooperation and economic development should bring us closer to that goal. Meanwhile, a sea-based force remains a major factor in reducing the danger of armed conflict—linking us with our allies, deterring potential adversaries, and insuring our capability to contain and conclude limited conflicts.

As we strive to promote the orderly evolution of a society of nations linked by peaceful aspirations, we continue to rely on the seas for deploying and supporting our land forces and for insuring the invulnerability of our strategic deterrent. The protection of sea lifelines throughout the world enables maritime activities to thrive in peacetime, and assured lifelines are essential components of our military strategy which provide us with options to meet contingencies at an appropriate level of response. The successful development of a nuclear submarine force equipped with Polaris missiles, and the current development of the Poseidon missile, vividly demonstrate the importance of marine science and technology to our defense.

We have no monopoly, however, on sea-based systems nor on naval technology. The advent of the nuclear-powered submarine and deep-diving capabilities add new elements of sophistication to offensive and defensive concepts, and the technology of undersea warfare has not stabilized. We continue to press the frontiers of technology to refine existing systems and remain in the forefront in developing new concepts.

In refining our tactical capabilities on the oceans, we seek to use the advantages the oceans offer to a sea-based force—flexibility and mobility in deployment and freedom to disperse and concentrate

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rapidly. In developing underwater capabilities we attempt to achieve the dual goal of making the oceans transparent to our underwater surveillance systems while we operate free of detection. This is the challenge to antisubmarine warfare research. Also, we rely heavily on the invulnerability of operating in the depths of the ocean in formulating our strategic and tactical options.

Much of our expenditures in marine science since World War II has been related directly or indirectly to an understanding of the surface and underwater environment. In the absence of a drastic and unexpected change in the power structure of the world, the demand for a more refined understanding of relevant scientific phenomena in support of naval activities will continue to increase. Development aspects of military oceanography depend upon the generation of basic knowledge; when this fund of knowledge is deficient, as in the case of our understanding of the sea, very active research programs are essential. Naval research and development activities will also continue to make major contributions to many nonmilitary programs which hinge on proper understanding and use of the oceans.

The U.S. is continuing its efforts to encourage all nations to become parties to the 1963 treaty prohibiting nuclear testing in the seas, atmosphere, and outer space. We are also continuing to improve our understanding of seismic phenomena under the oceans in earthquake belts both to strengthen our ability to detect and identify seismic phenomena resulting from underground nuclear tests, and to improve tsunami warning and earthquake prediction.

Chapter V

UTILIZING FOOD RESOURCES OF THE SEAS

> Next to the pursuit of peace, the greatest challenge to the human family is the race between food supply and population increase. That race is now being lost.
>
> LYNDON B. JOHNSON.

The Problem and a Solution

Protein malnutrition afflicts half the world population. Vigorous efforts by all nations are necessary to produce food, adequate in quantity and quality, to keep pace with the expanding world population and the needs of newly developing countries. The causes of world peace and individual welfare demand maximum effort from the more advanced nations.

This problem directly impinges on our Nation's interests, and these facts lie behind a long-standing policy to wage war on hunger.

The imbalance between protein supply and requirements is so serious that every reasonable approach is required to correct it. Cereals supply the bulk of the world's protein, but they do not meet the quantitative need, nor contain all of the essential amino acids. To provide both an adequate quantity and a proper balance of amino acids, additional cheap protein sources are needed to supplement cereals.

This potential of the sea to help meet a significant fraction of worldwide need for protein has been recognized for many years, discussed in every recent study on oceanography, and flagged by the President's Science Advisory Committee as deserving highest priority attention.

The recommendation by the Marine Sciences Council represents a next step—a plan for action to match a solution to the food problem. The new initiative to increase utilization of the food resources of the sea was adopted by the Council because of the high promise of helping to meet the worldwide food problem promptly, economically, with available or emerging technologies, and in the framework of existing institutions.

The World Market

The 1965 world catch of seafoods of all kinds was 115 billion pounds, two-thirds of which was used directly for human consumption. Figure 5 shows the trend of the world market, extrapolated to the year

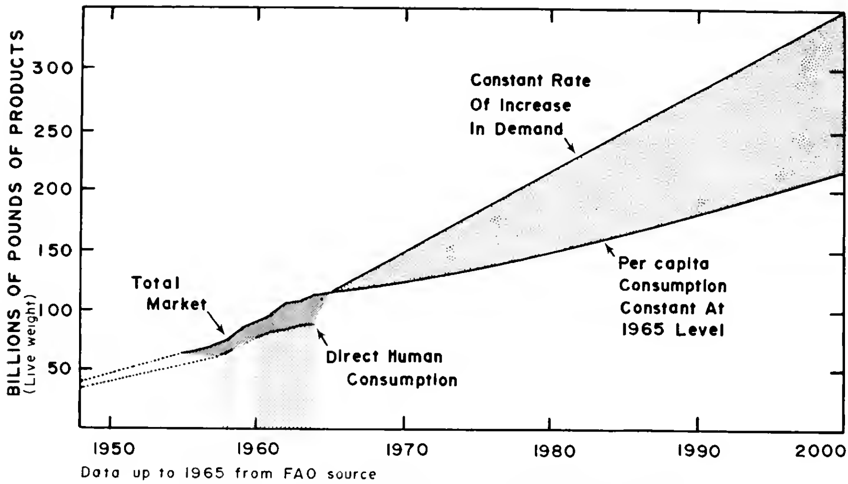

FIGURE 5.—*World market for all fishery products.*

2000. If per capita consumption remains the same as in 1965, more than 215 billion pounds will be required by the turn of the century. The current rate of increase in consumption, however, is about double the rate of world population growth. With better preservation of flavor and more attractive processing, more will be consumed directly as food, in addition to increases for animal feed. Thus it is likely that the per capita consumption of fish products will increase so that by the year 2000, the total could approach 350 billion pounds.

U.S. Market for Fish Products

The U.S. demand for fish products in 1965 amounted to 12 billion pounds. In the past five years it increased at a greater rate than our population, mainly from increased demand for fish meal as animal feed.

Imported fishery products presently supply over half of our requirements. A significant amount of these imports, however, is produced by American-owned companies. Foreign fishery products will continue to take a major share of our domestic market unless the relative cost of products offered by our domestic industry is reduced.

Figure 6 projects American consumption of fishery products to the year 2000 by which time the demand may be double or perhaps triple today's requirements.

Resources of the World's Waters

Against this projection of seafood demand, it is necessary to examine the supply. Data are insufficient on which to base good estimates of the ocean's sustainable yield. Experts are in wide disagreement and

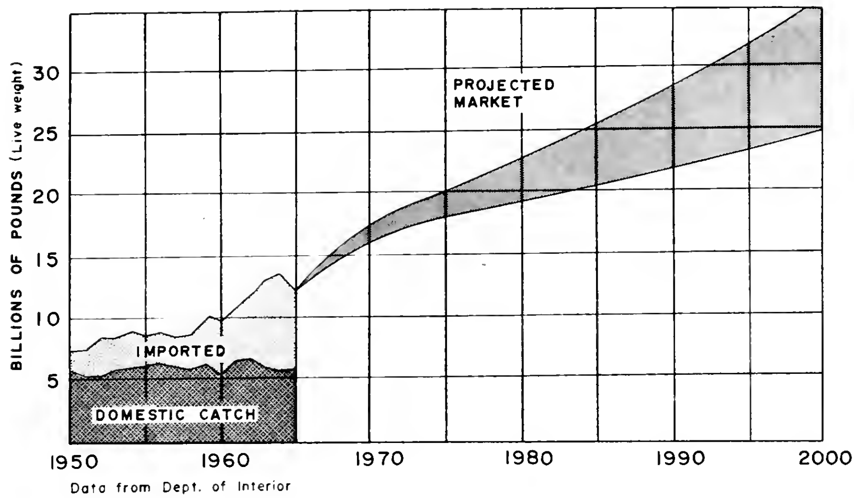

FIGURE 6.—*U.S. market for fishery products.*

their estimates vary from a highly conservative four to more than forty times the present catch. Intensified research on this question is clearly needed as a basis for rational management of the resource.

Fish are not uniformly distributed throughout the seas. Most species seem to be concentrated on continental shelves. Evidence suggests, however, that further exploration of fish populations, particularly for species not now widely used, may modify this present understanding. Figure 7 shows the quantities of fish taken from major fishing areas in 1965.

The U.S. Fishing Industry

In 1965 the United States ranked fifth as a fishing nation, behind Peru, Japan, mainland China, and the Soviet Union. Figure 8 shows the trends from 1938 to 1965 except for mainland China for which no figures have been reported since the rough estimates of 1960. The 6 billion pounds landed annually by American vessels constitutes about one-twentieth of the world catch.

In comparison with the industrially organized Soviet fishing activities, our own fishing industry is more fragmented. As of 1964 there were 128,000 U.S. fishermen operating about 65,000 boats of less than 5 tons, and 12,000 larger vessels. They supplied fish for processing by about 57,000 employees in 4,000 establishments throughout the country.

Ninety-five percent of all our fishing vessels are less than 100 tons. A comparison of U.S. fishing vessels with those of Japan and Spain

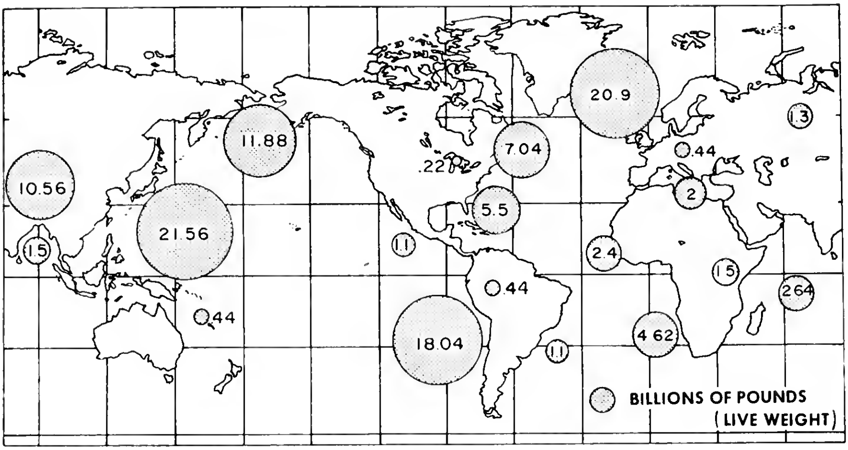

FIGURE 7.—*1965 world catch by major fishing areas (based on FAO statistics).*

[Data based on FAO statistics]

shows the marked absence in our fleets of the larger and generally more efficient ships (Fig. 9).

To assist the fishing industry, the Federal program in marine science and technology has focused in recent years on two main fields: assessing, developing, and managing fish stocks; and offering economic and technical assistance to the commercial fishing industry. Funding for fiscal year 1968 is given in Table IX.

Fishery resource assessment, development, and management depend upon an understanding of fish characteristics, locations, habits, and environment. By acquiring knowledge and disseminating information on these matters, the Bureau of Commercial Fisheries has helped to increase the catch of certain species significantly in recent years. For instance, studies on mortality, predators, feeding habits, growth, and environmental requirements have led to successful restoration of silver salmon stocks in the Columbia River, where the commercial gill net catch of silvers in 1966 was a record 4.2 million pounds. This compares with an average of 1.1 million pounds during 1960–65. Bonneville Dam recorded one of its largest spawning escapements, and sport fishermen in the lower river had a 1966 catch of some 2 million pounds compared with an average 1.1 million pounds during the 1960–65 period. Other programs, by locating and describing the extent, density, and variability of under-used fish resources—such as hake on the Pacific coast—have led to the establishment of fisheries that have landed about 8 million pounds of hake since late 1965. Still other studies of ocean currents have located upwellings and helped to define and locate tuna in the equatorial Atlantic Ocean, in the equatorial Pacific, and off the west coast of South America.

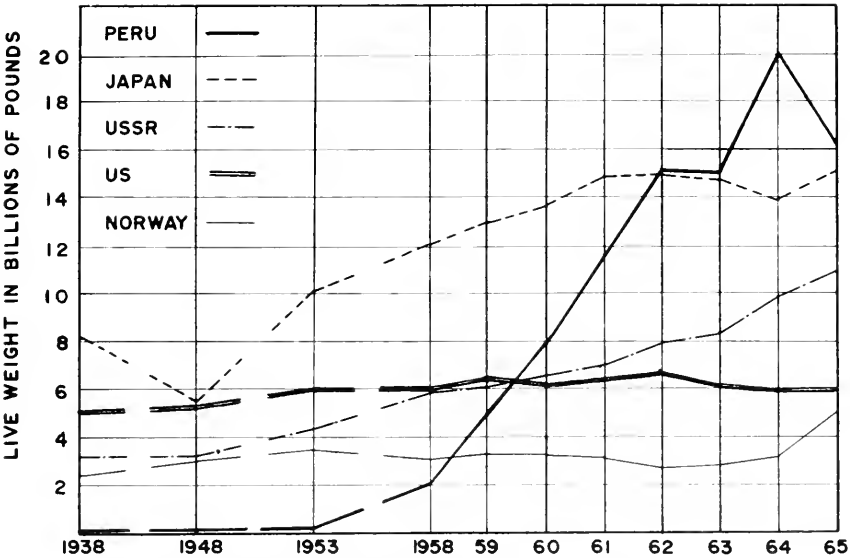

FIGURE 8.—*Fish catch of five countries.*

[Data from FAO sources]

The Departments of Interior and Navy have embarked on a joint program to utilize certain tactical environmental prediction data to aid selection of the best fishing depths and fishing grounds.

TABLE IX.—*Federal funding related to the food resources of the seas* [1]

	Estimated fiscal year 1968 (in millions)
Department of the Interior	$49.2
Department of Health, Education, and Welfare	[2] 4.2
Agency for International Development	2.0
Smithsonian Institution	[3] 1.8

[1] Does not include small amounts of funds for AEC, Department of Commerce, etc., listed in other "purpose" categories.

[2] Listed under "Health" in appendix.

[3] Listed under "Multigoal Activities" in appendix.

Seashore marshes are nurseries for some commercial fish, and more data are being sought about the ecology of these regions and the behavior of their young inhabitants, particularly where pollution may become significant. Much is being learned about control of predators and disease. Some of this knowledge should help rejuvenate the valuable oyster industry along our Atlantic coast.

Technical and economic assistance by the Federal Government is focused on improving harvesting techniques, new processing methods and products, new types of vessels, as well as new markets and economic analyses. A midwater trawling system, for example, enabled

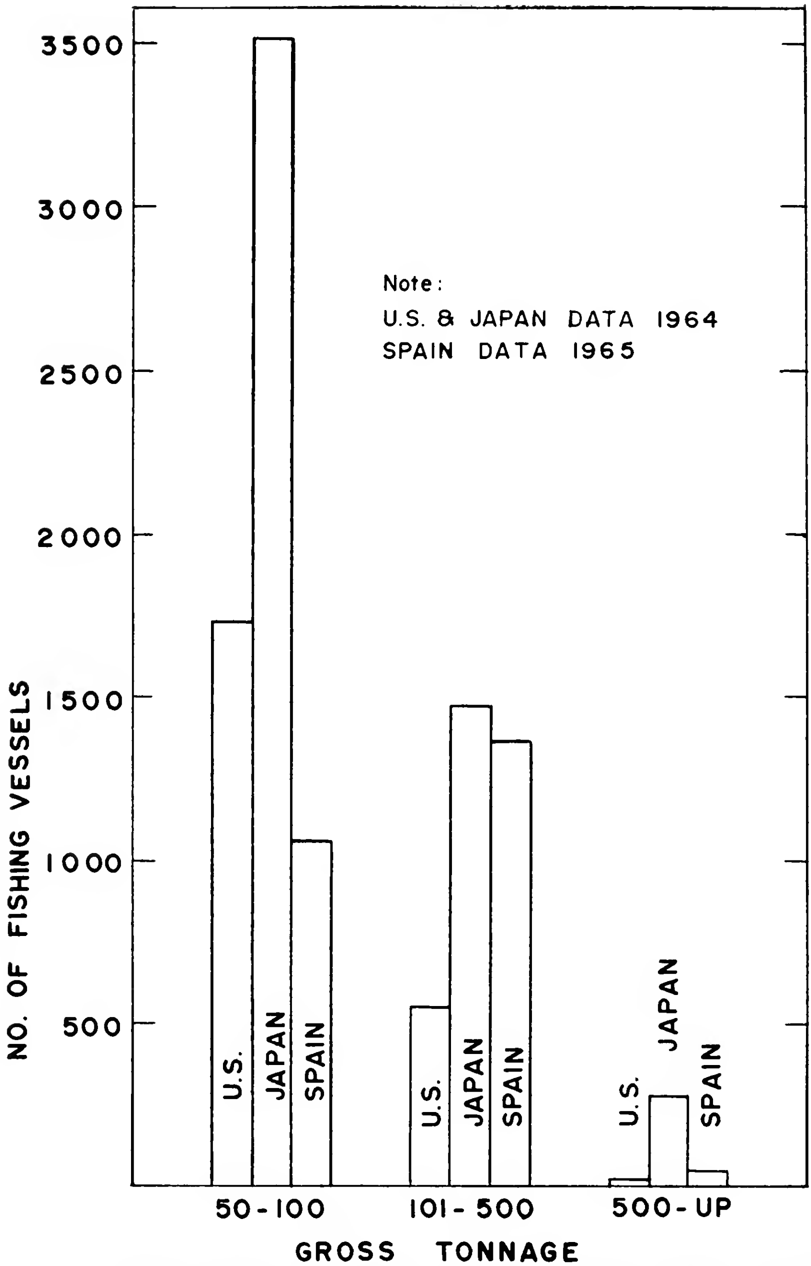

FIGURE 9.—*Comparisons of U.S. fishing vessel tonnage with Japan and Spain.*

small fishing vessels to capture over 4 million pounds of Pacific hake in Puget Sound, Wash., during the first six months of 1966. Future efforts are aimed at developing techniques for harvesting some of the estimated 4 billion pounds of sardine-like species available in the Gulf of Mexico.

Processing investigations sponsored by the Atomic Energy Commission have revealed that use of nuclear energy for pasteurization by irradiation of fishery products will allow certain species to be kept "sea fresh" longer. Engineering studies have been started to develop mechanical methods for removing the meat from blue crabs and to devise a sucessful shucking machine for the vast stocks of calico scallops off the coast of Florida.

Under its assistance programs, the Federal Government granted $1 million in subsidies in fiscal year 1966 for construction of seven new fishing vessels; in addition, federally insured mortgages amounting to $1.9 million were approved last year for construction or reconstruction of 30 vessels. Ninety-two direct loans, totaling $2 million, were made to owners and operators of fishing vessels. Two 296-foot stern trawler factory ships will be completed in the spring of 1968, the first of this type to be constructed in this country. Federal aid was granted in fiscal year 1966 in the amount of $3.8 million to States for financing fishery research and development projects.

Although not contributing in a major way to food from the sea, sport fishing is increasingly important to our leisure activity. The number of serious salt water sports fishermen was estimated at 8.3 million in 1965, and it is growing faster than the national population. Sport fishing, along with commercial fishing, should benefit from research on ocean fish stocks.

International Fishing Agreements

International agreements will continue to be of vital importance to the prudent use of world fishery stocks. In the past we have depended upon some seventeen international fishing conventions and agreements to resolve conflicting fishing interests. International arrangements for taking fur seal, halibut, and sockeye salmon in the Pacific Ocean have been particularly effective for conservation. Bilateral agreements have recently been developed to regulate Soviet and Japanese fishing for king crab on the U.S. Continental Shelf and in the Bering Sea. A new convention concerning Atlantic tuna awaits Senate ratification, and conservation measures have recently been applied for the first time to Pacific yellowfin tuna. In general, U.S. fishermen feel that most of these regulations have helped them, but issues remain concerning foreign fishing activities off our coasts.

Because of increased foreign fishing in our coastal waters, Congress enacted legislation during 1966 extending our fishery zone to twelve miles, a limit widely adopted by other nations. The extension of fishing jurisdiction will not, however, resolve the conservation problem for many stocks of fish found along U.S. coasts.

Institutional Constraints

In cases where American fisheries are not competing effectively with their foreign counterparts, institutional constraints have been cited as a principal cause. Domestic laws, customs, regulations—both international and local—limit the catch of a fisherman or group of fishermen. The restrictions include limitation on the area to be fished, fishing season, type of gear, boats, or the fishing techniques.

In private fishing grounds, it is quite natural and expected that rules are advantageous to the owner. Private property of individuals or the territorial waters of nations are often thus regulated. When there is common access and ownership, however—e.g., the resources of the high seas—or when the resources are owned by a political entity but open to public harvesting—e.g., the oysterbeds in Chesapeake Bay—regulation is more difficult.

Regulation may be necessary to mediate conflicting user interests, such as between sport and commercial fishing. Restrictions may also be imposed to conserve a sustainable supply. Such measures, in the form of limited seasons and limited take per person, are commonly and successfully applied to inland sport fishing and game but these measures are not so adaptable to commercial fishing on the open seas. Here other solutions have been employed, including the controversial device of limiting the efficiency of the catching equipment.

As more fishermen participate in fisheries, the share for each fisherman diminishes. In the future it may be necessary to consider these problems more broadly and to initiate new forms of international cooperation and management for the high seas fisheries. This is especially important as nations move to industrial methods and thus increase the threat to maintaining sustainable yields.

The initiative discussed next carries an implicit obligation: to develop a unified global approach to fisheries that harmonize national interests, conservation needs, and economic incentives.

A New Initiative for the Future

We propose to embark on an intensified, long-range program to exploit the oceans as a source of food to help feed the undernourished people of the world. This program would begin to implement provisions of the Marine Resources and Engineering Development Act of 1966 and respond to the expressed intentions of the Nation to make effective use of the sea in the war on hunger.

The primary objectives are:

—to alleviate human hunger by long-range programs carefully designed to extract more usable food from the sea, by the United States and other nations;

—to assume international leadership by policies that look to peaceful, cooperative uses of the sea and that make new and improved technologies available to the less developed nations;

—to upgrade and assist domestic fishing and fish-processing industries through the development of markets for species not now caught, new products, improved techniques, and expanded knowledge of the oceans.

This program concept considers all facets of the total system from raw ocean resources to consumer:

—It anticipates multiplying the presently used food resources of the ocean by a factor of perhaps five, processing and distributing these resources effectively in many forms suitable to the particular needs abroad and in this country;

—It recognizes the need for more effective regulatory policies aimed at maximizing sustainable worldwide yields and improving economic efficiency;

—It includes the concepts of "ranching" to increase the supply, innovative engineering, and systems analysis, as well as research, to upgrade the equipment and techniques;

—It contemplates active participation of the United States and foreign governments and private enterprise, bringing to bear technology, capital, and entrepreneurship to establish a self-sustaining industry.

The program will place emphasis on exploring the types of food which will be best suited to the needs of various people, both on a short-term and long-term basis.

First Step—A Demonstration of the Potential of Fish Protein Concentrate

Initial steps to implement the long-range program can begin now. Plans are being developed to exploit the special opportunities available as a result of applied research by the Bureau of Commercial Fisheries that has refined a relatively simple process for extracting low-cost animal protein from the lesser used fish of the sea. Whole hake and similar species can be converted into a nutritious and wholesome protein concentrate (FPC). FPC is bacteriologically and biochemically safe and stable without refrigeration or other special processing. It can be incorporated into cereal products at a five- to ten-percent level with no detectable "fishy" flavor. Its protein is easily digestible and biologically available. Ten grams will provide adequate animal protein to meet the daily requirements of one child, at an estimated daily cost of less than one penny. The relative costs of FPC compared to protein from some other sources are shown in Table X.

Since Congress has already authorized construction of a pilot plant, and the Food and Drug Administration has approved FPC[1] after

[1] 32 F.R. 1173 (Feb. 2, 1967).

TABLE X.—*Cost of protein from animal sources*

	Price per pound	Protein content (percent)	Protein price	
			Per pound	Per daily supply (10 grams)
Fish protein concentrate (FPC)	$0.25	80	$0.31	$0.0068
Dry milk	.15	35	.45	.0100
Dried fish (Africa)	.14	37	.38	.0085
Chicken (United States)	.25	15	1.65	.0360

Source: National Academy of Sciences' proposal for BCF (unpublished).

thorough testing and human feeding experiments, it is possible to proceed without delay to refine the process and develop a product for market studies discussed later.

On a cooperative bilateral basis, it is proposed to select and survey the fishing potential and market feasibility of FPC products in three less developed countries; one of these countries will be selected as the place in which to foster development of a local capability to produce and distribute FPC. The specific objective would be to demonstrate that—consistent with local needs, fish supplies, people, and customs—it is feasible to meet animal protein needs of a large number of preschool children and pregnant mothers promptly and economically. An initial goal for a small country would be to provide by 1971, ten grams of animal protein daily to each of one million people. This can be expanded as experience or circumstances dictate.

The main elements of the proposed FPC demonstration program, projected over a five-year period in Figure 10 are to:

—*develop commercial process for producing FPC*, including research to improve the present process and make it more economical and suitable for other species; also included: research on food technology, research on problems of toxic fish, and development of appropriate guidelines to foster stringent quality control. Design, construction, leasing, and operation of the authorized pilot plants are part of this development;

—*improve the fish catching, landing, and processing capabilities of three protein-deficient countries.* The nature and extent of the fish population accessible to the potential recipient countries, development of improved boats, catching equipment, and processing capability would be studied;

—*develop markets for FPC in at least one protein-deficient country.* Local fishing potential, analysis of local eating customs, as well as market and distribution patterns for appropriate food forms, would be evaluated;

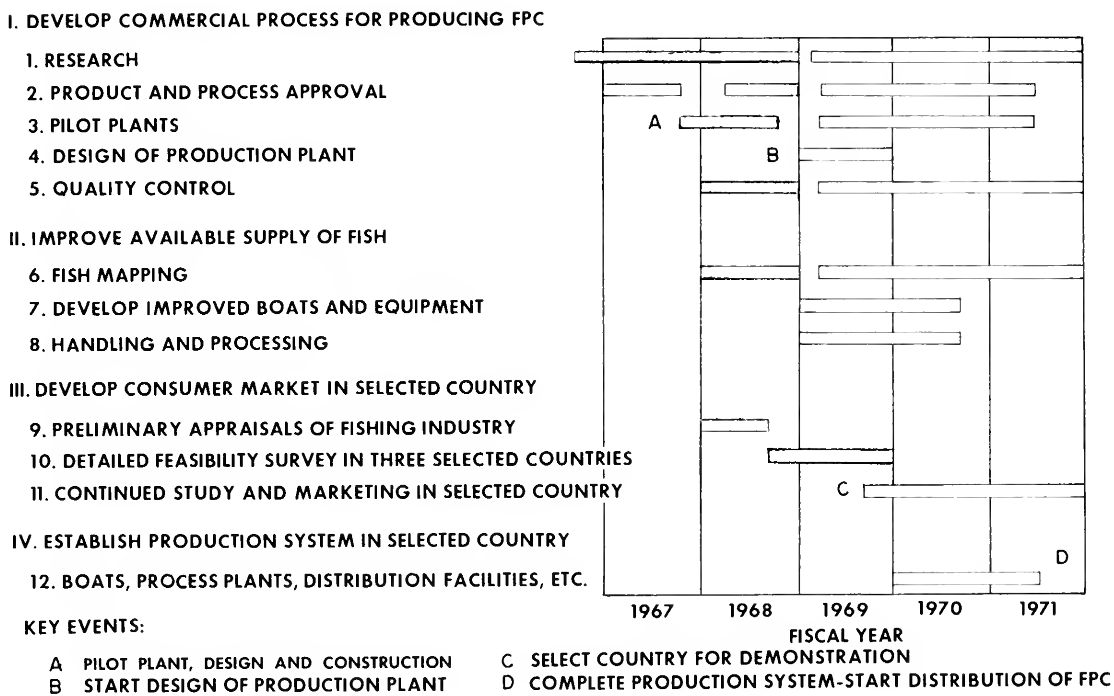

FIGURE 10.—*Phasing chart for FPC demonstration.*

—*establish a viable commercial FPC system in at least one protein-deficient country;*

—*encourage other nations and private interests to establish commercial fishing industries wherever feasible.*

The concept of utilizing FPC to help meet protein deficiencies is a "technology exporting" concept. We do not define this food-from-the-sea program as a means for shipping more fish protein to protein-deficient countries. Rather we define it as a program which will help those countries, through the importation of technological capability, to produce the fish protein themselves.

Management

Overall program management of the demonstration project and lead agency responsibility for all Government activity has been assigned to the Agency for International Development. Technical support will be provided by the Bureau of Commercial Fisheries and the Department of Health, Education, and Welfare. Resources of such organizations as the Smithsonian Institution, Environmental Science Services Administration, and the National Academy of Sciences will also be focused on these objectives. Special attention will be given to establishing and maintaining worldwide quality and sanitary standards through world organizations such as the Food and Agriculture Organization.

Inasmuch as success depends critically upon development of a low-cost product, consumer acceptance, and effective marketing, U.S. industry will be encouraged to have a major role in planning and developing the program.

Chapter VI

IMPLEMENTING SEA GRANT LEGISLATION

Perspective

The National Sea Grant College and Program Act of 1966 established a new instrument for strengthening the base of specialized education and ocean engineering research, and for improving communication of scientific or technological results to many marine science interests lacking their own research capabilities. This Act is one of the areas of special emphasis selected by the Council and will be implemented by the National Science Foundation as soon as authorization to use fiscal year 1967 funds for this purpose is secured from the Congress.

It is widely agreed that advances in science and technology depend on skilled manpower. In recent years, the Federal Government has assumed major responsibility—through a variety of fellowships, traineeships, and research and institutional grants—to support training and education in many technical fields, thus increasing the flow of new scientists and engineers to meet national needs. This Federal policy has strengthened the marine sciences. Professional manpower in marine sciences in 1961 was limited, totaling only 600 persons, trained mostly in a variety of classical disciplines, and in oceanography. Accordingly, special steps were taken in 1961 by several Federal agencies to expand the opportunities at universities for students, teachers, and graduate research. Today, professional manpower numbers 2,600 and nearly 1,000 individuals are enrolled in marine science curriculums in more than fifty colleges and universities.

It has become increasingly apparent, however, that this support of marine science was not adequately complemented by parallel support for the training of engineers who would engage in marine work. It also became apparent that applied marine research was not being supported adequately, compared to basic marine research. Finally, in the context of the broadened emphasis being placed on the civilian as well as military importance of using the seas, there was a conspicuous gap in the important process of information transfer between the Federal Government, States, departments within academic institutions, and certain sectors of industry.

Purpose of the Act

It was in this situation in 1966 that the Congress, recognizing the need to strengthen the Nation's capabilities in marine science and technology, with particular emphasis on ocean exploitation, passed the National Sea Grant College and Program Act (Public Law 89–688) which was signed into law October 15, 1966. The legislation amended the Marine Resources and Engineering Development Act and became the first operating program provided under the basic legislation.

The purpose of this Act is threefold—to strengthen the pool of trained manpower, to strengthen applied research, and to improve the process of information transfer.

Attainment of these objectives will be a long-term process, for the needed manpower resources cannot be developed quickly. But the Sea Grant Act is intended to begin the move toward those objectives and, ultimately, to accelerate application of scientific discoveries to all fields relating to the seas: defense, shipping, food, prospecting and mining, pharmaceuticals, transportation, recreation, weather prediction, and other useful areas.

The National Science Foundation is charged by law with initiating, developing, and supporting the programs authorized by the Sea Grant Act. The Marine Sciences Council is required to advise the Foundation with respect to the policies, procedures, and operations of the Foundation in carrying out its functions.

As a matter of policy, the Council and Foundation agreed that the sea-grant program should be largely oriented to national purposes, such as those dealing with food from the sea, ocean-related environmental forecasting, Continental Shelf exploitation, and multiple use of the seacoast (specifically addressed to pollution problems). The Council also recommended that existing legislative authorization for two years, ending fiscal year 1968, be extended for another finite interval of at least two years.

Features of the Program

In some respects the Sea-Grant concept is similar to existing programs, but in its mode of support, the Sea-Grant concept is new. Its novelty derives both from its focus on ocean engineering and, as suggested in Figures 11 and 12, on its cross-disciplinary and information transfer elements. Figure 11 is a traditional, two-dimensional view of ocean training, with disciplines matched against fields. Our purpose in representing ocean training on a three-dimensional grid, as in Figure 12, is to show that the Sea-Grant concept embraces a greater number of disciplines, including law, economics, and so on, and that

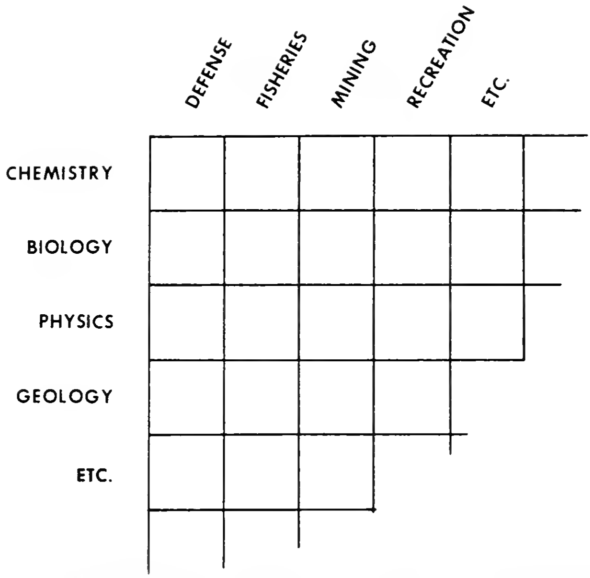

FIGURE 11.—*Two dimensional pattern of conventional ocean training.*

it is the collaborative effort of all these skills that will give the total marine enterprise its strength.

The Sea-Grant Program will be carried on in the universities, but there will be continuous interaction between the Federal Government, State governments, academic institutions, and industry to examine common problems and to pool diversified resources, facilities, and specialized talents for their solution. The program would thus augment rather than replace existing programs of support—and provide a "cement" for these ongoing efforts. It could provide excellent opportunities for "seed projects" that will attract private funding participation.

Industrial firms in widely diverse fields could participate in the program, enabling students to pursue on-the-job training in conjunction with their normal educational programs. Industrial requirements will help to shape the direction of the program and, indeed, the National Science Foundation looks to industry for the feedback so essential to accurate planning. Thus, the Sea-Grant Program will help to support existing industries through provision of trained manpower, new techniques, and concepts.

In short, the Sea-Grant legislation provides for grants and contracts to public or private institutions of higher education, institutes, and laboratories for the functions of education, applied research and information transfer aimed at marine resource development. Matching funds equal to half of the Federal grant or contract; i.e., one-third

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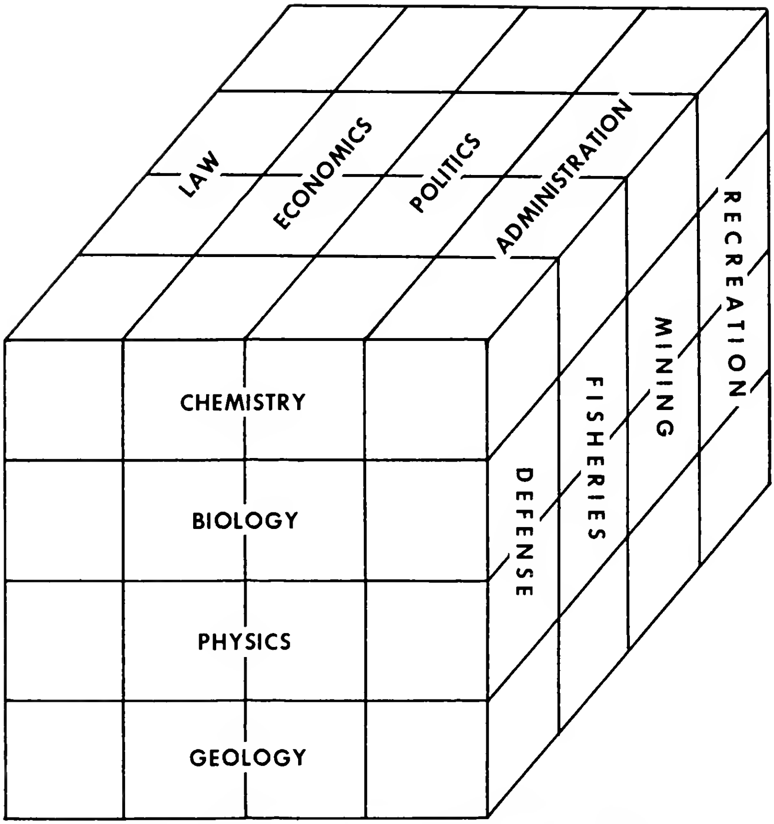

FIGURE 12.—*Sea grant training—a three dimensional pattern.*

of the total, must be provided by the recipient. Federal funds may not be used for construction of new facilities or rental.

Participants in any one State may not receive more than fifteen percent of the total appropriation to the Foundation for the Sea-Grant Program in any single fiscal year.

Funds are authorized for support of programs at Sea-Grant Colleges and at other suitable institutions. The term "Sea-Grant Colleges" is defined in the Act as encompassing public or private institutions of higher education which engage in a comprehensive set of related activities focused on resources development. Sea-Grant Programs, on the other hand, may embrace individual projects to meet any one of the three functional goals; i.e., trained manpower, applied research, and information transfer.

Although it is too early to describe the precise nature of the program, typical features could include the following:

—Location in a region with marine-related industry (e.g., fishing, boating);

—Full-time program director/coordinator;
—Evidence of support by host institution;
—Regular, part-time participation by faculty from allied departments;
—Defined study curriculum;
—Planning devoted at least partly to regional problems such as utilization of local marine resources;
—Programs of applied research;
—Related public information activities including workshops, seminars, etc.;
—Provision for multi-institutional collaboration.

Implementation

Sea-Grant College support will be granted to a limited number of institutions that qualify competitively to carry out comprehensive programs in both training and technology. They must have the ability to undertake advisory programs related to development of marine resources. Support will be provided successful applicants by means of a single broad grant to an institution. The appellation "Sea-Grant College" may be conferred upon an institution after the formative phases of the program and visible accomplishment. However, to achieve any degree of effectiveness, this three-faceted (research, training, information transfer) program anticipates considerable continuity of support. Within limits of appropriations, continuing support for a comprehensive Sea-Grant College program in an institution would ordinarily be provided as long as high-quality performance is maintained. Reviews will be conducted annually, and levels of support will depend on both promise and achievement.

The law stipulates that grantor contribution will be limited to two-thirds and that the grantee must provide at least one-third of funds required for an approved program. Institutions will be encouraged to provide even greater amounts, particularly from private sources.

Funding

For fiscal year 1967, the Congress is being requested to authorize the National Science Foundation to reallocate $1 million from its current regular appropriation to initiate the program. This would permit several small grants to begin activities at participating institutions, especially for necessary planning.

For fiscal year 1968, $4 million is being requested of the Congress. With such funds, the Foundation would provide grants up to several hundred thousand dollars each (supplemented by cost-sharing funds provided by the recipient) to several institutions. These funds will be used to support both comprehensive college programs and individual Sea-Grant projects.

Criteria

The National Science Foundation has developed, and the Council has endorsed, criteria by which proposals for such grants will be judged. These criteria, soon to be announced by the Foundation, are stated only in general terms, to encourage maximum flexibility and imagination on the part of applicants.

These criteria consider:

1. *Existing resources.*—The institution should have a substantial ongoing program in some area related to objectives of the Sea Grant Act, such as oceanography, marine biology, ocean engineering, etc. Additionally, any necessary facilities such as laboratory buildings, ships, and docks must be available, since the Act forbids Sea-Grant funding of such facilities. It must also demonstrate capabilities for interdisciplinary activities. In some cases, needed facilities might be provided by a consortium of institutions.

2. *Capacity for development.*—The institution should demonstrate the ability to plan and implement a new or augmented program. Each applicant will be required to submit a long-range plan, supported by appropriate statistical material, showing how its sea-grant activities will develop in relation to overall institutional plans.

3. *Commitment to program goals.*—Sea-Grant College support will be given only to those institutions which are prepared to conduct comprehensive programs encompassing the education, research, and information transfer objectives of the Act. This must be demonstrated not only by a willingness to share costs as required by the Act but by full commitment of responsible senior officials to an effective program. This commitment should be accompanied by a well-developed consideration of the proposed program's potential for contributing to the health and welfare of the Nation as well as to the Nation's economic strength in marine-related activities.

4. *Regional factors.*—Institutions conducting Sea-Grant College programs will be responsible for serving as regional centers for strengthening the marine resources utilization program. Each institution requesting support for a Sea-Grant College program will be expected to have examined thoroughly the needs and capabilities of its region. It must also consider national needs and services relating to the marine aspects of transportation, fisheries, mining, and other economic endeavors. Institutional programs will be expected to provide advisory services to regional economic and governmental interests as may be appropriate.

Under these criteria, program grants will be allocated within three major categories:

—Applied research to increase knowledge and skill and to improve techniques and equipment for use in development of marine resources;

—Training personnel at all levels—including two-year programs for technicians—who will participate in marine resource development;

—Marine advisory programs (information transfer) designed to aid persons currently employed or interested in marine resources development. Such programs would include, but not be limited to, workshops, advisory services, seminars, and demonstrations.

Chapter VII

OCEANOGRAPHIC DATA

Data Needs

The rational flow of information from collector to consumer is the lifeblood of a marine science and technology enterprise. If intensified but necessarily dispersed efforts are to be successful—to understand complex ocean phenomena, marine life, and the ocean-atmosphere interaction—and if understanding is to foster application, data handling must be responsive to a wide variety of user needs.

Studies have shown evidence of serious deficiences in the Nation's oceanographic data handling: delays in filing; archaic handling methods; lack of critical evaluation and inadequate identification of purpose. Since Federal interests are sharply involved both in production and consumption of marine data, the Marine Sciences Council decided to undertake a comprehensive study of requirements for data acquisition, storage, retrieval, and use. Non-Federal as well as Federal requirements will be taken into account. The study should lead to more effective data utilization as well as lower costs.

Marine science information—like any related body of information—involves a complex, often perishable data commodity including connected functions of acquisition, standardization and tests for accuracy, storage, retrieval, analysis, and synthesis. Today, real-time as well as archival data systems must be accommodated. Such data may be classified by field, such as physical oceanography or geology, and by geographical source. It may be classified according to whether the user's motivation is for description, analysis, or application.

Vast quantities of marine environmental information are required to support virtually all of the purposes of marine science and technology discussed in this report. Scientists, commercial fisheries experts, meteorologists, military planners and operators, and ocean engineers are naturally concerned with the collection and interpretation of materials in a manner suited to their own particular needs, as illustrated by Figure 13. Officials in Government and executives in business management increasingly depend on quantitative scientific information and objective analysis to make policy decisions.

As the problems to be solved become more complex, global in scope, and multidisciplinary in content, the data consumers will be less able to produce their own raw materials and will become more dependent on the work of others. To prevent unnecessary and costly duplication in data collection—the most costly part of marine sciences—collected data should be readily available to all users consistent with the need for national security.

The exploration of the oceans has been a somewhat random and often uncoordinated process. There has never been widespread agreement among the marine science community, as there is in some other fields, as to data handling procedures and standards with the result that materials are not as coherent and systematic as we now desire. In the meanwhile, technology now makes it possible to accumulate data at a vastly faster rate. Today, data users are often unaware of existing sources, and are unable to retrieve needed data quickly in readily usable form. In other cases, however, known data may be deliberately rejected because of doubts of its validity. These problems will need very careful definition before solutions can be formulated.

Any future system to improve management of data should be a system that deals in one consistent way with data from its source through authentication, indexing, filing, and retrieval. Such a system involves not only the data commodity itself, but intimately involves the variety of private and public users and contributors, the

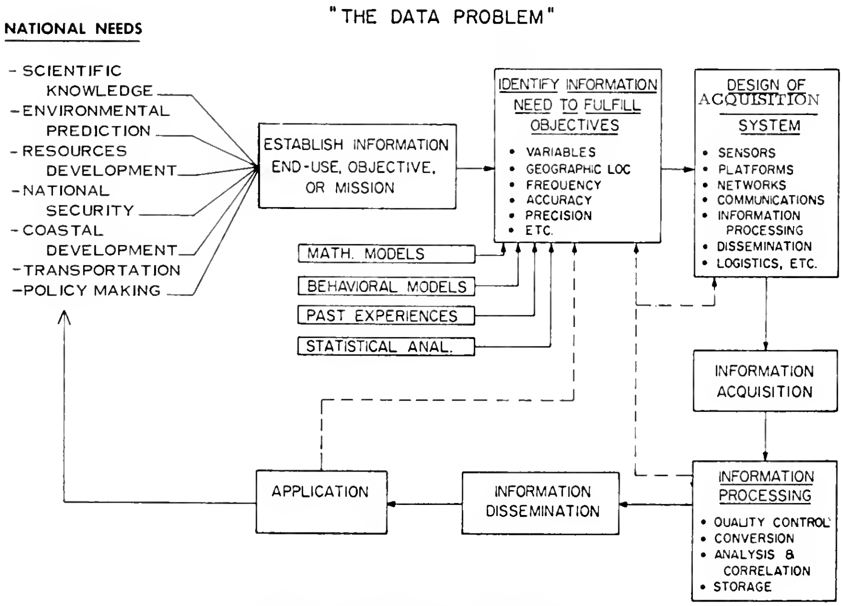

FIGURE 13.—*Marine sciences information management.*

information handling organizations, and the administrative and support activities.

When we refer to system, incidentally, we do not necessarily anticipate a centralized operation, but include the articulation of a number of specialized data centers appropriately linked and meeting quality standards.

Present Status and Next Steps

Some physical-chemical and other information is stored in data banks at the multiagency funded and managed National Oceanographic Data Center (NODC) in Washington, D.C., and various other DOD and ESSA data centers. Much information is in the literature, in the repositories of over 100 research or industrial institutions and Federal agencies, and in the files of many individual scientists.

The Marine Sciences Council has accordingly authorized its staff to undertake a comprehensive study of the Nation's oceanographic data requirements and management steps that could meet a wide variety of needs. This study is to be funded by various Federal agencies who are members or observers of the Council. The effort will be guided by a steering group whose members will be nominated by their agency heads. The study will be conducted on contract and will initially endeavor to identify the various users of data—Federal, State, academic, and industrial—and to catalog their requirements. These users include:

—the "nonapplied" scientist who is interested in the phenomenology of the oceans for scientific objectives but whose knowledge and perception are the basis for a rigorous understanding of the oceans and atmosphere;

—the naval planner concerned with antisubmarine warfare who must understand undersea phenomena that aid concealment;

—the climatologist who must acquire and analyze large quantities of often seemingly unrelated information in order to understand local, regional, and world climate;

—the meteorologist, oceanographer, and seismologist who are concerned with the influence of the oceans on the weather over ocean and land areas and who must warn of hurricane, storm surge, and of tsunami sea waves of destructive character;

—industrial managers undertaking expensive offshore mining or oil-drilling operations who need information on the ocean bed and water conditions above it;

—the fisherman, commercial or sport, who will be able to draw on oceanic data and aircraft, or spacecraft-derived surveillance, to predict location and density of fish stocks;

—the pollution analyst interested in the flushing capacity of ocean-connected bays or estuaries.

Previous data studies and evaluations in the areas of bathymetry, geosciences, hydrobiology, air-sea interactions, fish distribution, radiation, and the like will be assembled in support of, and to prevent duplication by, the new study. Existing activities, such as the U.S. Coast Guard sensor platform and buoy study and similar ESSA and U.S. Navy endeavors are now being, or will be, reviewed to assure correlation and prevent duplication with the data study.

The functions and role of the NODC will be key elements within the scope of the study. The NODC is now providing such services as:

—exchange of data, including provision of free machine listings and punched cards in return for receiving data on standard NODC forms;
—participation in international programs and providing international exchange of services;
—consultative and advisory services;
—forms and publications;
—answering "incidental" requests for information and data.

The very breadth, complexity, and rapidly changing character of marine data has made the NODC job exceedingly difficult. The lack of overall national data methods, limited funds, and incomplete knowledge of user needs, are among other factors that have prevented the NODC from evolving into the institution of the breadth and scope that is needed to meet the objectives of the marine sciences legislation. Means will thus be examined, aimed at, but not limited to the following:

—evaluation and reduction of an inherited data backlog including the development of criteria to determine the value of some of the collections;
—consideration of a common, nationally (and internationally) acceptable programming "language" for linkage with other data storage facilities, memory banks, and computers;
—development of systems and processing capabilities to handle data;
—the development of additional quality control, archiving, and information retrieval systems.

The data study will be a key mechanism for rationalizing the data picture on a national scale for the benefit of all actual and potential originators and users of oceanographic data. The Marine Sciences Council objectives, however, can only be achieved if they are in harmony with the endeavors of other interested bodies and if the products of the study will result in improving the present situation and providing for future growth. Consultation with the variety of performers in marine science affairs and understanding of other data management systems to insure compatibility and economy will be among the first steps. The study will consider data on the world's oceans, the Great Lakes, and the Gulf of Mexico.

Chapter VIII

MAN'S USES OF THE SHORELINE

Competition for Coastal Resources

As population pressures along our coasts intensify, competition increases for the use of limited shoreline resources. Paradoxically, at the same time we seek to derive increased and multiple benefits from the shore, the by-products of technological progress continue to diminish its value. In all too many instances, polluted harbors and bays, oil-covered beaches, and eroded shorelines have accompanied economic development along our coasts. The need for concerted Federal and local initiatives to arrest further shoreline degradation has now reached a level of some urgency.

Seventy-five percent of our population lives in the States bordering the oceans and the Great Lakes. Coastward migration continues. The oceans have a direct impact on the health and welfare of every coastal resident, as well as the tens of millions of Americans who swim, boat, fish, and relax along our beautiful coasts. Also, thousands of commercial fishermen depend for their catches on clean waters of our bays, estuaries, and nearshore coastal waters, and some communities are now turning to the oceans as a source of industrial and drinking water.

At the same time, many industries and municipalities consider the marine environment as a convenient dumping ground for garbage, sewage, industrial, and agricultural wastes. Coastal engineering projects, while benefiting one area, may adversely affect silt deposition or erosion in others.

Science and technology can provide tools to help understand the interaction of man's activities and his coastal ecology. But understanding is not enough. For shorelines to serve many competing interests requires informed interaction of political, economic, and social institutions. The resources of the Federal and State governments can assist, but not supplant local actions to preserve our coasts while deriving their benefits.

Industry must have a key role in these matters since it uses water in industrial processes, often discharges wastes into coastal waters, and contributes to technology of waste disposal needed to maintain water quality standards.

Urban Planning

The coastline is not a boundary separating man's activities in the oceans from his endeavors on land. These activities interrelate in many ways. Sea transportation, for example, must connect with transportation networks on land. Similarly, urban development does not end at the water's edge. As municipalities look increasingly seaward for new inhabitable areas, or perhaps offshore airports, correlated planning of urban and ocean activities becomes essential. Waste disposal requirements must be correlated with the assimilation capabilities of nearby waters. Communities developing a filled-in marshland along estuaries may affect nursery grounds of commercial fish species. Damming and filling activities along the coasts—and harbor development—must anticipate changes in shoreline circulation patterns. Sanitation problems associated with ducks, gulls, and other marine birds near populated areas now become important. Not only do they add to pollution but these marine birds collect in marshes around airports and interfere with aircraft takeoffs.

Interactions between the sea and land directly affecting man's health and welfare are reflected in numerous Federal programs. Problems of shellfish sanitation, storm damage, shoreline erosion, navigation, and protective harbors have received continuing attention by the Departments of Interior and Health, Education, and Welfare and the Army Corps of Engineers. Radioactivity measurements in the sea, both to identify any danger to our health and to trace ocean currents, have also been supported by the Atomic Energy Commission with new attention required as to byproducts that may reach the sea from nuclear reactors and desalting facilities: radioactive waste, brine, and hot effluents. Those from fossil fuel plants will also need study.

In view of the importance of recreation to public health and welfare, Federal legislation has been enacted to set aside a number of seashore areas for public use. At present only three percent of the shoreline of our States (excluding Alaska) has been set aside for public recreation and natural conservation, and wise land use of such scarce resources requires more understanding of the shoreline itself.

The Council considered that the pollution of bays and estuaries and the Great Lakes requires special attention. Preliminary studies of several different agencies had already been underway, including joint Federal-State programs to establish and enforce water quality standards for all interstate streams, from the headwaters to the estuaries, bays, and basins. Accelerating this effort and correlating programs of different agencies add cohesiveness and momentum to development of water quality standards along our coasts.

The present levels of Federal support for marine science studies related to estuaries is shown in Table XI.

TABLE XI.—*Federal marine science activities in estuaries*

	President's budget, fiscal year 1968 (thousands)
Department of the Interior	24,900
Department of Defense	3,500
Department of Health, Education, and Welfare	1,400
National Science Foundation	700
Atomic Energy Commission	200
Department of Commerce	25
Smithsonian Institution	25
Total	30,750

A Major Initiative: Understanding a Large Estuary

Recent legislation authorized construction of a scale model of the Chesapeake Bay by the Army Corps of Engineers. This three-dimensional model of a scale of 1:2,000 is intended to provide a focus for long-range, interdisciplinary studies of the complex phenomena which influence the Chesapeake Bay area.

In focusing attention on the use of a pilot model by one agency, the Council expects other Government agencies and State and private institutions to participate in a multidisciplinary study of related problems. Information being developed by the Federal Water Pollution Control Administration will be of special value.

For generations, the Chesapeake Bay estuary has been put to a number of diverse and often conflicting uses. It is used as a source of food: estuarine fish and shellfish. The Chesapeake Bay estuary is also used for recreation—swimming, boating, and sport fishing. It receives municipal and industrial wastes. This latter use, along with the dredging of navigable channels and harbors and other engineering projects, may drastically change the marine environment.

In view of the large and complex nature of the bay, the model will be useful in enhancing our ability to develop a theoretical framework for empirical measurements made in the past. Also, the model will allow us to improve and extend our understanding of the physical characteristics of the bay, the ecology of the environment, and the interactions of man's activities on marine organisms. Of particular interest will be understanding of the capacity of the Potomac estuary and subestuaries to absorb pollutants by using such a model at costs which should be relatively low compared to that of large-scale field tests.

Insights gained during these studies will be of educational value in considering comparable interacting forces which influence the waters of other bays and estuaries in the United States and the Great Lakes.

Chapter IX

MINERAL RESOURCES OF THE CONTINENTAL SHELF

Further Use of Shelf Resources

Ships, oil derricks, sand dredges, and fish-processing plants have been familiar sights to our coastal inhabitants for years, but they represent only the beginning of our mastery of the resources along the thousands of miles of our coastline. The International Convention on the Continental Shelf, which went into force in 1964, added more than 1 million square miles to the public lands of the United States as shown in Figure 14, an increase of almost one-third. (This extension refers only to adjacent seabed territory in areas where the ocean's depth is less than 200 meters. According to the convention, jurisdiction may extend to even deeper water if the seabed is subject to technological exploitation.)

Simultaneously, the promise of mineral and fishery resources on the Continental Shelf has attracted increased attention as a source of economic wealth and growth. Our understanding of the distribution, richness, and availability of oil, gas, and mineral deposits on the shelf is still limited, however, particularly with regard to deposits off the Alaskan and northwest coasts.

The role for private initiative and investment on the shelf must be considered similar to private industry's role on land. The petroleum and gas industry has on its own initiative pioneered in exploration and development of the geological resources of the Continental Shelf, and the search for oil and gas has led to the rapid development of many geophysical exploration tools and platforms. In turn, the Government's role now is similar to its earlier responsibilities in the development of the West for establishing the administrative, legal, and financial framework, in the public interest, to encourage development of public lands while protecting private investments, and helping to minimize friction between conflicting types of commercial usage.

The Government already supports programs in geological research and survey and mapping activities, as well as weather and ocean prediction services along the coastlines, to assist industrial activities. These support functions articulate closely with the private activities that they serve, and must continue to develop in phase with further utilization of shelf resources.

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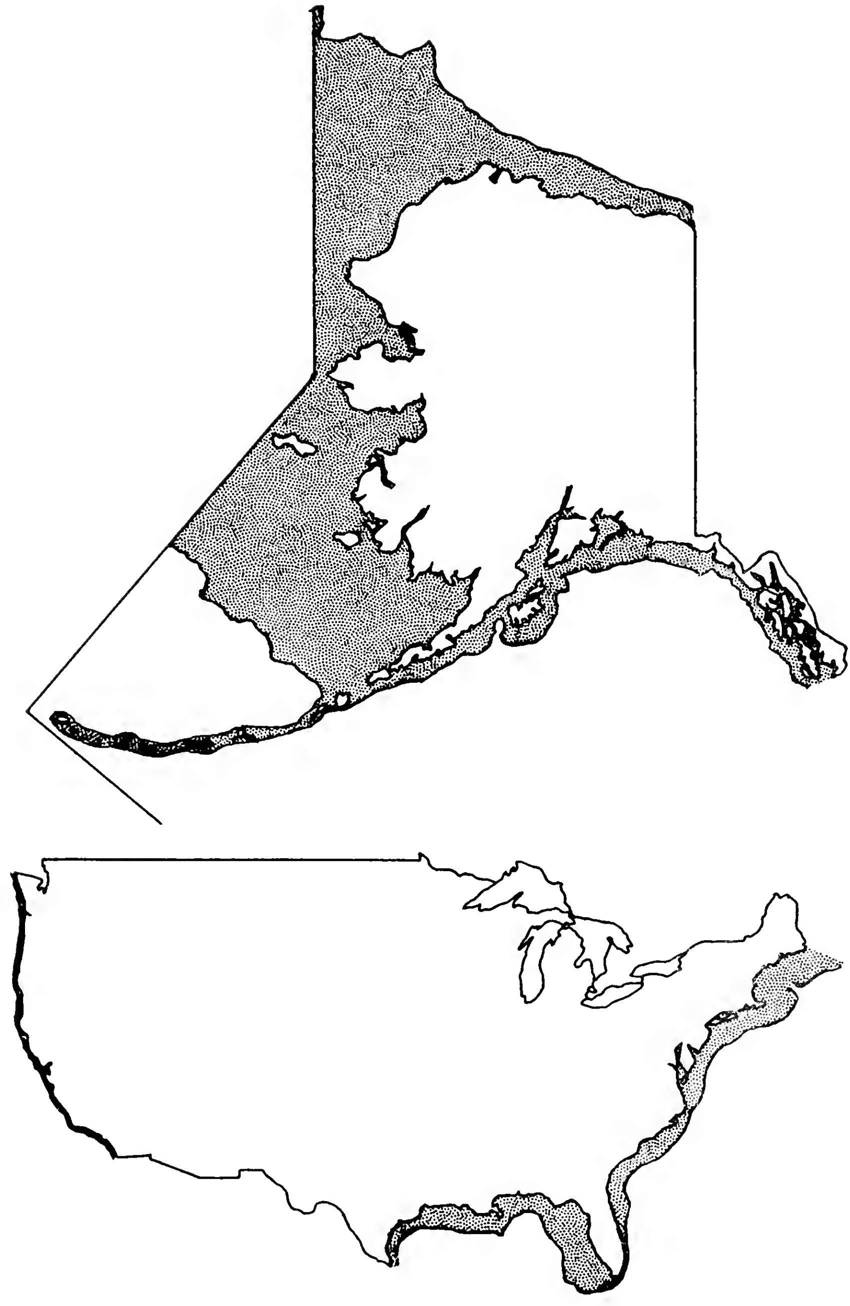

FIGURE 14.—*U.S. Continental Shelf (to a depth of 200 meters).*

As a further step in expanding our understanding of the economic potential of the shelf, one of the priority recommendations of the Council calls for increased Federal efforts to locate, describe, and assess offshore solid mineral deposits.

Commercial Activities on the Shelf

Petroleum and gas exploitation has been centered primarily in the Gulf of Mexico, off the California coast, and increasingly off Alaska, while exploration is underway along the coasts of Washington and Oregon, and now off the northeast coast. The annual investment of industry in locating and developing offshore oil and gas deposits, including development and construction of mobile and fixed-platform drilling rigs, is in the hundreds of millions of dollars. During fiscal year 1966 the Federal Government received $248 million for offshore leases and royalties, with most of the sum being paid by the petroleum industry.

The Continental Shelf is a promising commercial source of sand, gravel, and seashell deposits used by the construction industry, and the underwater mining of sulphur is increasing. (See Table XII for production levels of resources of the shelf.) Almost every large mining and aerospace firm has initiated feasibility studies related to the solid mineral deposits of the Continental Shelf although only a few of them are engaged in the high-cost exploratory work. Most industrial firms are awaiting the identification of promising areas on the shelf and the development of improved sampling and recovery techniques before launching major developmental programs.

Another important resource is "underground" fresh water in streams on the Continental Shelf. A source of fresh water was discovered last year by the Lamont Geophysical Laboratory, drilling into the Blake Plateau off Florida in a federally supported program with an oil rig borrowed from an oil company; an example, incidentally, of benefits derived from Government-industry-academic cooperation.

TABLE XII.—*Value of mineral production from oceans bordering the United States, 1960–65*

[Millions of dollars]

Commodity	1960	1961	1962	1963	1964	1965
From sea water:						
Magnesium metal and compounds, salt and bromine	$69.0	$73.0	$89.1	$84.6	$94.5	$104.0
From ocean subfloors:						
From wells:						
Petroleum, natural gas, and sulphur	423.6	496.6	620.7	730.8	820.3	940.0
From beaches and in shore sea floors:						
Sand and gravel, zircon, feldspar, cement rock and limestone	46.8	46.2	44.3	42.5	43.6	45.0

Source: Department of the Interior.

Sea water has long been a source of salt, and today it is also a major source of magnesium and bromine with lesser amounts of sodium, calcium, and potassium compounds being recovered as byproducts of extraction processes. With the development of improved desalting techniques, the chemical industry is looking to sea brine for possible new commercial opportunities.

Federal Research Activities

Whether the ultimate consumer of research and survey data be a fisherman or an oil firm, the movement of the water, the nature of the sea bottom, and our ability to determine precisely locations in and below the water surface are of key importance. The Federal Government, as shown in Table XIII, is currently engaged in a variety of marine science information-gathering activities on the shelf. These include reconnaissance studies of the Atlantic Continental Shelf and its margin which have already suggested new sources of phosphate and manganese (Fig. 15). New petrogeological structures have been identified off the northeast coast; underwater seismic areas have been studied along the Alaska and California coasts; systematic studies of the Gulf Stream and other coastal currents, and geophysical mapping of offshore sand are leading to understanding of the stability of seafloor sediments.

TABLE XIII.—*Marine science activities on the Continental Shelf*

	President's budget, fiscal year 1968, (millions)
Smithsonian Institution	$0.1
Department of Commerce	18.6
Atomic Energy Commission	2.0
Department of Transporation	.5
National Science Foundation	.7
Department of the Interior	34.7
Department of Defense	13.8
Total	70.4

Federal research programs in support of shipping activities along the coasts include improvements in the quality and detail of nautical charts, enabling ships to operate at maximum efficiency and reducing navigational hazards along coasts and in harbors. The understanding and control of marine boring and fouling organisms will save millions of dollars of damage to underwater structures.

The Future

As worldwide mineral demands increase and suppliers turn to lower-grade ores, costs are likely to rise. Such increases, however, may be prevented by the discovery of new sources of minerals that can

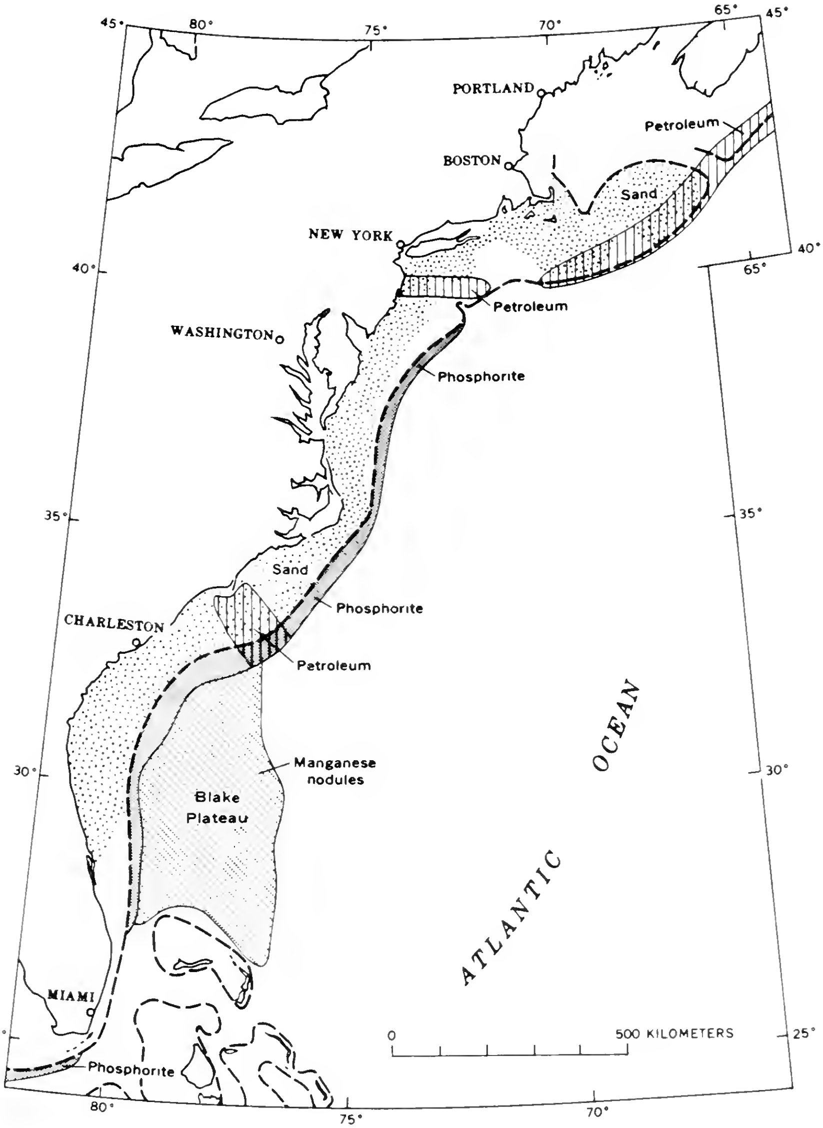

FIGURE 15.—Potential mineral resources of the Atlantic Coast Continental margin.

Source: Department of Interior.

be economically exploited. Many of these will, of course, continue to be found on land. But geological samplings have already demonstrated the presence of many minerals on and near the Continental Shelf. These are newly discovered deposits of sulphur in the Gulf of Mexico, manganese off the Atlantic and Pacific coasts, and phosphorite off our Southeast and California coasts.

Federal programs are underway for investigating sources of gold, silver, platinum, and tin in placer deposits along the Pacific and Alaskan coasts.

New mining technology may be required as these programs move ahead, with unusual opportunities for invention and innovation.

A stable legal framework must go hand-in-hand with technology to reflect a judicious balance of public and private interests in order that industry can extend the present geographical boundaries of the exploitable resources. The Council is working with the Departments of Interior, State, and Justice, the Public Land Law Review Commission, and other concerned organizations in supporting legal studies to identify alternative Federal policies and consequences of each.

In looking to the future, the Council identified as an area for special emphasis the acceleration of Government-wide planning, surveys, and survey methodology designed to assist the extractive industries on the shelf. Included in this expanded effort to assess mineral resources will be:

—expansion of marine science activities of the Geological Survey;
—extension of technological studies of the Bureau of Mines;
—use of Coast and Geodetic Survey ships and other federally supported ships to conduct pilot surveys of promising areas;
—automation of the data processing capability of these ships;
—economic analyses of identified deposits.

Fiscal year 1968 efforts will be devoted primarily to planning the expanded effort and to initial work in limited areas of the shelf. Intensive pilot investigations of limited areas should provide useful experience in planning investigations of broader areas of the shelf.

Chapter X

OCEAN OBSERVATIONS FOR WEATHER AND SEA STATE PREDICTION

Environmental Prediction

A very substantial part of the Federal effort in marine sciences and technology is devoted to observation and prediction of the ocean environment. Every agency is engaged to some extent, but the Navy and the Environmental Science Services Administration (ESSA) support the greater part of the effort. Many surveys are conducted to meet explicit mission requirements; others contribute to the full spectrum of objectives of the Nation's marine science interests: defense, fishing, shoreline protection, etc. Where surveys are to be conducted, by whom, with what instruments, with what priority, and to what effect could not be evaluated in the short time since the Council was established, but appropriate steps are being considered in each agency and across the Government to improve such analyses.

In the meantime, however, one area of civilian need, heretofore relatively undersupported, has gained emphasis by the Council—the broadening of an environmental observation and prediction system of marine data and collection procedures for the purpose of describing and predicting both the state of the oceans and conditions in the atmosphere.

Benefits

The economic impact of improved environmental prediction is substantial. Industrial, commercial, agricultural, and other land activities directly affected by weather will be better served: building construction; aviation and marine transportation; and recreation. Better ice prediction on the Great Lakes would be of economic benefit. More accurate and longer range warning of tropical storms and hurricanes would save lives and property, as suggested by data in Table XIV and Figure 16.

Improved understanding of the causes of drought conditions and long-range weather predictions would permit better planning of water conservation measures for crops and management of municipal water supplies. Similarly, improved prediction of rainfall will assist in improving flood warnings which would allow advance application of necessary control measures.

TABLE XIV.—*U.S. economic loss from various hurricanes since 1955*

[In millions of dollars]

Hurricane	Year	Damage
Diane	1955	800
Audrey	1957	150
Donna	1960	400
Carla	1961	400
Isabella	1964	10
Cleo	1964	130
Hilda	1964	330
Dora	1964	250
Betsy	1965	1,500
Alma	1966	60
Total		4,030

Source: Dept. of Commerce.

Improved predictions of many ocean conditions would directly benefit coastal communities, shipping and offshore oil, gas, and other resource exploitation activities. Predictions of ocean temperatures, currents, ice, and sea state conditions in the open sea aid fishing, maritime commerce, and naval operations. Forecasts of subsurface ocean conditions are equally important for fishing, naval activities, and exploitation of the Continental Shelf.

Improved accuracy and time range of weather forecasts and improved predictions of the state of the oceans depend on a deep understanding of the mutual interactions of ocean and atmosphere.

For these purposes, the atmosphere and the oceans can be considered as continually interacting parts of a single global fluid system. The oceans, as solar-heated reservoirs of moisture, critically influence weather and climate. The weather in turn plays a role in driving the currents of the oceans and determining the sea state. In turn, the oceans determine the patterns of climate as demonstrated, for instance, by the influence of the Gulf Stream in moderating the weather and climate of Western Europe.

Technological Tools

Technology is beginning to provide new tools to observe and measure the global state of the atmosphere and oceans and the relationships between oceanic conditions and the weather. Meteorological satellites detect and track hurricanes and other ocean storms. Seismological instruments detect undersea earthquakes that cause tsunamis. Radar and other remote probing devices detect squalls and storms.

Modern computers and data processing techniques have considerably improved our capability for handling the increasingly large volumes

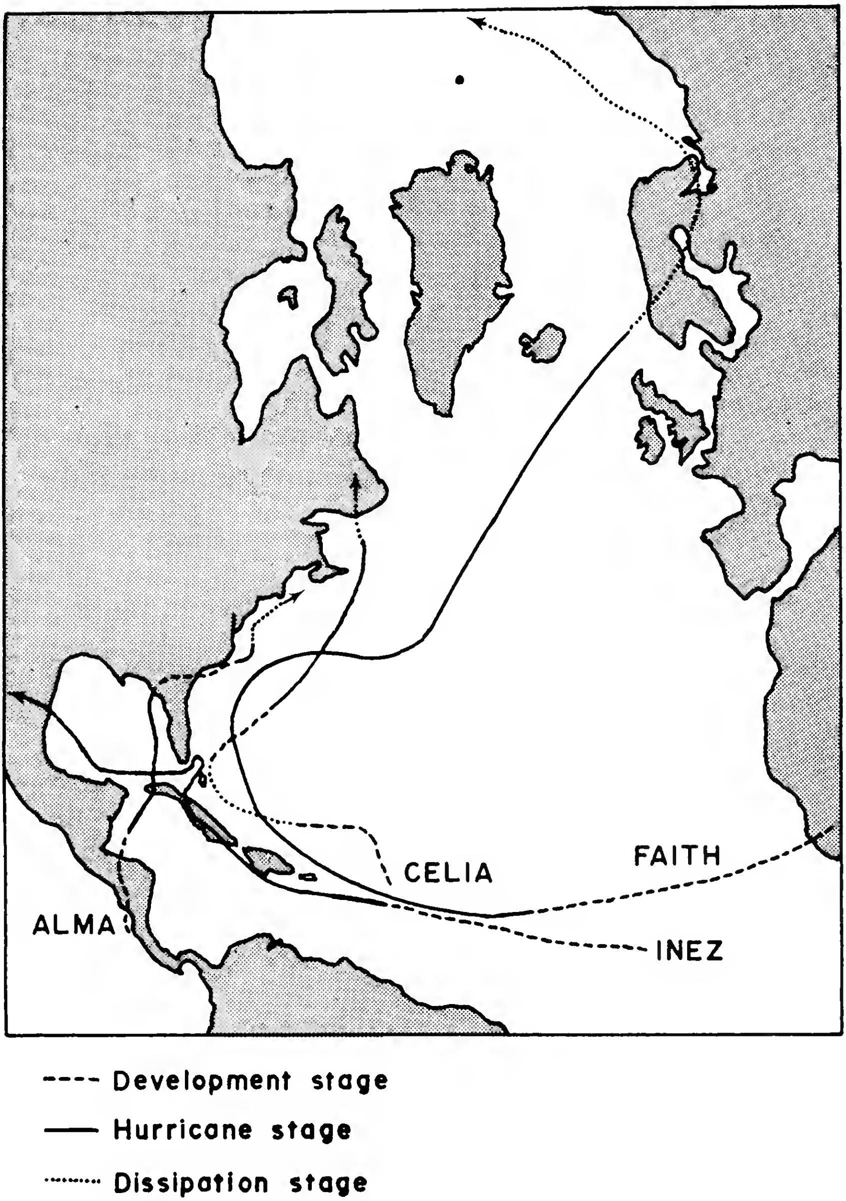

FIGURE 16.—*Tracks of some hurricanes, 1966*

of data becoming available from conventional and satellite-borne instrumentation.

Video displays and photographs from Tiros, Nimbus, ESSA, Advanced Technology Satellite 1, Gemini, and other satellites have already shown that ocean currents, ice masses, estuary flow, and sea-bottom contours in shallow water or clear water can be observed from space (Fig. 17). Manned orbital spacecraft may offer additional possibilities for onboard photography and data analysis of oceanographic atmospheric phenomena.

The National Aeronautics and Space Administration is cooperating with the U.S. Navy via the ICO in organizing a "spacecraft oceanography project" whose purpose is to assess and develop the feasibility of space research and technology to marine sciences. Similarly, NASA is continuing its cooperative efforts with ESSA in the development of improved spacecraft for global weather measurements.

Air-sea interaction studies have been recognized as key elements to meet requirements for environmental prediction. When we have the understanding to make such predictions, we will:

—have the capacity to make long-range weather forecasts;

—better understand the causes for fluctuations and motions of tropical storms and hurricanes;

—be able to develop improved techniques for prediction of devastating coastal inundations;

—predict the ice conditions over coastal and open ocean areas;

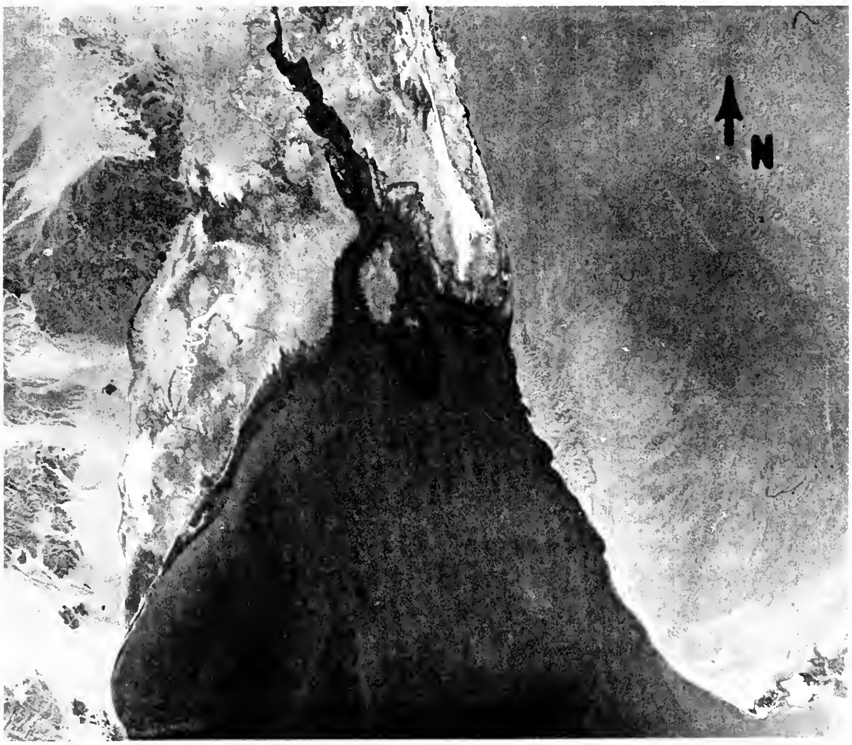

FIGURE 17.—*View from Gemini IV of the north end of the Gulf of California showing mouth of Colorado River.*

—predict complex weather conditions such as fog and other coastal and marine weather phenomena which result when air masses move across land and ocean;
—predict the state of the ocean's temperature gradients;
—predict the time and space variations of the oceanic and near-shore currents.

In turn, these capabilities require: (1) development of instrumentation to measure the physical processes which take place at the interface of ocean and atmosphere, and (2) the mounting of controlled and comprehensive observational programs in well-defined areas to study the small-scale processes so that they can be related to the larger scale atmospheric and oceanic phenomena.

Oceanic Research

Complementary to air-sea interaction studies, it will be necessary to develop a further understanding of the dynamics of ocean current systems themselves; i.e., the relation of the ocean current systems to the physical state of the ocean, and the thermal and mechanical mechanisms and forces which drive the currents and cause their fluctuations in time and space. A comprehensive program to achieve such understanding will require observational studies of ocean current systems as well as the mathematical simulation of current systems. A prototype system for predicting environmental conditions concerned with antisubmarine warfare and submarine activities is in operation in the western part of the North Atlantic and a new dynamic prediction model for the system is being tested. This prototype could be the forerunner of an improved system with global coverage which will also provide data valuable both to naval and nondefense marine operations.

Because of the global nature of the phenomena being studied, synoptic observations are necessary, with stations optimally distributed in the oceans. A system of observation stations, including buoys, is essential for the implementation of the "World Weather Watch," an international effort recommended by the United Nations and in which the United States is planning to participate. Comprehensive World Weather Watch design studies are presently underway in the United States and other countries of the world, under the aegis of the World Meteorological Organization.

First steps are being undertaken toward examining the role of a variety of ocean data sensor vehicles in such an observation system. A Government-wide buoy systems study—managed by the U.S. Coast Guard—will include compilation and analysis of requirements of all agencies and scientific institutions. Information on existing and planned platforms will be consolidated. After a cost effectiveness analysis, a step-by-step plan for initial implementation of oceanographic-meteorological data gathering buoy systems will be prepared, together with associated research, development, and implementation plans.

Improving Prediction—New Areas of Emphasis

As part of an overall effort to improve environmental prediction, the Council has recommended that the following projects receive priority attention:

1. Initiation of a design study to determine which system, and which combination of marine sensors, platforms, and communication links, will best serve the needs of the Nation for long-range and reliable environmental predictions.

2. Improvement in marine weather service for:

—more rational, economical and safe rerouting of marine transport;

—improved tracking and path prediction of severe storms and hurricanes for earlier and improved warnings to fishermen and Continental Shelf resource developers.

3. Improvement of ocean, surf and nearshore sea state predictions so that:

—sea and storm caused destruction of life and property in coastal communities can be reduced;

—the design and maintenance of offshore oil and gas rigs, harbors, sea walls, shoreline habitation developments, and other structures can be effected, with maximum economy and safety.

4. Implementation of improved Tsunami Warning Service so that:

—longer range warnings can be given to ships or communities that may be threatened;

—a further understanding may be gained of the effects of seismic disturbances on the oceans, for possible long-range prediction of such disturbances.

5. Increased emphasis on air-sea interaction research studies and ocean circulation dynamics which will result in:

—the initiation during the next few years of the first of a series of increasingly comprehensive field programs of measurement and observation;

—increased use of computers for establishing more advanced models of ocean circulations and their interaction with the atmosphere;

—development of new instrumentation and techniques.

The above priority items are important, but they are not the only elements of this program. While much of this program is centered on ESSA and the Navy, other agencies are also expected to make significant contributions from their ongoing programs. A key feature of the program will be the coordination with other projects and efforts, such as the data management study, the national Coast Guard-managed sensor platform and buoy study, and the work of international oceanographic and meteorological groups.

Chapter XI

ENGINEERING IN THE MARINE ENVIRONMENT

Ocean Engineering

A strengthened engineering component of marine sciences and technology is one of the objectives set forth in legislation. Engineering, however, is not an end but rather a means—for tools, techniques, facilities, and services must match requirements for research and for applications. By a number of circumstances, some the result of planned marine development, but the most fortuitous contributions from other fields, we find the technologies ripe for meeting new marine requirements.

Ships and submarines, undersea cables and tunnels, coastal protection, and offshore oil operations are examples of successful ocean engineering. These evolve from classical engineering principles, modified to take into account the different environmental factors and forces of the oceans, and oriented to the tasks man wants to accomplish in the sea. Such engineering thus concerns propulsion, materials, sources of energy, structures, communications, etc. Engineering design must accommodate such factors as cost, safety, reliability, availability of components, and ease of maintenance. Implicit, too, is the systems approach to problem solving, taking into account such environmental factors as:

—sea surface motion;
—tides and currents;
—wave impact and wind loading;
—heavy hydrostatic pressures;
—large buoyant forces;
—opacity of sea water to electromagnetic energy;
—high attenuation and scattering of light energy;
—high conductivity of sounds;
—lack of gaseous oxygen for man or chemical combustion;
—presence of all common elements in sea water;
—variable two-phase nature of water-bottom interface;
—severe corrosion and fouling.

National Security

Since the first ship was built, marine engineering and naval architecture have been vital elements of national security. A fleet, second to none for more than thirty years, reflects the high technical skills of the U.S. Naval Establishment, and the significant contributions of the technical industries that support it. By far the largest fraction of Federal funds for ocean engineering has been spent in the defense area and, for some years to come, this is almost sure to continue. Today, however, new demands are being added. For nonmilitary as well as military reasons, man is venturing below the thin layer near the ocean surface to utilize the relatively unexplored and unused third dimension of the sea.

Search and Recovery—An Area of Emphasis

As noted earlier, an area considered by the Council as deserving special emphasis concerns a deep-ocean search and retrieval capability. Steps to increase development in that field are proposed for the Navy for fiscal year 1968 in the context of that agency's mission. The Thresher catastrophe dramatized both the compelling reasons for finding and recovering objects from the deep-ocean bottom, and the frustrating discovery that, in 1963, this Nation had virtually no capability to accomplish such tasks in water more than 400 feet deep. In January 1966, when two U.S. aircraft collided over Spain, the importance of deep-ocean search and recovery skills was again confirmed. The subsequent recovery of an unarmed nuclear weapon from 2,850 feet of water near Palomares, demonstrated that the Nation had acquired some capability, embryonic though it might be, in the three intervening years. The task, however, required three months, dozens of ships and aircraft, thousands of people, and millions of dollars. Subsequently, the Navy has conducted a dozen or more search and recovery operations which not only salvaged especially valuable aircraft, torpedoes, and other equipment, but also developed needed experience.

To date, the deepest important recovery was from 3,000 feet, yet more than eighty percent of the world seas exceed that depth. To improve and extend that capability, the Navy program for fiscal year 1968 contains funds to start the development of a small, manned submersible and associated equipment capable of operating eventually at depths down to 20,000 feet. Only deep trenches which comprise two percent of the world's oceans are deeper. Initial emphasis will be on development of suitable materials and equipment, and on outfitting the currently approved 3,500-foot depth rescue vehicles with equipment to gain more practical experience in search and recovery at sea.

Rescue of Personnel From Submarines

A new system for rescuing personnel from sunken combatant submarines is currently under development to replace the McCann bell system developed over thirty-five years ago. The central element of this new rescue system is a 30-ton, 50-foot rescue vehicle capable of removing two dozen people per trip from a disabled submarine. Figure 18 shows how people will transfer from the disabled submarine to the rescue vehicle. The first prototype rescue submarine is scheduled for delivery in June 1968 and construction of a second submarine begins the next year. The vehicle can be transported in the C–141 aircraft, thus enabling the rescue system to respond quickly to a submarine disaster almost anywhere.

Salvage

The Navy program includes development of techniques to raise sunken ships or large elements from deep water. Studies being conducted now emphasize recovery from continental margin depths—1,000 feet or less. For salvage in deeper water, economical solutions are being sought for techniques for generating large but controllable lift and buoyancy forces; means of eliminating or minimizing the adverse effects of sea-surface motion; extension of man-in-the-sea to

FIGURE 18.—*Artist's sketch of planned U.S. Navy Rescue Vehicle evacuating crew from disabled submarine.*

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deeper depths and for longer duration; development of tools, equipment, power sources, and underwater workboats to augment man's capabilities at deeper depths.

Ships and Deep Submersibles

As one of the nine areas for emphasis, the Council endorsed a proposal of the Coast Guard that one of that agency's major ships, planned originally as a replacement for the twenty-three-year-old *Evergreen* on the North Atlantic ice patrol, be designed and outfitted especially for subpolar oceanography. In addition to ice patrol, it will be employed to investigate water-mass interchanges in support of the Navy and will be one of the most effective tools to accentuate a program of oceanography in near-Arctic waters.

This is the only new ship for marine sciences being requested for general observational activities in the fiscal year 1968 program. To some extent, the slowing down of ship construction reflects the foresight of decisions over the past few years in funding new ships in phase with anticipated requirements. It also signals an interval of taking stock and considering what platforms or devices other than ships may better serve needs for marine observations. Aircraft, helicopters, ground effect machines, and stationary buoys, either manned or unmanned, offer alternatives to be examined.

The deep-submergence research vehicle is one of the most exotic new developments in the arsenal of research tools. The Government's acquisition of the bathyscaphe *Trieste* in 1957 signaled the beginning of this era, and the privately funded design and construction of *Aluminaut* in 1958 constituted a quantum jump in depth capability of a true submarine. A whole family of such vehicles has followed, with a wide span of depth, performance, and payload characteristics. Most have been designed and built by private industry, but more often than not are deployed on Federal research and development projects. The evolution of these vehicles, shown in Figure 19, was accompanied by an initial lag of demand behind supply. 1967 may be the year of transition. Two *Alvin*-type vehicles should be delivered to the Navy in fiscal year 1968, and unless more small submersibles are built in the near future, the demand for these craft may exceed the supply.

Of particular importance is the NR–1, the small, nuclear-powered, ocean engineering and research submersible being constructed by the Navy which should be ready for operation next year. Its endurance of thirty days submerged (as compared with a maximum of about thirty hours for a working dive in today's vehicles) opens significant opportunities for exploration of the Continental Shelf and for biological, physical, and acoustic research.

Experience in operation—including the unprecedented mobilization of these capabilities for the ordnance search off Spain—has pro-

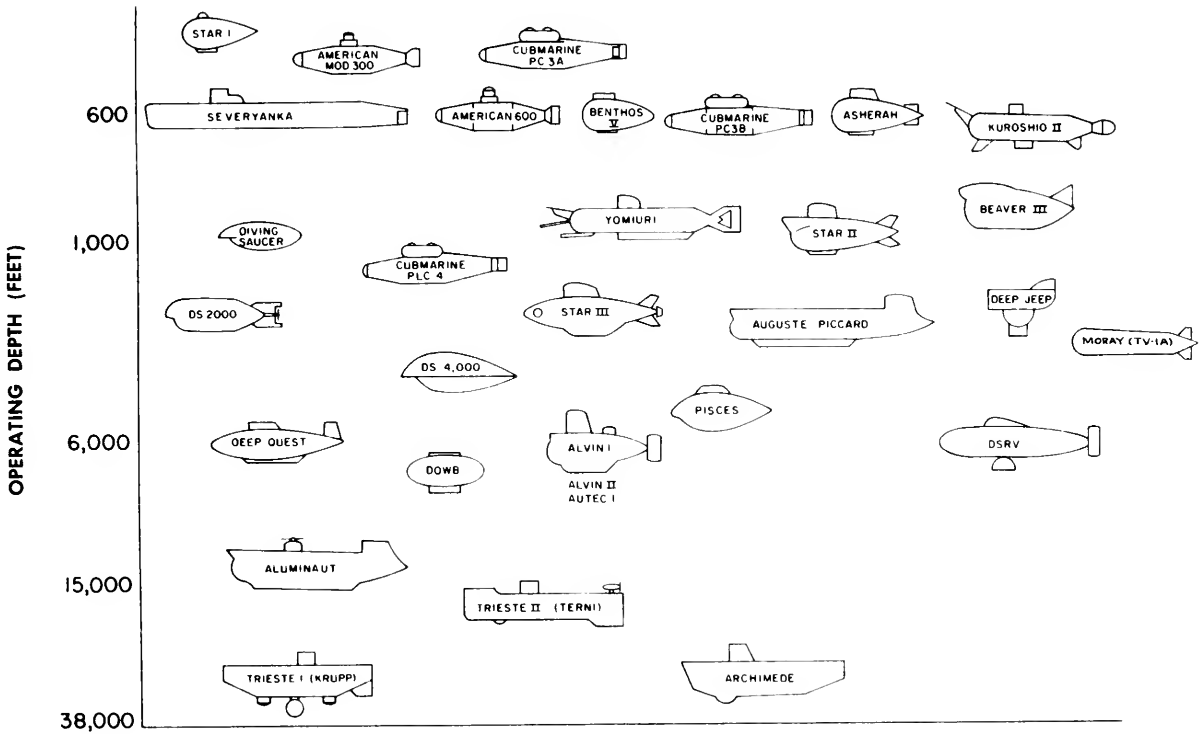

FIGURE 19.—*A spectrum of research submersibles.*

vided lessons pertaining to performance and safety that should guide design of the next generation of vehicles. To this end, the Council is planning to collect and make available all possible data that would assist future development.

Mineral Resources

Determining the extent and quality of sea-floor mineral deposits with the accuracy taken for granted on land is not yet possible. Even the crudest of evaluations is expensive and difficult to perform. Engineering to modify terrestrial drilling and sampling techniques to the shallow waters of the Continental Shelf is being intensified by the Bureau of Mines.

Certification and Standardization

Certification of safe construction, licensing of operators, and standardization of practices and equipment are vital elements of any developing technology. A beginning has been made by the Navy and the Coast Guard in establishing safety specifications and standards for both military and nonmilitary deep submersibles. For insurance purposes the American Bureau of Shipping will conduct inspections of commercial submersibles.

Man-in-the-Sea

The presence of man at the site of his undersea work is usually advantageous and on occasion essential. Within his physiological limits, man can go underwater and work as an exposed diver, wearing only a light protective suit and underwater breathing apparatus. Where the effects of submergence exceed physiological endurance, he needs the protection of a pressure-proof capsule. Thus protected, he gains greater mobility, endurance, carrying capacity, and relative comfort; but he sacrifices manual dexterity, maneuverability, access to restricted areas, and the ability to use tactile sensing. The goal of the Navy's man-in-the-sea program is to extend the depth and duration of penetration into the ocean depths by the unprotected diver through a series of experiments (called Sealab) in living and working at several hundred feet depth for many weeks. During the coming year the Sealab III experiment at 400 feet will be concluded and preparations will begin for Sealab IV. Continued efforts can be expected to extend our capabilities to the deepest areas of the Continental Shelf, seeking solutions to such technical barriers as precise control of partial pressure of the breathing mixture; communication; comfort of personnel; navigation in low visibility; adequate and suitable tools.

Much man-in-the-sea technology has been and will be developed by private industry for such work as petroleum and mineral recovery.

The Government will encourage such development and strengthen in-house capabilities in the future since not only the Navy but nearly every other agency has underwater missions which will be aided by capable divers.

Test and Evaluation Facilities

In support of the accelerated development of ocean technology, the Navy is currently operating: a test range off San Clemente Island, Calif., that will support future Sealab experiments, testing of rescue, search, and salvage systems; a pressure-test facility at the Marine Engineering Laboratory, Annapolis, Md.; the Atlantic Undersea Test and Evaluation Center (AUTEC), a highly instrumented ship and weapon range located in a 5-mile long, 6,000-foot depth, sheltered body of water in the Bahamas (that will go into full operation in 1967); and its Pacific counterpart, the Barking Sands Tactical Underwater Range at Kauai, Hawaii.

New facilities will also be needed for nonmilitary development to meet both Government and private needs. Additional ranges or laboratories for these purposes have been suggested. Studies will be undertaken of future requirements, and of the best means for meeting them.

General Purpose Technology and an Area of Emphasis

To carry out many of the explicit, foreseeable tasks requires a versatile ocean engineering that is not yet in being. No existing agency has specific responsibility for developing a reservoir of general ocean technology.

From experience in other areas, some general purpose capability to meet the unforeseen has also been found essential. Determining what is needed and which agency or agencies should assume responsibility for such future nondefense developments, will be examined by the Council.

In support of defense objectives mentioned earlier and as an area of special Council emphasis, the Navy will initiate key components in the area of deep-ocean technology, with $5.5 million earmarked in fiscal year 1968.

Chapter XII

RESEARCH—THE BASE OF THE MARINE SCIENCE EFFORT

Research Content and Scope

Earlier chapters have been concerned with the application of ocean science and technology to meet the needs of the Nation. The possibility of meeting each need depends on a strong scientific base. In the past, the efforts of the Federal Government have been directed primarily toward strengthening this base, through intensified academic research, constructing modern ships and laboratories, and supporting education and training to assure a continuing influx of talented people into this field. The Marine Resources and Engineering Development Act of 1966 gives new impetus to the application of our marine science capabilities. Implementation of that Act, as recommended by the Council in this document, gives added significance to this year's Presidential request for fiscal support of academically related research.

Oceanographic research is considered here to encompass (1) scientific exploration, which seeks to answer the questions of how or why, and (2) geographic exploration which is concerned more with the questions of what, where, and when. Both basic and mission-related research are included. Fundamental disciplines are involved, such as physics, chemistry, biology, and mathematics; so, too, are the earth sciences and basic fields of engineering.

When science meets the sea, two general groups of scientists participate. In one group, a scientist may consider himself oceanographer first and marine biologist second. In the other, the scientist, such as the microbiologist, looks to the sea as a laboratory, providing special opportunities to understand his subjects. Both groups are necessary to the strength of the scientific base.

Research contributions in the marine sciences have come from the universities, from industry, and from government laboratories. Research has been conducted both by multidisciplinary teams and by the physicist, chemist, biologist, or geologist working alone. The Federal Government has not only drawn on scientific results of completed research but has continuously sought the advice of non-Federal scientists as to what should be done and by whom. Close communication between the Federal Government and the universities has been a big factor in the success of U.S. science.

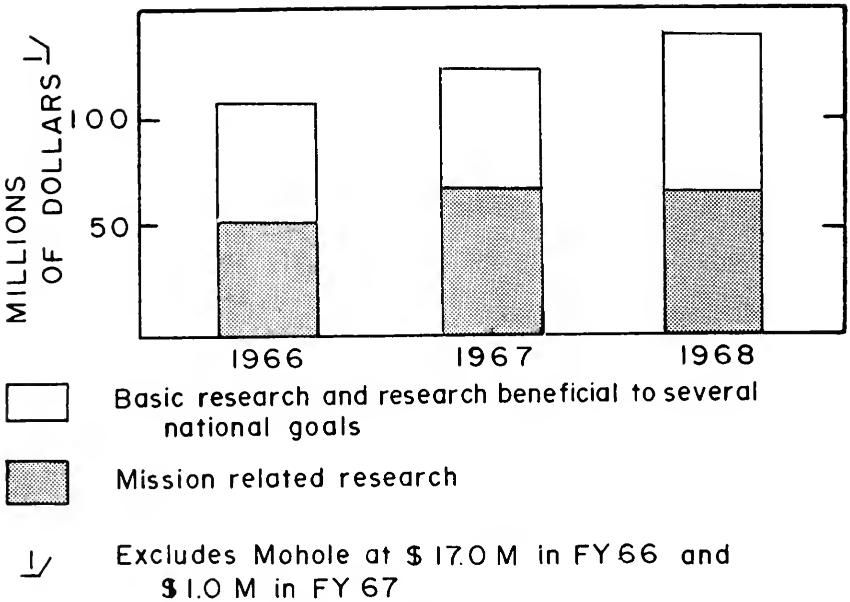

FIGURE 20.—*Funding for oceanographic research.*

Fiscal Year 1968

Research support proposed in the marine sciences for the next fiscal year of $138 million is roughly $18 million more than was appropriated for 1967. Research funding during the past three years constitutes a constant thirty percent share of the total marine sciences budget (See Figure 20). This also represents a continuing two percent of the Federal research budget. Most of the 1968 increase is reflected in the budgets of the Navy, Commerce, and the National Science Foundation. Details are presented in Part Two of this report. Of special note is the Foundation's designation of marine sciences as one of the four fields which deserve increased support in order to fill hollows in the broad spectrum of research. The task of identifying areas of marine science which must be strengthened to meet the national need will not be the sole responsibility of the National Science Foundation; this task must also be assumed by all agencies supporting research in this field, and this area will receive continued attention by the Council.

Trends

Oceanography, as a field of scientific specialization, is comparatively new. The first academic degree was granted only thirty-five years ago. The growth in university training is shown in Figure 21. A 1964 survey funded by the National Science Foundation found 2,650 persons professionally employed in marine science and technology, of whom only 616 held degrees related to marine science (353 Ph.D., 176 M.S., 87 B.S.). The remainder applied their specialized training in other basic disciplines to oceanic problems. In most universities the field is one for graduate specialization, and it has been recognized that research experience should be integrated with formal education. The Federal budget includes support for student training in a variety of ways. Some receive fellowships while many more are given the opportunity to participate in the research supported at the universities by grants and contracts.

More facilities are becoming available for research. Since 1960 more than fifty ships have been built or modernized and fifty-eight new laboratories and similar facilities have been established. Others have been strengthened. New tools and instruments are becoming available, somewhat the consequence of increased involvement of the industrial community. Manned deep submersibles are justifying the vision of their early advocates and are being used increasingly as scientists become aware of their potential. U.S.-built submersibles made 229 dives for research in 1966, as compared to twenty-eight in 1965. Towed unmanned vehicles are making it possible to examine the deep ocean in new detail, and sophisticated instrument packages, capable of freefall and recovery, are collecting information long wanted by the oceanographer. Buoy technology has advanced to the point where experiments requiring long time series observations can be realistically planned. Satellite navigation has made available a new precision in spatial measurement at sea, and the utility of satellite-mounted sensors for large-scale investigations is being demonstrated.

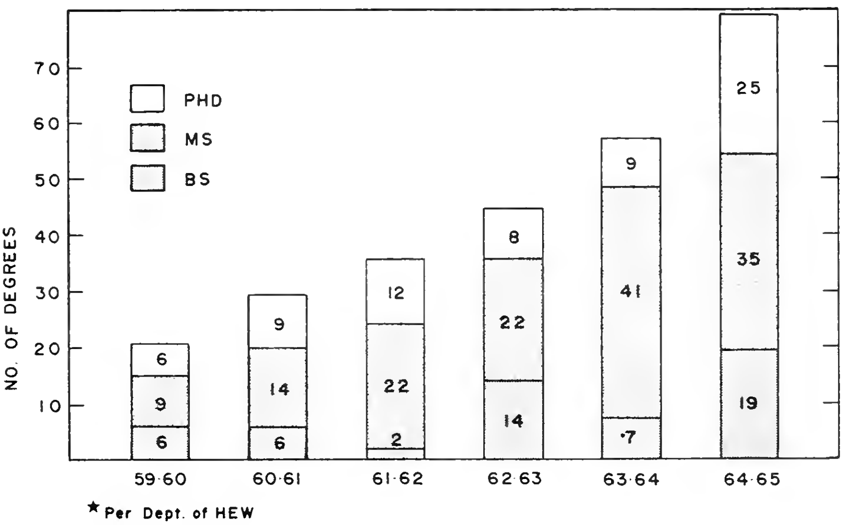

FIGURE 21.—*Degrees granted in oceanography, 1960–65* [1]

[1] Source: Department of Health, Education, and Welfare.

Scientific leadership should continue to come from the universities. As projects continue to grow in complexity and cost, a higher level of collaboration with industry and Government is likely. More joint ventures may be expected, with additional consideration of accommodating scientists from universities not having major facilities of their own.

Another type of joint venture in which commercial ships serve as platforms of opportunity for research has been found to serve the interests of marine science successfully, economically, and without interference with the primary commercial missions.

Chapter XIII

LOOKING AHEAD

Marine science affairs—the subject of this report—is a term intended to portray the body of oceanic activities that link science and society. Many of these relationships are old, dating to man's earliest efforts to extract fish and salt from the sea, and to his earliest explorations of our planet. But many of the relationships between science and society are new and still not fully understood.

The development of understanding has begun, however, a development that can lead us to our objective: the formulation of public policies and purposes which will stimulate and guide the many separate ocean activities and relate them directly to major goals of society.

The major challenges which lie ahead of this Nation do not terminate at the water's edge. Neither do the solutions.

As the world population grows faster than its food supply, the sea may provide nutrition. As the world demand for energy and minerals grows faster than the population, resources in and under the sea will be needed. As coastal cities become more crowded, the quality of urban living may be enhanced by preserving the natural heritage of our shoreline.

Two of the programs discussed earlier may serve to illustrate this relationship to social goals. One is the program for exploiting the food resources of the sea and the other is weather forecasting.

The food resources program relates directly and immediately to one of the most urgent of current world problems: the problem of protein malnutrition. Technological progress with the food resources program will lead to economic and social gains in protein production, gains which will have profound world significance. Half the world's population suffers from some form of protein deficiency. If ocean fishing methods are improved—through advances in fisheries technology and the exportation of that technology to needy nations—a sharp increase in fish protein production could begin to eradicate protein deficiency among the present world population.

Weather forecasting—another field which relates directly to society—is a field whose advancement depends upon man's increased understanding of the oceans. In the system of heat energy coming to the earth from the sun, the ocean is the great regulator of weather and climate. A network of deep-water buoys, stationed throughout the oceans as meteorological and oceanographic observation stations, in conjunction with adequate global atmospheric data obtained from radiosondes, satellites and balloons, could transmit data to computers ashore for analysis and prediction. When coupled to high-speed computers, this monitoring system could enable us to improve the accuracy and time scale of weather forecasts, extending our forecasting capabilities to more than a week ahead, a capability which will be important to various fields of human endeavor—agriculture, shipping, travel, health, recreation—indeed, any activity which is affected by weather.

As we extend our understanding of the oceans, this new knowledge will enable us to determine new technological resources which must be developed to bring us closer to our goals. We will learn, too, with this extended understanding, the appropriate role of the Federal Government, the interactions of Federal, State, and local interests, and international cooperation in accomplishing these important tasks.

As use of the seas and Great Lakes expands, immediate steps to promote international cooperation as well as mitigate conflict and debilitating rivalry will be needed. Oceans can tie the nations of the world together more than they separate them geographically. The sciences of and access to the oceans are universal. Now all nations must increase their energies to promote the peaceful and cooperative use of the oceans, so that the ocean's bounty may serve the needs of mankind.

The time is ripe to apply our knowledge of the sea. To be sure, there is much that we still do not know—this will always be true—but we know more of the sea than our actions toward exploitation might suggest. The technology is ready—new structural materials, miniaturized electronics, computers, nuclear power, underwater vehicles. These tools await utilization.

At the same time, we must continue to nourish the source of this technology—the sciences from which marine technology derives. The sciences of the sea are still very young and their potential for mankind still untapped. Before man can enjoy the benefits of these unexplored domains, a body of science must be enlarged from which marine technology can draw new tools and new clues of fruitful exploration.

A responsibility of the Federal Government in this important undertaking is the development of marine science policies which both foster and respond to society's dependence on the oceans. But the rational evolution of such policies cannot come through Federal actions alone, for this evolution requires a creative partnership among Federal, State, and local governments, as well as the academic and industrial communities.

A start has been made by the Marine Sciences Council, in relating marine activities to broad goals, in selecting areas for special emphasis, and in strengthening interagency programs. In the months to come, the independent analysis of marine science policies, being conducted now by the Commission on Marine Science, Engineering, and Resources will complement the Federal Government's own studies.

The President's budget proposals for fiscal year 1968 and his activating the Marine Sciences Council respond to the legislative mandate of 1966. Both are responses to observations of the President's Science Advisory Committee that important Federal functions had received inadequate attention in the past: that there was need at a central point in Government for the formulation of national marine science policies which would foster exploration, development, and use of the oceans. The Marine Sciences Council, being composed of the most senior Federal officials who have departmental responsibilities in marine sciences and who report individually, and through the Council collectively, to the President, serves as a vehicle for imparting direction and momentum to the collective national effort.

With congressional approval of the President's budget proposals which are reflected in this report, the Council will have a major responsibilty to be sure that these steps return dividends and that they serve as building blocks in a strengthened marine sciences program.

Looking ahead, forward planning on a Government-wide basis will complement our shorter term initiatives, especially to encourage an influx of fresh ideas and provide policy officials with a greater awareness of the impact of new options afforded by the marine environment.

Long-range perspectives will then reflect (*a*) future commitments for funds that arise from current decisions; (*b*) the time interval necessary for training of manpower and development of scientific resources; (*c*) the long time framework associated with interactions beween various economic, cultural, and political institutions, and (*d*) the longer term impact of man's actions on his environment, so as to anticipate and moderate detrimental effects.

During the coming months the Marine Sciences Council will give special attention to a selected number of policy areas:

—Identification of the goals of the Nation and of society and the capacity of marine sciences to accelerate progress toward these goals;

—The potential contribution of marine science and technology to world order and peace;

—The role of the Federal Government along the shoreline and in the oceans, and methods of cooperation between the Federal Government and States, regions, universities, and private industry;

—The administrative, legal, and technological framework for encouraging the rational exploitation of the resources of the sea;

—Further strengthening of the healthy base of scientific research which characterizes our marine science programs;

—Consideration of the optimum Federal organization for developing and implementing marine science policies and programs, including analysis of the recommendations of the Commission on Marine Science, Engineering, and Resources concerning the Federal structure being developed independently for the President and the Congress.

This year, Congress has not been asked to enact new marine science legislation. The many instruments already provided allow us to move forward in meeting many of the urgent problems of our times.

In marine science affairs, this year marks an opportunity to develop policies to blend political, economic, and cultural interests that comprise our democratic society. The task of studying how our Nation may build on our technology and our heritage is truly a monumental and magnificent opportunity. This report suggests fruitful areas for intensified effort by all members of the marine science community.

Part Two

TABLE OF CONTENTS

A. GOVERNMENT PROGRAM, FISCAL YEAR 1968

Section A

TABLE I: Total Federal program by major purpose and organization

Summary by major purpose

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
International cooperation and collaboration	5.1	7.1	7.4
National security	125.4	179.7	191.6
Fisheries development and seafood technology	38.7	51.5	49.2
Transportation	10.4	19.2	27.8
Marine pollution abatement and control	8.4	8.5	9.5
Health	5.1	6.6	4.2
Minerals, chemicals, water, and energy resources	3.8	5.4	5.8
Recreation	10.3	11.5	13.6
Shore stabilization and protection	1.2	1.5	1.7
Multipurpose activities:			
Oceanographic research [1]	[2] 71.6	55.0	73.2
Education	2.2	3.3	5.5
General purpose ocean environmental observation and prediction services [3]	13.7	15.6	21.1
Mapping, charting, and geodesy	32.3	33.7	39.1
General purpose nuclear power engineering development	3.5	8.7	10.5
National data centers	1.7	1.8	2.1
Total	333.4	409.1	462.3

[1] Research beneficial to more than 1 of the headings above.
[2] Includes Project Mohole.
[3] Activities supporting more than 1 of the major purpose categories.

Detail of major purpose by organization

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
1. International cooperation and collaboration	5.1	7.1	7.4
(a) State Department	5.0	5.1	5.4
(1) Contributions to international organizations for marine science program activities	2.8	2.9	2.9
(2) International fisheries commissions (U.S. share)	2.2	2.2	2.5
(b) Agency for International Development:			
(1) Marine food resources for developing nations	.1	2.0	2.0
2. National security	125.4	179.7	191.6
(a) Department of Defense:			
(1) Problem oriented surveys for defense systems	6.5	6.2	8.7
(2) Marine science and technology in support of specific defense systems	11.4	12.2	12.3
(3) Undersea search, rescue, recovery, and man-in-the-sea	16.4	34.1	45.0
(4) Deep ocean technology	1.5	1.3	5.5
(5) Navy Instrumentation Center	2.0	2.0	2.0
(6) Capital investment for ship construction	12.7	13.5	[1] 0
(7) Marine science in support of "safeguards" for the Limited Nuclear Test Ban Treaty of 1963	2.0	1.8	1.7
(8) Classified military oceanography program	72.9	108.6	116.4
3. Fishery development and seafood technology	38.7	51.5	49.2
(a) Department of the Interior:			
(1) Fishery resources assessment, development, and management	23.2	26.1	24.8
(2) Technical and economic assistance to commercial fishing industry	15.0	24.8	22.3
(3) Fish protein concentrate	.5	.6	2.1
4. Transportation	10.4	19.2	27.8
(a) Department of Defense:			
(1) Channel and harbor development and protection	1.9	2.5	2.7
(b) Department of Commerce	5.5	11.9	8.5
(1) Reduction of shipbuilding costs	.3	.8	1.0
(2) Reduction of ship-operating costs	.8	3.6	2.5
(3) Reduction of port costs	0	.3	.6
(4) Advanced ships and systems	3.9	6.7	3.5
(5) Ship design	.5	.5	.9
(c) Department of Transportation	3.0	4.8	16.6
(1) Search and rescue	.8	1.4	.7
(2) Aids to navigation	1.4	1.6	1.8
(3) Merchant marine safety	.3	.2	.3
(4) Ice breaking	0	1.0	1.5
(5) International ice patrol	.5	.6	.3
(6) Capital investment for ship construction	0	0	12.0

[1] 2 AGOR's in classified program.

Detail of major purpose by organization—Continued

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
5. Marine pollution abatement and control	8.4	8.5	9.5
(*a*) Department of Defense:			
(1) Pollution and flushing of bays, estuaries, and the Great Lakes	.1	.1	.1
(*b*) Department of the Interior:			
(1) Water quality enhancement	4.5	4.2	5.0
(*c*) Atomic Energy Commission:			
(1) Environmental research	3.8	4.2	4.4
6. Health	5.1	6.6	4.2
(*a*) Department of Health, Education, and Welfare:			
(1) Nutritional and health aspects of marine foods	1.6	1.7	1.7
(2) Marine toxins and pharmaceuticals	.7	.7	.6
(3) Use of marine life in biomedical research	2.0	1.3	1.0
(4) Health problems related to marine pollution	.7	.8	.9
(5) Capital investment	.1	2.1	0
7. Minerals, chemicals, water, and energy resources	3.8	5.4	5.8
(*a*) Department of the Interior:			
(1) Geologic investigations and resource appraisal	1.0	2.1	2.6
(2) Mining research	.5	1.4	1.4
(3) Marine sources and interrelationships for supply of fresh water	1.7	1.1	1.0
(4) Leasing and management of mineral resources	.6	.8	.8
8. Recreation	10.3	11.5	13.6
(*a*) Department of Defense:			
(1) Recreation beaches and small craft harbors	.9	1.2	1.4
(*b*) Department of the Interior	9.1	9.7	11.9
(1) Acquisition of marine based recreational areas	2.4	2.5	3.6
(2) Development of marine areas for recreation	3.8	4.0	3.9
(3) Conservation of marine locales, gamefish, and wildlife	2.9	3.2	4.4
(*c*) Department of Transportation:			
(1) Search and rescue	.3	.6	.3
9. Shore stabilization and protection	1.2	1.5	1.7
(*a*) Department of Defense:			
(1) Beach erosion control and hurricane storm surge protection	1.2	1.5	1.7
10. Multigoal activities	125.0	118.1	151.5
Oceanographic research [2]	71.6	55.0	73.2
(*a*) Department of Defense	19.3	20.8	25.3
(*b*) Department of Commerce	3.5	4.7	8.9
(*c*) National Science Foundation	[3] 46.7	27.1	36.5
(*d*) Department of Transportation	1.1	1.1	1.1
(*e*) Smithsonian Institution	1.1	1.3	1.4

[2] Research beneficial to more than 1 of the headings above.
[3] Includes Project Mohole.

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Detail of major purpose by organization—Continued

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
10. Multigoal activities—Continued			
Education	2.2	3.3	5.5
(a) Department of Defense	.5	.8	1.1
(b) Department of Commerce	.1	.1	.1
(c) Department of the Interior	.2	.2	.2
(d) National Science Foundation	1.0	1.7	3.4
(e) Department of Health, Education, and Welfare	.3	.4	.6
(f) Department of Transportation	.1	.1	.1
General purpose ocean environmental observation and prediction services [4]	13.7	15.6	21.1
(a) Department of Defense	7.2	9.6	11.0
(b) Department of Commerce	1.0	.6	2.1
(c) Atomic Energy Commission	1.0	.8	.9
(d) Department of Transportation	3.6	4.2	6.4
(e) National Aeronautics and Space Administration	.9	.4	.8
Mapping, charting, and geodesy	32.3	33.7	39.1
(a) Department of Defense	17.6	18.8	22.9
(b) Department of Commerce	14.7	14.9	16.2
General purpose nuclear power engineering development:			
(a) Atomic Energy Commission	3.5	8.7	10.5
National data centers	1.7	1.8	2.1
(a) National Oceanographic Data Center	1.2	1.4	1.6
(b) Smithsonian Oceanographic Sorting Center	.4	.3	.4
(c) Great Lakes Data Center	.1	.1	.1

[4] Activities supporting more than 1 of the major purpose categories.

TABLE II.—*Total Federal program by department and independent agency summaries*

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Department of Defense	174.9	235.8	258.7
Department of Commerce	25.0	32.5	36.0
Department of the Interior	56.5	71.2	72.3
National Science Foundation	[1] 47.7	29.0	40.1
Atomic Energy Commission	8.3	13.7	15.8
Department of Health, Education, and Welfare	5.4	7.0	4.8
Department of Transportation	8.1	10.8	24.6
Smithsonian Institution	1.5	1.6	1.8
State Department	5.0	5.1	5.4
Agency for International Development	.1	2.0	2.0
National Aeronautics and Space Administration	.9	.4	.8
Total	333.4	409.1	462.3

[1] Includes Project Mohole, discontinued in fiscal year 1967.

TABLE III.—*Total Federal program by function and agency*

Summary by function

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
1. Research and development	194.7	224.6	262.7
(a) Research (basic and applied)	122.3	121.5	138.1
(b) Development of new equipment and technology	72.4	103.1	124.6
2. Investment	46.8	66.8	72.0
(a) Ships	29.4	35.7	28.8
(b) Major equipment	9.1	16.3	30.7
(c) Shore facilities	4.8	9.5	6.2
(d) Other	3.5	5.3	6.3
3. Operations	91.9	117.7	127.6
(a) Surveys	68.9	89.2	100.6
(b) Services	20.1	25.1	23.1
(c) Other operations	2.9	3.4	3.9
Total	333.4	409.1	462.3

Detail by function and agency

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
RESEARCH AND DEVELOPMENT			
Total	194.7	224.6	262.7
1. Department of Defense	89.0	112.9	136.2
(a) Department of the Navy	81.7	104.5	127.5
(1) Research	24.9	25.5	30.0
(Research ship operating costs)	(4.3)	(5.4)	(8.4)
(2) Development of new equipment and technology	56.8	79.0	97.5
(Ship operating costs)	(4.2)	(5.3)	(6.0)
(b) Department of the Army	5.1	6.4	6.8
(1) Research	2.5	3.1	3.4
(2) Development of new equipment and technology	2.6	3.3	3.4
(c) Advanced Research Projects Agency	2.2	2.0	1.9
(1) Research	1.4	1.2	1.3
(2) Development of new equipment and technology	.8	.8	.6
2. Department of Commerce	9.6	17.4	18.0
(a) Environmental Science Services Administration	4.1	5.5	9.5
(1) Research	3.6	5.1	9.0
(Research ship operating costs)	(2.5)	(3.1)	(4.1)
(2) Development of new equipment and technology	.5	.4	.4
(b) Maritime Administration	5.5	11.9	8.5
(1) Research	5.0	11.4	7.6
(2) Development of new equipment and technology	.5	.5	.9
3. Department of the Interior	26.5	36.6	38.3
(a) Bureau of Commercial Fisheries	18.8	27.4	26.8
(1) Research	17.2	25.6	24.5
(Research ship operating costs)	(1.9)	(2.2)	(2.8)
(2) Development of new equipment and technology	1.6	1.8	2.3
(b) Geological Survey	1.4	2.1	2.4
(1) Research	.8	1.0	1.3
(2) Development of new equipment and technology	.6	1.1	1.1

See footnotes at end of table.

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
RESEARCH AND DEVELOPMENT—continued			
3. Department of the Interior—Continued			
(*c*) Office of Saline Water	1.0	.5	.6
(1) Research	.6	.2	.2
(2) Development of new equipment and technology	.4	.3	.4
(*d*) Bureau of Sport Fisheries and Wildlife	2.9	3.1	4.1
(1) Research	1.1	1.4	1.6
(2) Development of new equipment and technology	1.8	1.7	2.5
(*e*) Bureau of Mines	.4	.8	1.0
(1) Research	.1	.3	.4
(Research ship operating costs)	(.05)	(.15)	(.3)
(2) Development of new equipment and technology	.3	.5	.6
(*f*) Federal Water Pollution Control Administration:			
(1) Research	1.5	2.0	2.6
(*g*) Bureau of Outdoor Recreation:			
(1) Research	.1	.2	.2
(*h*) National Park Service:			
(1) Research	.4	.5	.6
4. National Science Foundation:			
(1) Research	[1] 44.8	25.8	36.2
(Research ship operating costs)	(9.1)	(8.3)	(10.7)
5. Atomic Energy Commission	8.3	13.7	15.8
(1) Research	4.9	5.1	5.5
(Research ship operating costs)	(.3)	(.3)	(.3)
(2) Development of new equipment and technology	3.4	8.6	10.3
6. Department of Health, Education, and Welfare	5.2	4.8	4.7
(*a*) U.S. Public Health Service	4.8	4.2	4.0
(1) Research	4.4	3.8	3.6
(2) Development of new equipment and technology	.4	.4	.4
(*b*) Food and Drug Administration:			
(1) Research	.2	.3	.3
(*c*) Office of Education:			
(1) Research	.2	.3	.4
7. Department of Transportation:			
(*a*) U.S. Coast Guard	4.3	6.6	5.9
(1) Research	1.6	1.9	1.7
(Research ship operating costs)	(1.2)	(1.2)	(1.2)
(2) Development of new equipment and technology	2.7	4.7	4.2

See footnotes at end of table.

Detail by function and agency—Continued

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
RESEARCH AND DEVELOPMENT—continued			
8. Smithsonian Institution:			
(1) Research	1.1	1.3	1.4
9. State Department:			
(1) Research	5.0	5.1	5.4
10. National Aeronautics and Space Administration:			
(1) Research	.9	.4	.8
INVESTMENT			
Total	46.8	66.8	72.0
1. Department of Defense	33.3	50.8	43.8
(a) Department of the Navy	33.3	50.8	43.6
(1) Ships (new construction of surface ships)	26.2	33.7	16.6
(2) Major equipment	7.1	14.1	26.9
(3) Shore facilities	0	3.0	.1
(b) Department of the Army:			
(1) Shore facilities	0	0	.2
2. Department of Commerce:			
(a) Environmental Science Services Administration	3.0	2.2	1.9
(1) Ships	1.7	1.5	0
(2) Shore facilities	.7	0	.6
(3) Major equipment	.6	.7	1.3
3. Department of the Interior	6.8	6.6	7.4
(a) Bureau of Commercial Fisheries	2.4	1.6	1.9
(1) Ships	.7	0	0
(2) Shore facilities	1.3	1.2	1.4
(3) Major equipment	.4	.4	.5
(b) Geological Survey	.3	.7	.7
(1) Shore facilities	(2) 0	.1	.1
(2) Major equipment	.3	.6	.6
(c) Bureau of Sport Fisheries and Wildlife:			
(1) Other	3.4	3.3	4.3
(d) Bureau of Mines	.1	.7	.4
(1) Ships	.1	.5	.2
(2) Shore facilities	0	.1	.1
(3) Major equipment	0	.1	.1
(e) Federal Water Pollution Control Administration	.6	.3	.1
(1) Ships	.2	0	0
(2) Shore facilities	.4	0	0
(3) Major equipment	0	.3	.1

See footnotes at end of table.

Detail by function and agency—Continued

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
INVESTMENT—continued			
4. National Science Foundation	2.8	3.0	3.7
(1) Ships	.5	0	0
(2) Shore facilities	2.3	3.0	3.7
5. Department of Health, Education, and Welfare:			
(*a*) U.S. Public Health Service:			
(1) Shore facilities	.1	2.1	0
6. Department of Transportation:			
(*a*) U.S. Coast Guard	.7	.1	13.2
(1) Ships	0	0	12.0
(2) Major equipment	.7	.1	1.2
7. Agency for International Development:			
(1) Other	.1	2.0	2.0
OPERATIONS			
Total	91.9	117.7	127.6
1. Department of Defense	52.6	72.1	78.7
(*a*) Department of the Navy	52.5	72.0	78.5
(1) Surveys	49.2	68.3	74.5
(Survey ship operating costs)	(7.5)	(7.2)	(8.6)
(2) Services	2.8	2.9	2.9
(3) Other	.5	.8	1.1
(*b*) Department of the Army:			
(1) Services	.1	.1	.2
2. Department of Commerce:			
(*a*) Environmental Science Services Administration	12.4	12.9	16.1
(1) Surveys	12.2	12.6	15.8
(Survey ship operating costs)	(4.7)	(5.1)	(6.4)
(2) Services	.2	.3	.3
3. Department of the Interior	23.2	28.0	26.6
(*a*) Bureau of Commercial Fisheries	17.9	22.9	20.9
(1) Surveys	2.0	2.3	2.6
(Survey ship operating costs)	(.6)	(.9)	(1.1)
(2) Services	15.9	20.6	18.3
(Service ship operating costs)	(.3)	(.3)	(.3)
(*b*) Geological Survey:			
(1) Services	.5	.6	.6
(*c*) Bureau of Sport Fisheries and Wildlife:			
(1) Other	2.4	2.6	2.8
(*d*) Federal Water Pollution Control Administration:			
(1) Surveys	2.3	1.8	2.2

See footnotes at end of table.

Detail by function and agency—Continued

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
OPERATIONS—continued			
3. Department of the Interior—Continued			
(*e*) Bureau of Land Management:			
(1) Services	.1	.1	.1
4. National Science Foundation:			
(1) Services	.1	.2	.2
5. Atomic Energy Commission:			
(1) Services	[2]	[2]	[2]
6. Department of Health, Education, and Welfare:			
(*a*) U.S. Public Health Service	.1	.1	.1
(1) Surveys	.1	.1	.1
(2) Services	[2]	[2]	[2]
7. Department of Transportation:			
(*a*) U.S. Coast Guard	3.1	4.1	5.5
(1) Surveys	3.1	4.1	5.4
(Survey ship operating costs)	(2.5)	(3.1)	(4.3)
(2) Services	[2]	[2]	.1
8. Smithsonian Institution:			
(1) Services	.4	.3	.4

[1] Includes Project Mohole.

[2] Less than $50,000.

TABLE IV.—*Special analyses: Continental Shelf; Great Lakes; estuaries*

CONTINENTAL SHELF

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Smithsonian Institution	0.1	0.1	0.1
Department of Commerce	13.0	15.8	18.6
Atomic Energy Commission	1.9	2.0	2.0
Department of Transportation	.2	.5	.5
National Science Foundation	.6	.6	.7
Department of the Interior	26.3	35.5	34.7
1. Bureau of Commercial Fisheries	(21.9)	(29.0)	(27.8)
2. Geological Survey	(1.6)	(2.7)	(3.1)
3. Bureau of Sport Fisheries and Wildlife	(1.8)	(2.0)	(2.1)
4. Bureau of Mines	(.2)	(1.2)	(1.2)
5. Bureau of Outdoor Recreation	(.1)	(.3)	(.2)
6. Bureau of Land Management	(.1)	(.1)	(.1)
7. Office of Saline Water	(.6)	(.2)	(.2)
Department of Defense	9.9	11.8	13.8
1. Department of the Army	(1.3)	(2.4)	(2.7)
2. Department of the Navy	(8.6)	(9.4)	(11.1)
Total	52.0	66.3	70.4

GREAT LAKES

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Department of Commerce	0	0	(2)
Department of Transportation	.2	.2	.2
State Department	1.1	1.1	1.1
National Science Foundation	.1	.2	.2
Department of the Interior	3.4	3.5	2.6
1. Bureau of Commercial Fisheries	(1.3)	(1.4)	(1.2)
2. Geological Survey	(.1)	(.2)	(.1)
2. Bureau of Sport Fisheries and Wildlife	(.3)	(.3)	(.3)
4. Federal Water Pollution Control Administration	(1.7)	(1.5)	(1.0)
5. Bureau of Outdoor Recreation	(0)	(.1)	(0)
Department of Defense	2.2	2.4	2.8
1. Department of the Army	(2.1)	(2.3)	(2.6)
2. Department of the Navy	(.1)	(.1)	(.2)
Total	7.0	7.4	7.0

[2] Less than $50,000.

TABLE IV.—*Special analyses: Continental Shelf; Great Lakes; estuaries*—Con.

ESTUARY PROJECTS

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Smithsonian Institution	(2)	(2)	(2)
Department of Commerce	1.0	(2)	(2)
Atomic Energy Commission	.1	.2	.2
National Science Foundation	.5	.6	.7
Department of Health, Education, and Welfare	[1] 1.5	[1] 3.5	1.4
Department of the Interior	19.4	23.4	24.9
1. Bureau of Commercial Fisheries	(8.9)	(11.8)	(11.2)
2. Geological Survey	(.5)	(.5)	(.5)
3. Bureau of Sport Fisheries and Wildlife	(6.9)	(7.1)	(9.0)
4. Federal Water Pollution Control Administration	(2.8)	(3.8)	(4.0)
5. Office of Saline Water	(.3)	(.2)	(.2)
Department of Defense	3.0	3.2	3.5
1. Department of the Army	(1.8)	(1.8)	(2.0)
2. Department of the Navy	(1.2)	(1.4)	(1.5)
Total	25.5	31.0	30.8

[1] Construction accounts for $11 in fiscal year 1966 and $2.1 in fiscal year 1967.
[2] Less than $50,000.

TABLE V.—*Excess foreign currency programs*

EXCESS FOREIGN CURRENCY PROGRAMS

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
1. Fishery development and seafood technology:			
(a) Department of the Interior:			
(1) Fishery resources assessment, development, and management	0.3	0.5	0.1
2. Multigoal activities:			
Oceanographic research:			
(a) Department of Commerce (Environmental Science Services Administration):			
(1) Storm surge studies	(1)	(1)	(1)
(2) Physical oceanography			(1)
(b) Smithsonian Institution:			
(1) Specimen research	0	.2	1.3
Data centers:			
(a) Smithsonian Institution:			
(1) Service operations	0	.2	.5

[1] Less than $50,000.

Section B

Table I.—*A selected list of oceanographic research ships, United States and foreign*

NAVY SURVEY/RESEARCH SHIPS [1]

Name	Displacement	Crew	Scientists	Age	Mission
Tanner class:					
Tanner	6,500	330	8	1944	Precise coastal surveys.
Maury				1943	
San Pablo class:					
San Pablo	2,600	174	8	1942	Deep-water oceanographic and hydrographic data.
Rehoboth.					
Bowditch class:					
Bowditch	13,000	80	15	1944	Deep ocean surveys for special requirements.
Dutton.					
Michelson.					
Requisite class:					
Towhee	1,250	82	2	1941	Nearshore, shallow- and medium-depth hydrographic and oceanographic work.
Sheldrake.					
Serrano class:					
Serrano	1,235	82	2	1943	
Littlehales	600	19	1	1945	(N) Coastal oceanography for military requirements.
Mizar (AGOR-11)	3,000	39	12	1964	Basic and applied oceanography for military requirements.
Archerfish (submarine)	2,220	55	4	1943	Oceanographic surveys.
Gillis class (AGOR)					Basic and applied oceanography.
Gillis	1,320	26	15	1963	
Conrad				1963	
Davis				1963	
Sands				1964	
Lynch				1965	
Thompson				1965	
Washington				1965	
Desteiguer				1967	
Bartlett				1967	
New design AGOR:					
AGOR	2,000	25	25	1968	
AGOR				1968	
Argo	2,079	40	24	1944	Basic oceanographic research.
Chain	2,100	29	23	1944	Do.
Gibbs (AGORI)	2,800	48	24	1944	Do.
Oconostota	206	10	4	1944	Do.
Mission Capistrano	10,460	57	15	1944	Underwater Acoustics Branch.
Kellar class:					
Kellar (small AGS)	1,350	26	15	1966	Same as *Requisite* class.
Silas Bent class (medium AGS):					
Silas Bent	2,550	41	34	1965	Same as *San Pablo* class.
Kane				1966	

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION SHIPS

[Scientists include technical complement]

Name	Displacement	Crew	Scientists	Age	Mission
Class I:					
Surveyor	3,150	40	66	1960	Complex oceanographic capability.
Oceanographer	3,805	42	64	1966	Do.
Discoverer	3,805	42	64	1966	Do.
Not named	2,900	34	42	1968	Do.

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION SHIPS—Continued

Name	Displacement	Crew	Scientists	Age	Mission
Class II:					
Explorer	1,900	39	56	1940	Hydrography and limited oceanography.
Pathfinder	2,000	39	56	1942	Do.
Mount Mitchell	1,794	36	40	1967	Do.
Fairweather	1,794	36	40	1967	Do.
Rainier	1,794	36	40	1967	Do.
Class III:					
Pierce	760	25	11	1963	Do.
Whiting	760	25	11	1963	Do.
Hydrographer	1,106	35	29	1930	Do.
Bowie	267	23	5	1943	Do.
Hodgson	289	23	6	1943	Do.
Davidson	890	25	11	1967	Do.
McArthur	890	25	11	1967	Do.
Class IV:					
Patton	150	14	1	1941	Do.
Lester Jones	150	14	1	1944	Do.
Marmer	220	15	2	1932	Do.
Rude	173	7	3	1966	Wire drag boat for harbor and waterway obstruction surveys.
Heck	173	7	3	1966	Do.

U.S. COAST GUARD SHIPS

Name	Displacement	Crew	Scientists	Age	Mission
"Secretary" class (ocean station vessels):					
Ingham	2,827	125	3	1937	Ocean station vessels equipped with oceanographic winches and laboratory space.
Spencer.					
Campbell.					
Taney.					
Bibb.					
Duane.					
Hamilton.	3,050	138	6	1966	
Seaplane tender class (ocean station vessels):					
Casco	2,800	125	3	1943	Do.
Yakutat.					
Humboldt.					
Cook Inlet.					
Castle Rock.					
Barataria.					
Gresham.					
Bering Strait.					
Chincoteague.					
Absecon.					
Half Moon.					
McCullough.					
"Lake" class (ocean station vessels):					
Sebago	1,913	125	3	1944	Do.
Mendota.					
Escanaba.					
Minnetonka.					
Ponchartrain.					
Androscoggin.					
Chautauqua.					

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

U.S. COAST GUARD SHIPS—Continued

Name	Displacement	Crew	Scientists	Age	Mission
"Lake" class (ocean station vessels)—Continued					
Klamath.					
Wachusett.					
Winnebago.					
Winona.					
Owasco.					
Oceanographic vessels:					
Evergreen	1,000	48	6	1943	Buoy tender with oceanographic capability.
Rockaway	2,800	110	13	1943	Former seaplane tender.
Icebreakers:					
Eastwind	6,500	234	10	1945	Icebreaker with oceanographic capability.
Northwind.					
Westwind.					
Edisto.					
Southwind.					
Staten Island.					
Burton Island.					
Glacier	8,300	240	10	1955	Do.

NATIONAL SCIENCE FOUNDATION SHIPS

Name	Displacement	Crew	Scientists	Age	Mission
Eltanin (AGOR-9)	3,800	47	38	1957	Oceanographic research.
Anton Bruun	1,700	32	24	1930	To be deactivated in fiscal year 1967
Antarctic Trawler	600	10	6	1968	Oceanographic research.
Atlantis II [2]				1962	Do.
Pillsbury [3]				1943	Do.
Alaminos [4]				1944	Do.
Yaquina [5]				1944	Do.
Eastward [6]				1965	Do.
Maury [7]				1967	Do.
Te Vega [8]				1930	Do.
Inland Seas [9]				1944	Do.
Alpha Helix [10]				1965	Do.
Territu [11]				1954	Do.

Footnotes at end of table.

BUREAU OF COMMERCIAL FISHERIES SHIPS

Name	Displacement	Crew	Scientists	Age	Mission
Albatross IV	1,088	19	12	1963	Fishery oceanography.
Black Douglas [12]	371	11	5	1926	Do.
Charles H. Gilbert	383	11	5	1952	Do.
David Starr Jordan	846	22	13	1965	Do.
George B. Kelez	936	12	6	1944	Do.
Geronimo	760	15	8	1944	Do.
John R. Manning	147	7	2	1950	Fishery oceanography and patrol work.
Miller Freeman	1,200	20	9	1967	Fishery oceanography.
Murre II	250	4	5	1943	Do.
Townsend Cromwell	652	13	7	1963	Do.
Undaunted	760	15	12	1944	Do.
George M. Bowers	120	4	6	1955	Fishing gear research.

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

BUREAU OF COMMERCIAL FISHERIES SHIPS—Continued

Name	Displacement	Crew	Scientists	Age	Mission
Delaware	518	13	4	1937	Fishery exploration and gear research.
Delaware II	680	13	6	1968	Do.
John N. Cobb	250	7	4	1950	Do.
Oregon	410	10	5	1946	Do.
Oregon II	906	14	10	1967	Do.
Pribilof	1,893	19	--------	1954	Cargo ship serving the Pribilof Island seal management program.
BUREAU OF MINES SHIPS					
Grass Valley	500	12	20	1945	Marine mining.
Virginia City	1,235	20	20	1943	Do.
BUREAU OF SPORT FISHERIES AND WILDLIFE SHIPS					
Dolphin	400	9	7	1953	Marine game fish research.
PRIVATE INSTITUTIONS—SHIPS					
UNIVERSITY OF WASHINGTON					
Brown Bear	750	11	21	1934	Oceanographic research and student training.
Hoh	91	--------	8	1943	
Thompson (AGOR)[13]	---------	--------	--------	------	
SCRIPPS INSTITUTION OF OCEANOGRAPHY					
Agassiz	825	18	14	1944	Oceanographic research.
Argo	2,079	40	24	1944	
Horizon	900	18	14	1944	
Oconostota	206	10	4	1944	
Paolina-T	170	9	5	1944	
Washington (AGOR)[13]	---------	--------	--------	------	
Alpha Helix	512	22	--------	1965	Biological oceanography.
AGOR (new design)[13]	---------	--------	--------	1968	
OREGON STATE UNIVERSITY					
Yaquina [14]	820	18	14	1944	Oceanographic research.
TEXAS A. & M. COLLEGE					
Alaminos [14]	740	18	14	1944	Do.
UNIVERSITY OF MIAMI					
Gerda	135	3	5	1948	Do.
J. E. Pillsbury	935	--------	20	1943	Do.
UNIVERSITY OF ALASKA					
Acona	154	6	8	1961	Do.
HUDSON LABORATORY					
Josiah Gibbs	2,800	48	24	1944	Do.

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

PRIVATE INSTITUTIONS—SHIPS—Continued

Name	Displacement	Crew	Scientists	Age	Mission
LAMONT GEOLOGICAL OBSERVATORY					
Conrad (AGOR)[13]					Oceanographic research and student training.
Vema	734	19	17	1923	
NARRAGANSETT MARINE LABORATORY					
Trident	856	18	13	1944	Oceanographic research.
WOODS HOLE OCEANOGRAPHIC INSTITUTION					
Atlantis II	2,100	28	25	1962	Do.
Chain	2,100	29	23	1944	
Crawford	322	15	8	1927	
Gosnold	304			1943	
AGOR (new design)[13]				1968	
STANFORD UNIVERSITY					
Te Vega[14]	270	15	15	1930	Do.
NEW YORK UNIVERSITY					
Kyma	95			1952	Do.
UNIVERSITY OF MICHIGAN					
Inland Seas[14]				1944	Research, Great Lakes.
UNIVERSITY OF HAWAII					
Territu[14]				1954	Oceanographic research.
DUKE UNIVERSITY					
Eastward[14]	474	30		1965	Biological oceanography.
JOHNS HOPKINS UNIVERSITY					
Maury	40	3	4	1950	Oceanographic research.

[1] This inventory partially duplicates those ships listed under private institutions.
[2] Listed with Woods Hole Oceanographic Institution.
[3] Listed with University of Miami.
[4] Listed with Texas A. & M.
[5] Listed with Oregon State University.
[6] Listed with Duke University.
[7] Listed with Johns Hopkins University.
[8] Listed with Stanford University.
[9] Listed with University of Michigan.
[10] Listed with Scripps Institution of Oceanography.
[11] Listed with University of Hawaii.
[12] Declared surplus and transferred to General Services Administration in May 1966.
[13] Listed with Navy research ships.
[14] Also shown under National Science Foundation.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]

Name	Displacement	Crew	Scientists	Age
ARGENTINA				
Alferez Mackinlay	195	(2)	-	1914
Bahia Blanca	843	[3] 63	-	1928
Capitan Canepa	1,250	96	7	1940
Chiriguano	808	[3] 65	-	1945
General San Martin	4,854	170	38	1954
Madryn	843	[3] 63	-	1928
Sanaviron	808	51	6	1945
Santisima Trinidad	2,450	173	17	1944
Ushuaia	1,275	[3] 65	-	1939
AUSTRALIA				
Derwent Hunter	-	6	3	1946
Diama	-	-	-	-
Diamantina	1,490	140	8	1945
Gascoyne	2,185	130	6	1943
Lancelin	-	-	-	-
Peron	-	-	-	-
Tagula	-	-	-	-
Wareen	108	12	2	1938
BAHAMAS				
65-foot research vessel	-	-	-	-
Two 40-foot research vessels	-	-	-	-
BELGIUM				
Hinders	72	5	5	1944
West Hinder	419	9	2	1950
BERMUDA				
65-foot research vessel	-	-	-	-
CHINA (COMMUNIST)				
Ex-Chung Ning	200	-	-	-
Ex-Futing	160	-	-	-
CHINA (NATIONALIST)				
Chiao Shan	170	-	-	-
Ching Tien	535	-	-	1939
Yang Min	880	60	10	1943
CONGO				
Ombango	-	-	-	-
CUBA				
Yara	449	-	-	1895
(Unnamed)	-	-	-	-
DENMARK				
Biologen	-	-	-	-
Dana	-	21	5	1937
Erika Dan	2,647	[3] 85	-	1958
Freja	322	[3] 40	-	1938
Hejmdal	705	[3] 40	-	1935
Jens Voerer	-	9	2	1960
Nella Dan	3,675	35	42	1961
Ophelia	-	-	-	-

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
BRAZIL				
Almirante Saldanha	3,825	[3] 456	----	1934
Argus	300	----	----	1962
Canopus	1,463	[3] 102	----	1958
Emilia	----	----	----	----
Jose Bonifacio	1,300	[3] 152	----	1909
Orion	300	----	----	1962
Rio Formoso	----	----	----	----
Sirius	1,463	[3] 102	----	1958
Taurus	300	----	----	1962
(Unnamed)	700	16	20	1962
BULGARIA				
71-foot power vessel	----	----	----	----
CANADA				
A. T. Cameron	----	25	9	1958
Baffin	4,203	72	30	----
Beacon Hill	2,250	140	6	1944
Calanus	42	3	2	----
Ehkoli	154	17	6	----
Fort Frances	1,040	43	8	1944
Harengus	----	[3] 9	----	----
Investigator	110	9	2	----
Labrador	6,000	90	18	1954
New Liskeard	1,040	40	9	1944
Oshawa	1,040	43	8	1944
Port Dauphine	319	13	8	----
Sackville	1,177	31	7	1941
Ste. Catherines	1,368	43	2	1943
Stone Town	1,368	43	2	1944
Whitethroat	580	26	8	1944
CHILE				
Explorador	90	6	6	1962
Yelcho	1,732	87	12	1943
FEDERAL REPUBLIC OF GERMANY				
Attair	110	----	----	----
Anton Dohrn	1,000	29	17	1955
Frithjof	543	----	----	1920
Gauss	846	40	13	1941
Hooge	109	[3] 13	----	----
Meerkatze	673	[3] 24	----	1943
Neptun	----	6	5	1961
Poseidon	950	----	----	1957
Ruden	109	[3] 13	----	----
Rungholt	110	----	----	----
Suderoog	415	----	----	1956
Uthorn	68	4	8	1942
Wattenberg	----	----	----	----
Wega	110	----	----	----
78-foot research vessel	----	----	----	----
FINLAND				
Aranda	1,100	27	22	1953

See footnotes at end of table.

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TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
FRANCE				
Amaltha	850	30	13	1961
Amiral Mouchez	719	[3] 91	----	1937
Antedon	----	----	----	----
Calypso	360	12	10	1942
Duthiers	----	----	----	----
Estafette	500	----	----	1944
Ingenieur Hyd Nicolas	800	[3] 68	----	1944
Octant	800	[3] 50	----	1944
Origny	----	51	5	1956
Pluteus II	75	6	14	1953
Roselys	----	----	----	----
Sentinelle	500	----	----	1944
Thalassa	1,481	32	22	1960
45-foot research vessel	----	----	----	----
77-foot research vessel	----	----	----	----
GERMAN DEMOCRATIC REPUBLIC				
Gadus	----	----	----	----
Helmut Just	475	----	----	1952
Johann Kruger	475	----	----	1951
Robert Koch	1,520	[3] 44	----	1955
182-foot trawler	----	----	----	----
129-foot logger	----	----	----	----
GREECE				
Alkyoni	252	----	----	----
Ariadni	338	31	----	1942
Vegas	213	----	----	----
GREENLAND				
Jensen	----	----	----	----
HONG KONG				
Cape St. Mary	----	----	----	----
ICELAND				
169-foot research vessel	----	----	----	----
INDIA				
Bangada	60	[3] 9	----	----
Conch	32	6	7	1956
Kalava	----	----	----	----
Kistha	1,900	[3] 214	----	1943
Medusa	----	----	----	----
Mysis	----	----	----	----
Varuna	----	13	4	1961
INDONESIA				
Burdjamhal	1,200	[3] 90	----	1953
Samudera	541	27	6	1951
IRELAND				
Cu Feasa	----	8	4	1960
ISRAEL				
68-foot power vessel	----	----	----	----

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
ITALY				
Cavolini				
Daino	821		11	
F. Vercelli	50	5	2	
Gadro II				
Pinasse				
Rinaldo Dohrn				
Taffetta	1,020		15	1943
JAPAN				
Chofu Maru	458	23	15	1960
Hayabuju Maru				
Hojishi Maru		28	2	1960
Hokko Maru	220	[3] 27		1960
Hokusei Maru		21	22	1957
Kagoshima Maru	635	42	53	1960
Kaiyo	277	21	20	1942
Keiten Maru				
Koyo Maru	1,215	44	5	1958
Meiyo	630			
Nagasaki Maru				
Oshoro Maru	969	38	45	1927
Ryofu Maru	1,867	42	20	1937
Shinyo Maru	475	23	2	1937
Shiroyama				
Shoyo Maru	603	48	5	1956
Shunpu Maru	246	19	10	1954
Soya	2,736	94	34	
Soyo Maru	400	33	5	1955
Taisei Maru				
Takyuo	880			1957
Tenyo Maru		22	34	1949
Toko Maru		35	18	1954
Toyoshio Maru				
Umitaka Maru	2,100	51	13	1955
Wakataka Maru		14	4	1959
Yoko Maru				
Yushio Maru	143	20	8	1942
KOREA				
Buk Han San Ho				
Jin Yang Ho				
Mae Rim Ho				
MADAGASCAR				
Maran-Atha				
MEXICO				
32-foot power vessel				
MONACO				
Winaretta-Singer				
MOROCCO				
El Morchid	138	10	3	1956

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
NETHERLANDS				
Cirrus	1, 930	44	19	1943
Cumulus	1, 819	44	19	1943
Dreg I	46	[3] 10		1950
Dreg II	46	[3] 10		1950
Dreg III	46	[3] 10		1951
Dreg IV	46	[3] 10		1951
Hydrograaf	260	[3] 19		1910
Luymes	1, 100	[3] 108		1952
Max Weber				
Snellius	1, 100	[3] 108		1952
Willem Beukelsz	205	12	6	1956
Zeefakkel	355	[3] 29		1951
NEW CALEDONIA				
Orsom III				
NEW ZEALAND				
Ikatere				
Lachlan	1, 490	140	8	1944
Taranui				
Viti	670	17	6	1940
NORWAY				
Asterias	61	[3] 4		
Fridtjof Nansen	58	[3] 3		
G. M. Dannevig	56	4	2	1949
G. O. Sars	950	38	10	1950
Gunnar Knudsen	50	1	4	1946
Helland-Hansen	186	8	7	1957
Johan-Hjort	1, 030	38	10	1958
Peder-Ronnestad	172	8	4	1958
Sverdrup	400	9	10	1962
PAKISTAN				
Macchera		12	1	
Madagar	1, 682	100	2	
New Hope		[3] 5		
Zulfiquar	1, 611	160	3	1940
PERU				
145-foot research vessel				
PHILIPPINES				
Sequoia	1, 057			
POLAND				
Baltyk	1, 000			1955
Hydrograf I	82			1958
Imor	140			1958
Kompas	140	[3] 30		1935
Kontroller I	82			1958
Koziorozec	219	[3] 15		1950
Michael Siedlecki II				
Zodiac	140	[3] 30		1935

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
PORTUGAL				
Almirante Lacerda	672			1941
Azevia	200	[3] 25		1942
Baldaque de Silva				
Bicuda	200	[3] 25		1942
Carvalho Arauso	1,020	90		1942
Comandante Carvalho	672			1941
Corvina	200	[3] 25		1942
Dourada	200	[3] 25		1942
Espadilha	200	[3] 25		1942
SENEGAL				
Gerard Treca				
SPAIN				
H 2	256			
H 3	256			
Juan de la Cosa	770			1935
Malaspina	990	[3] 130		1935
Tofinyo	990	[3] 130		1933
Xauen	700			
SWEDEN				
Albatross	1,185	31	12	1942
Ejdern	80			1916
Grisslan	50			1940
Gustaf Klint	650			1941
Johan Nordenanckar	210			1924
Kompass	50			1938
Mussen	50			1940
Nils Stromcrona	140			1894
Petter Gedda	135			1924
Ran	260			1945
Svanlan	140			1881
Svartan	50			1940
Svenskund	415			1891
Tarnan	50			1940
TAIWAN				
104-foot research vessel				
TURKEY				
Arar	200	11	1	
Bulur				
Carsamba	1,150	64	1	
Gezer				
Gaeruer				
UNION OF SOUTH AFRICA				
Africana II	1,300	30	6	1950
John D. Gilchrist	95	6	9	1947
Kunene	85	9	2	
Natal	1,435	120	4	1944
Protea	1,020	[3] 100		1941
Sardinops	341	15	3	
Trachurus	85	9	2	

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
UNION OF SOVIET SOCIALIST REPUBLICS				
Academik Berg				
Akademik Vavilov	400			1949
Alidada				
Azimut	420			1914
Barograf	260	[3] 19		
Chukcha	2,700	[3] 55		
Ekholot				
Ekvator	1,200			1915
Gals	540			
Gidrofon	650	[3] 100		
Gidrograf	600			1918
Gidrolog				
Gidrometr	650	[3] 100		
Gidroskop	650	[3] 100		
Gidrostat				
Gorizont	650	[3] 100		
G 71				
G 089				
G 110				
G 117				
G 138				
G 199				
G 402	550			
G 482	550			
GPB 21				
GPB 22				
GPB 40				
GPB 85				
GPB 86				
GPB 88				
GPB 90				
GPB 91				
GPB 285				
GPB 288				
GPB 297				
GPB 452				
Issledoyatel				
Kamchadel	1,300	[3] 80		1937
Kompas	415			1918
Lebedj	1,100			
Lieutenant Schmidt				
Mazirbe	438	22	4	1958
Merepoeg	90			1937
Mikhail Lomonosov	5,960	62	69	1957
Ob	12,000			1957
Okean	1,500			
Okeanograf	426	20	9	1958
Okhotsk	3,200	[3] 160		1938
Oleg Koshevoi				
Opit				
Ost	650	[3] 100		
Otkvpshchikov	230	20	6	1950
Partizan	1,300	[3] 80		1937
Persei II				
Pervenets	442	23	13	1956
Petr Lebedev	4,600			1960
Pochin				

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
UNION OF SOVIET SOCIALIST REPUBLICS—continued				
Poliarnik	446	20	10	1952
Polyarnyi	1,300	[3] 80	----------	1937
Priboi	----------	----------	----------	----------
Prof. Mesiatsev	----------	----------	----------	----------
Prof. Rudovits	626	22	6	1952
Prof. Vasnetsov	----------	----------	----------	----------
Sergery Vavilov	4,600	----------	----------	1960
Sevastopol	2,447	66	26	1951
Severyanya	1,050	[3] 60	----------	----------
Sorakoram	----------	----------	----------	----------
SRT 4509	----------	----------	----------	----------
Srt Gonets	----------	----------	----------	----------
Srt Grot	----------	----------	----------	----------
Topseda	230	20	6	1950
Val	----------	----------	----------	----------
Variometr	----------	----------	----------	----------
Vchs Danilevski	----------	----------	----------	----------
Vest	640	[3] 100	----------	----------
Vitiaz	5,710	64	73	1939
Vorovski	2,300	285	18	1900
Zaria	580	25	9	----------
Zenit	----------	----------	----------	----------
Zhemchug	422	23	11	1950
Zuid	640	[3] 100	----------	----------
UNITED ARAB REPUBLIC				
Mabahess	----------	----------	----------	----------
UNITED KINGDOM				
Alexander Meek	25	3	3	----------
Calanus	----------	----------	----------	----------
Cape St. Mary	----------	17	3	1951
Clione	781	23	5	1961
Clupea	----------	----------	----------	----------
Cook	1,600	135	14	1945
Dalrymple	1,600	135	14	1945
Dampier	1,600	135	14	1945
Discovery	2,800	40	21	1962
Echo	160	16	2	1958
Egeria	160	16	2	1958
Enterprise	160	16	2	1958
Ernest Holt	1,000	24	6	1948
Explorer	----------	[3] 38	----------	1955
Explorer II	----------	----------	----------	----------
Manihine	208	18	3	1906
Mara	60	8	3	1938
Meda	46	[3] 11	----------	----------
Owen	1,600	135	14	1945
Platessa	200	11	4	1946
Sarsia	319	19	4	1953
Scotia	----------	----------	----------	----------
Scott	830	[3] 84	----------	1937
Shackelton	830	[3] 84	----------	1937
Sir William Hardy	----------	16	4	1955
SML 324	46	[3] 11	----------	----------

See footnotes at end of table.

TABLE I.—*A selected list of oceanographic research ships, United States and Foreign*—Continued

SELECTED LIST OF FOREIGN SURVEY/RESEARCH SHIPS [1]—Continued

Name	Displacement	Crew	Scientists	Age
UNITTD KINGDOM—Continued				
Sula				
Tellina	118	6	2	1960
Vidal	1,940	[3] 161		1951
William Herdman	47	5	5	1945
4 Weather-class	1,800	60	7	1943
URUGUAY				
Capitan Miranda	516			1930
VENEZUELA				
Biomar				
Caribe	40	[3] 23		1950
Golfo de Cariaca				
Guaiqaueri		11	6	1943
Torbes	40	[3] 23		1950
VIETNAM				
Hoa Giang	950	[3] 55		1944
YUGOSLAVIA				
Mb Bios	10	[3] 4		1950
Mv Bios	161	7	10	1953
Predvodnik	54	7	4	1945
ZANZIBAR				
Manihine	208	18	3	1906

[1] Reproduced by permission from *The Ocean Sciences*. Copyright C 1964 by U.S. Naval Institute, Annapolis, Md.

[2] Indicates no information available.

[3] Total.

TABLE II.—*A selected list of undersea research vehicles*

U.S. UNDERSEA RESEARCH VEHICLES

Vehicles	Owner/operator	Operating depth (ft.) and endurance	Payload (lbs.)	Crew	Range (nautical miles)
Aluminaut (1965)	Reynolds International Inc./Reynolds Submarine Services Corp.	15,000; 32 hours	6,000	4–6	96
Alvin I (1965)	Office of Naval Research/ Woods Hole Oceanograpic Institution.	6,000; 8 hours	1,200	2	16
Alvin II (1967)	General Dynamics/Office of Naval Research.	6,500; 8 hours	1,200	2	16
American Submarine Model 300 (1961).	American Submarine Co.	300; 3 hours	450	2	9
American Submarine Model 600 (1963).	do	600; 6 hours	750		18
Archerfish (1943, converted 1964).	U.S. Navy			71	

TABLE II.—*A selected list of undersea research vehicles, United States and Foreign*—Continued

U.S. UNDERSEA RESEARCH VEHICLES—Continued

Vehicles	Owner/operator	Operating depth (ft.) and endurance	Payload (lbs.)	Crew	Range (nautical miles)
Autec (1968)	General Dynamics/Atlantic Underwater Test and Evaluation Center.	6,500; 8 hours	1,200	2	16
Beaver Mark IV (1968).	North American Aviation	2,000	1,500	2–6	-------
Benthos V (1963)	Lear Siegler, Inc.	600; 2 hours	400	2	4
Cubmarine PC3A (1964)	Perry Submarine Builders, Inc./Ocean Systems, Inc.	300; 8 hours	750	2	16
Cubmarine PC3B (1963)	do	600; 2 hours	950	2	12
Cubmarine PC5 (1967)	do	1,200; 5 hours	1,000	5	18
Deep-Jeep (1964)	Naval Ordnance Test Station, China Lake, Calif.	2,000; 4-6 hours	200	2	10
Deepquest (1967)	Lockheed Aircraft Corp./Lockheed and Missiles Space Co.	6,000; 24 hours	3,400	4	48
Deep Submergence, Rescue Vehicle (1968).	U.S. Navy/Deep Submergence Systems Project.	3,500–6,000; 12 hours.	[1] 24	3	-------
Deepstar 2,000 (1967)	Westinghouse Electric Corp.	2,000; 8 hours	400–1,000	2	16
Deepstar 4,000 (1966)	do	4,000; 6 hours	350	3	18
Deepstar 20,000 (1969)	do	20,000; 8 hours	1,000	3	20
Deepview (1967)	U.S. Naval Ordnance Test Station, China Lake.	5,000; 8 hours	800	2	-------
Dolphin AG (SS) 555	U.S. Navy	-------	-------	22	-------
Dowb (1966)	General Motors Defense Research Lab.	6,500; 81 hours	1,000	2	40
Grouper (1942, converted 1964).	U.S. Navy	60 days	-------	88	-------
GSV-1 (1969)	Grumman Aircraft Engineering Corp.	2,000; 1 month	16,000	6-8	-------
Hikino (1968)	U.S. Naval Ordnance Test Station, China Lake, Calif.	Unlimited; 4 hours.	400	2	-------
Moray (TV-1A) (1964)	do	3,500; 3.6 hours	150–200	2	21
NR-1 (1968)	U.S. Navy/Special Projects Office.	30 days	2,200	7	-------
Perry-Link Deep Diver (1967).	Perry Submarine Builders, Inc./Ocean Systems, Inc.	1,300; 8 hours	1,500	4	16
Px-15 (1967)	Grumman Aircraft Engineering Corp.	2,000; 6 weeks	[2] 7-9	5–6	-------
Star I (1963)	Electric Boat Co., General Dynamics Corp.	200; 3 hrs	200	1	3
Star II (ASHERAH) (1964)	Electric Boat Co., General Dynamics Corp./University of Pennsylvania Museum.	600; 8 hrs	250	2	8
Star III (1966)	Electric Boat Co., General Dynamics Corp.	2,000; 10 hours	1,000	2	10
Trieste II (1964)	U.S. Navy/COMSUBPAC	20,000; 5 hours	20,000	3	10
Watercoupe (1967)	Bruce Industries, Calif.	600; 48 hours	400	2	-------

TABLE II.—*A selected list of undersea research vehicles, United States and Foreign*—Continued

FOREIGN UNDERSEAS RESEARCH VEHICLES

Vehicles	Owner/operator	Operating depth (ft.) and endurance	Pay-load (lbs.)	Crew	Range (nautical miles)
Archimède (1961)	French Navy	36,000; 12 hours	4,000	3	12
Auguste Piccard, (1964)	Swiss National Exposition Corp.	2,500; 8 hours	20,000	40	48
Kuroshio II (1960)	Hokkaido University, Japan.	650		4–6	(3)
Pisces	International Hydrodynamics Co., Ltd., Canada.	5,000; 7 hours	1,500	2	42
Sever	U.S.S.R.	2 hours			
Severyanka (1958)	U.S.S.R./All-Union Institute of Marine Fishery and Oceanography.	550		60	16,500
SP-300 Diving Saucer (1964)	Cousteau/Westinghouse Electric Corp.	1,000; 4 hours	100	2	4
Yomiuri (1964)	Mitsubishi/Yomiuri Shimbun Newspaper, Japan.	1,000		6	24

1 Rescuees.
2 Tons.
3 Tethered.

TABLE III.—*Laboratories and Institutions*

TABLE III–1: Federal civilian laboratories
TABLE III–2: Federal military laboratories
TABLE III–3: State institutions
TABLE III–4: Private institutions

TABLE III–1.—*Federal civilian*

Alabama:
- Gulf Coast Research Center—PHS.
- Southeastern Fish Cultural Laboratory—B.S.F. & W.

Alaska:
- Arctic Health Research Laboratory—PHS.
- Exploratory Fishing Base—BCF.

California:
- Biological Laboratory (3)—BCF.
- California Cooperative Fisheries Investigation—BCF.
- Geological Survey Research Center—GS.
- Inter-American Tropical Tuna Commission—Multigovernmental.
- Tiburon Marine Laboratory—B.S.F. & W., BCF.
- Tuna Resources Laboratory—BCF.

Canal Zone:
- Smithsonian Tropical Research Institute—Smithsonian.

Connecticut:
- Biological Laboratory—BCF.

District of Columbia:
- Biological Laboratory—B.S.F. & W.
- Icthyological Laboratory—BCF.
- National Oceanographic Data Center—Multiagency.
- Oceanographic Sorting Center—Smithsonian.
- U.S. Coast Guard Oceanographic Unit—Department of Transportation.

Florida:
- Biological Laboratory (2)—BCF.
- Eastern Gulf Marine Laboratory—B.S.F. & W.
- Exploratory Fishing and Gear Research Base—BCF.
- Tropical Atlantic Biological Laboratory—BCF.
- National Hurricane Research Laboratory—ESSA.

Georgia:
- Biological Laboratory—BCF.
- Exploratory Fishing Gear and Research Station—BCF.

Hawaii:
- Biological Laboratory—BCF.

Maine:
- Biological Laboratory—BCF.

Maryland:
- Biological Laboratory—BCF.
- Engineering Laboratory—C. & G.S. (ESSA).
- Institute for Oceanography—ESSA.
- Sea-Air Interaction Laboratory—ESSA.

Massachusetts:
- Biological Laboratory—BCF.
- Exploratory Fishing and Gear Research Base—BCF.

Michigan:
- Biological Laboratory—BCF.
- Exploratory Fishing and Gear Research Laboratory—BCF.
- Great Lakes Research Group—(ESSA).
- Great Lakes Water Laboratory—FWPCA.

Minnesota:
- Fresh Water Laboratory—FWPCA.

Mississippi:
- Exploratory Fishing and Gear Research Base—BCF.

New Jersey:
- Sandy Hook Marine Laboratory—B.S.F. & W.

North Carolina:
- Biological Laboratory—BCF.
- Radiobiological Laboratory—BCF.

Oregon:
- Water Pollution Control Laboratory—FWPCA.

Rhode Island:
- Narragansett Marine Gamefish Laboratory—B.S.F. & W.
- Northeast Shellfish Sanitation Research Center—PHS.

South Carolina:
- Biological Laboratory—BCF.
- Exploratory Fishing and Gear Research Station—BCF.

Texas:
- Biological Laboratory—BCF.

Virginia:
- Land-Sea Interaction Laboratory—ESSA.
- Norfolk Ship Base—ESSA.

Washington:
- Biological Laboratory—BCF.
- Exploratory Fishing and Gear Research Station—BCF.
- Joint Oceanographic Research Group—ESSA, University of Washington.
- Marine Mammal Laboratory—BCF.
- Northwest Research Center—PHS.
- Pacific Oceanography Institute—ESSA.
- Salmon-Cultural Laboratory—B.S.F. & W.
- Shellfish Sanitation Laboratory—FWPCA.

TABLE III–2.—*Federal military*

Alaska:
- Arctic Research Laboratory (University of Alaska).

California:
- Naval Civil Engineering Laboratory.
- Naval Electronics Laboratory.
- Naval Missile Center.
- Naval Ordnance Laboratory.
- Naval Ordnance Testing Station.
- Naval Post Graduate School.
- Naval Radiological Defense Laboratory.

Connecticut:
- Navy Underwater Sound Laboratory.

District of Columbia:
- Army Coastal Engineering Research Center (CERC).

Florida:
- Navy Mine Defense Laboratory.

Maryland:
- David W. Taylor Model Basin.
- Naval Oceanographic Office.
- Naval Ordnance Laboratory.
- Naval Research Laboratory.
- Navy Marine Engineering Laboratory.

Michigan:
- Army Lake Survey

Mississippi:
- Waterways Experiment Station (Army Corps of Engineers).

New York:
- Naval Applied Science Laboratory.

TABLE III–2.—*Federal Military*—Continued

Pennsylvania:
- Naval Air Development Center.
- Naval Air Engineering Center.

Rhode Island:
- Naval Underwater Weapons Research and Engineering Station.

Virginia:
- Naval Weapons Laboratory.

TABLE III—3.—*State institutions*

Alabama:
- University of Alabama.

Alaska:
- University of Alaska.

California:
- Humboldt State College.
- University of California (San Diego) (Scripps Institution).

Connecticut:
- University of Connecticut.

Delaware:
- University of Delaware.

Florida:
- Florida Atlantic University.
- Florida State University.
- University of Florida.

Hawaii:
- University of Hawaii.

Illinois:
- University of Illinois.

Louisiana:
- Louisiana State University.

Michigan:
- University of Michigan.

Mississippi:
- Gulf Coast Research Laboratory.

New Hampshire:
- University of New Hampshire.

New Jersey:
- Rutgers University.

New York:
- New York University.
- State University of New York.

North Carolina:
- University of North Carolina.

Ohio:
- Ohio State University.

TABLE III–3.—*State Institutions*—Continued

Oregon:
  Oregon State University.

Pennsylvania:
  Pennsylvania State University.

Puerto Rico:
  University of Puerto Rico.

Rhode Island:
  University of Rhode Island.

Virginia:
  Virginia Institute of Marine Sciences.

Washington:
  Applied Physics Laboratory (University of Washington).
  University of Washington.

Wisconsin:
  University of Wisconsin.

TABLE III–4.—*Private institutions*

California:
  Beaudette Foundation.
  California Institute of Technology.
  Marineland of the Pacific
  Stanford University.
  University of Southern California.
  University of the Pacific.

Connecticut:
  Yale University.

District of Columbia:
  American University.

Florida:
  Cape Haze Marine Laboratory.
  Nova University.
  University of Miami.

Maryland:
  The Johns Hopkins University.

Massachusetts:
  Harvard University.
  Masachusetts Institute of Technology.
  William F. Clapp Laboratory.
  Woods Hole Oceanographic Institution.

New Jersey:
  Princeton University.
  Stevens Institute of Technology.

New York:
  Columbia University (Hudson Laboratories, Lamont Geological Observatory).
  Cornell University.

North Carolina:
  Duke University.

Ohio:
  Battelle Memorial Institute, Columbus Laboratories.

Pennsylvania:
  Lehigh University.
  University of Pennsylvania.

Washington:
  Battelle Memorial Institute, Pacific Norhtwest Laboratory.
  Walla Walla College.

Bimini, Bahama Islands:
  American Museum of Natural History, Lerner Marine Laboratory.

Part Three

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Selected Data on the Oceans and Their Resources

Section A

TABLE I—*Largest oceans and seas in the world, showing area, average depth, and maximum depth*

Oceans and seas	Area (thousand square miles)	Average depth (feet)	Maximum depth (feet)
Pacific Ocean	63,855	14,050	36,198
Atlantic Ocean	31,744	12,690	27,498
Indian Ocean	28,371	13,000	26,400
Arctic Ocean	5,427	5,010	17,880
Mediterranean Sea	967	4,780	15,900
South China Sea	895	5,420	18,090
Bering Sea	876	4,710	16,800
Caribbean Sea	750	7,310	24,580
Gulf of Mexico	596	4,960	14,360
Okhotsk Sea	590	2,760	11,400
East China Sea	482	620	9,840
Yellow Sea	480	150	300
Hudson Bay	476	420	850
Sea of Japan	389	4,490	12,280
North Sea	222	310	2,170
Black Sea	178	3,610	7,360
Red Sea	169	1,610	7,370
Baltic Sea	163	180	1,440

Source: Rand McNally New Cosmopolitan World Atlas, 1967 edition.

TABLE II.—*Length of coastline of the United States, by coastal reach*

[In statute miles]

Coastal reach	General [1] coastline	Tidal [2] shoreline	Tidal [3] shoreline detailed
Atlantic coast	2,069	6,370	28,673
New England	(473)	(1,395)	(6,130)
Middle Atlantic	(285)	(947)	(4,112)
Chesapeake	(143)	(1,019)	(6,505)
South Atlantic	(1,168)	(3,009)	(11,926)
Gulf coast	1,631	4,097	17,141
Pacific coast	7,933	17,542	41,767
Hawaii	750	900	1,052
U.S. territories and possessions	729	820	1,487
Total U.S. seacoast	13,112	29,729	90,120
Great Lakes [4]	3,533	3,533	3,533
Exterior and interior coastlines	16,645	33,262	93,653

[1] Measurements were made with a unit measure of 30 minutes latitude. The corresponding mileage varies slightly, but at the latitude of San Francisco, 30′ is about 34.5 miles. Shoreline of bays and sounds is included to a point where such waters narrow to the width of the unit measure, and the distance across at such point is included.

[2] As above, except that a unit measure of 3 statute miles was used.

[3] As above, except that a unit measure of 100 feet was used.

[4] Measurements on detailed basis not available; approximated here by using "general coastline" miles.

Source: Department of Commerce, Coast and Geodetic Survey; Department of Defense, Corps of Engineers (for Great Lakes information).

TABLE III.—*Inland water areas of the United States, by regions*

[In square miles]

Locality	Area	Locality	Area
Coastal States:		Inland States[1]—Continued	
New England	3,149	East South Central	1,116
Middle Atlantic	6,719	West South Central	1,637
Chesapeake	1,688	Mountain	6,936
South Atlantic and Gulf	18,296		
Pacific	19,680	Total inland	77,127
Total coastal	49,532	Total United States	126,659
Inland States:[1]		Great Lakes	60,306
East North Central	57,653	Other	66,353
West North Central	9,785		

[1] In general, includes lakes, reservoirs, and ponds having 40 acres or more of area and streams and estuaries, canals, etc., ⅛ of a statute mile or more in width. Does not include water surface of the oceans, bays, Gulf of Mexico, Long Island Sound, Puget Sound, and the Straits of Juan de Fuca and Georgia.

Source: U.S. Department of Commerce, Coast and Geodetic Survey.

TABLE IV.—*Area of the United States Continental Shelf, by coastal regions*

[Thousands of square statute miles]

	Area[1] measured from coastline bounded by—		
	3-nautical-mile band	100-fathom[2] contour	1,000-fathom[2] contour
Atlantic coast	6	140	240
Gulf coast	5	135	210
Pacific coast	4	25	60
Alaska coast	20	550	755
Hawaii	2	10	30
Puerto Rico and Virgin Islands	2	2	7
Total	39	862	1,302

[1] That part of the sea floor extending from the low water line at the coast seaward to the indicated distance or depth.

[2] Fathom is a unit of length equal to 6 feet.

Source: U.S. Coast and Geodetic Survey.

Section B

TABLE I.—*U.S. fishing fleet, 1964, by period of construction*

Period in which constructed	New England	Middle Atlantic	Chesapeake[1]	South Atlantic	Gulf	Pacific	Great Lakes[2]	Hawaii	Total United States[3]
Before 1900	2	15	23	5	7	4	0	0	53
1900–1904	8	15	29	3	13	6	0	0	73
1905–09	4	18	23	0	17	35	1	0	98
1910–14	6	22	33	6	15	141	4	0	226
1915–19	13	21	25	5	19	293	3	0	368
1920–24	26	26	41	22	49	181	6	0	345
1925–29	74	35	55	32	106	457	23	10	783
1930–34	57	32	53	54	74	166	26	3	463
1935–39	68	36	91	67	218	343	74	4	885
1940–44	152	93	137	125	276	649	49	4	1,395
1945–49	158	137	232	270	642	1,043	136	28	2,553
1950–54	60	73	162	156	805	571	38	4	1,795
1955–59	44	50	235	244	796	336	27	1	1,616
1960–64	45	31	89	100	526	306	3	3	1,056
Unknown	4	4	17	19	19	36	0	0	99
Total	721	608	1,245	1,108	3,582	4,567	390	57	11,808

[1] Includes sailing vessels.
[2] Includes 4 vessels operated in Lake Winnebago.
[3] Total U.S. figures do not normally equal aggregate of regions because of duplication—i.e., vessels operated in more than 1 region.

Source: Fishery Statistics of the United States, 1964, U.S. Department of the Interior.

TABLE II.—*Employment of fishermen and shoreworkers for United States, 1930, 1940, 1950, 1960, 1963, and 1964*

	1930	1940	1950	1960	1963	1964
Total	198,712	215,010	263,478	224,056	215,722	211,851
Fishermen	119,716	124,795	161,463	130,431	128,470	127,875
Shoreworkers	78,996	90,215	102,015	93,625	87,252	83,976

Source: Fishery Statistics of the United States, 1964, U.S. Department of the Interior.

TABLE III.—*Number of fishermen and other persons employed in wholesaling and manufacture of fish products in the United States, 1964*

Region	Fishermen employed			Average number of employees in wholesale and manufacturing	
	Total	On fishing vessels	On boats and shore	Season	Year
Total, United States	[1] 127,875	[1] 40,705	[1] 87,180	83,976	57,219
New England	20,194	4,058	16,136	11,842	8,248
Middle Atlantic	9,118	2,990	6,128	7,436	6,235
Chesapeake	18,554	3,898	14,656	10,284	7,454
South Atlantic	11,281	3,442	7,839	8,148	5,387
Gulf	25,171	11,744	13,427	16,924	11,804
Pacific	33,099	15,767	17,332	23,476	13,273
Great Lakes	2,533	836	1,697	2,880	2,184
Mississippi River and tributaries	9,457	12	9,445	2,659	2,359
Hawaii	743	233	510	327	275

[1] Columns do not add to totals, because of duplication.

Source: Fishery Statistics of the United States, 1964, U.S. Department of the Interior.

TABLE IV.—*Employment in selected ocean-related industries in coastal States (including those bordering the Great Lakes), 1965*

	Selected industries	Fisheries	Manufacturing		Ship and boat building and repairs	Water transportation [1]	Wholesale trade: Fish and seafoods
			Canned or cured seafood	Fresh or frozen packaged fish			
All coastal States	(3) 297,509	(3) 13,021	(3) 12,906	(3) 18,762	79,745	158,626	14,449
Alabama	4,060	469	(2)	128	(2)	3,141	322
Alaska	702	43	----------	----------	----------	659	----------
California	36,297	2,377	4,733	936	10,766	16,504	981
Connecticut	[3] 768	104	----------	----------	(2)	569	95
Delaware	[3] 462	(2)	(2)	----------	119	343	----------
Florida	20,238	1,614	236	2,705	8,420	5,626	1,637
Georgia	4,963	130	----------	1,915	1,507	1,140	271
Hawaii	[3] 2,197	(2)	173	----------	(2)	1,950	74
Illinois	[3] 4,506	86	234	(2)	1,024	2,698	464
Indiana	[3] 640	----------	----------	----------	(2)	640	----------
Louisiana	[3] 23,646	950	1,631	885	(2)	19,265	915
Maine	6,091	346	721	424	3,667	474	459
Maryland	20,487	100	631	1,712	9,092	8,120	832
Massachusetts	13,112	3,354	278	2,770	1,716	3,494	1,500
Michigan	4,961	138	----------	----------	3,414	1,066	343
Minnesota	1,766	90	----------	----------	1,304	372	----------
Mississippi	[3] 2,335	124	391	109	(2)	1,521	190
New Jersey	[3] 20,770	(2)	920	311	9,046	10,007	486
New York	45,704	245	689	310	3,976	38,853	1,631
North Carolina	3,756	216	236	385	994	1,110	815
Ohio	[3] 7,452	130	----------	(2)	2,757	4,370	195
Oregon	6,635	129	613	461	1,989	3,254	189
Rhode Island	1,712	127	----------	----------	829	573	183
South Carolina [4]	2,445	75	293	159	529	1,307	82
Texas	31,339	1,349	----------	2,212	----------	19,358	837
Virginia	[3] 8,177	76	(2)	2,542	(2)	4,350	1,209
Washington	18,332	647	1,127	798	7,744	7,414	602
Wisconsin	3,956	102	----------	----------	3,269	448	137

[1] Excludes employment on oceanborne vessels.
[2] Denotes figures withheld to avoid disclosure of individual reporting units.
[3] Does not include figures withheld to avoid disclosure of individual reporting units.
[4] These are 1964 data; 1965 not available.

NOTES

Employment as shown here is the reported wage and salary employees of private nonfarm employers and certain nonprofit organizations covered under the Federal Insurance Contributions Act. The data are as of the pay period including Mar. 12, 1965.

Entries for "all coastal States" do not necessarily equal total for United States, since some ocean-related industry is conducted in inland States.

Section C

TABLE I.—*U.S. oil and gas drilling activity and production: total and offshore, 1958–64*

	Wells completed				Production[2]		Offshore production as percent of total United States	
	Oil	Gas[1]	Dry	Total	Oil (million barrels)	Gas (billion cubic feet)	Oil	Gas
TOTAL								
1958	24,137	4,779	18,822	47,758	2,449	11,030		
1959	25,800	5,029	19,265	50,094	2,548	12,046		
1960	21,186	5,258	17,574	44,018	2,575	12,771		
1961	21,101	5,664	17,106	43,871	2,622	13,254		
1962	21,249	5,848	16,682	43,779	2,676	13,876		
1963	20,288	4,751	16,347	41,386	2,753	14,847		
1964	20,620	4,855	17,488	42,963	2,805	15,401		
OFFSHORE[3]								
1958	292	62	99	453	57	128	2.3	1.2
1959	281	88	117	486	73	207	2.9	1.7
1960	340	97	126	564	86	273	3.3	2.1
1961	295	114	133	542	103	318	3.9	2.4
1962	322	80	232	634	127	452	4.7	3.3
1963	309	71	305	685	149	564	5.4	3.8
1964	416	107	321	844	173	622	6.2	4.0
1964 (offshore as percent of total)	2.0	2.2	1.8	2.0	6.2	4.0	----------	----------

[1] Includes field condensate.

[2] Marketed production.

[3] Louisiana only; its offshore production of oil and gas combined is estimated to represent close to 90 percent of the total U.S. output. California accounts for the major part of the balance. In the years 1960 through 1964 its production of offshore oil ranged between 32,000,000 and 36,000,000 barrels; gas production was relatively insignificant. The majority of its 2,000 offshore wells were slant drilled from shore or pier; only about one-sixth of its production originates from offshore platforms. (These activities are not reflected in the above table, since comparable data are not available.) There has been considerable drilling activity over the years in Texas offshore areas, but to date results have been disappointing; offshore production of oil in 1965 amounted to only 3,700 barrels and no gas production was reported. Drilling activity has been underway off coastal areas of Washington and Oregon also, but without results thus far.

Sources: Petroleum Production, Drilling and Leasing on the Outer Continental Shelf, U.S. Department of the Interior, May 1966. Bureau of Mines and Geological Survey, U.S. Department of the Interior, Louisiana Department of Conservation, the Battelle Memorial Institute.

TABLE II.—*Estimated value of offshore production of crude oil and gas, by State, 1960–1964*

[Millions of dollars]

Year	California	Louisiana	Combined
Crude oil and field condensate:			
1960	78.0	279.5	357.5
1961	82.5	325.1	407.6
1962	85.0	400.1	485.1
1963	89.0	466.7	555.7
1964	90.0	526.5	616.5
Total	424.5	1,997.9	2,422.4
Natural gas and casinghead gas:			
1960	nil	69.8	69.8
1961	(1)	85.7	[2] 85.7
1962	1.2	114.3	115.5
1963	2.9	139.9	142.8
1964	3.5	159.0	162.5
Total	[2] 7.6	568.7	[2] 576.3
Combined value:			
1960	78.0	349.3	427.3
1961	[2] 82.5	410.8	[2] 493.3
1962	86.2	514.4	600.6
1963	91.9	606.6	698.5
1964	93.5	685.5	779.0
Total	[2] 432.1	2,566.6	[2] 2,998.7

[1] Data not available.

[2] Total is understated by value of 1961 California gas production.

Source: Battelle Memorial Institute, based in part on data from U.S. Bureau of Mines, State of Louisiana, and Mid-Continent Oil and Gas Association.

TABLE III.—*Industrial expenditures on offshore oil and gas leases, by States and recipient governments, 1954–64, inclusive*

[Millions of dollars]

Year	California		Louisiana		Texas		Total	
	State	Federal	State	Federal	State	Federal	State	Federal
1954	0	0	42.4	117.6	(1)	23.6	42.4	141.2
1955	15.1	0	51.6	100.9	(1)	8.8	66.7	109.7
1956	10.1	0	23.6	4.0	(1)	0	33.8	4.0
1957	19.0	0	15.6	8.0	(1)	0	34.6	8.0
1958	65.8	0	10.5	15.0	(1)	0	76.3	15.0
1959	8.8	0	60.6	108.4	(1)	0	69.4	[2] 110.5
1960	8.2	0	14.2	[3] 278.3	(1)	36.4	[4] 30.7	[3] 314.7
1961	22.9	0	23.6	[3] 50.0	(1)	0	[4] 54.8	[3] 50.0
1962	38.1	0	25.4	[3] 569.8	(1)	.7	[4] 71.8	[3] 570.5
1963	23.5	13.7	17.2	[3] 70.2	(1)	.4	[4] 49.0	[3] 84.3
1964	75.9	.9	31.1	[3] 151.9	(1)	.4	[4] 115.3	[3] 190.5
11-year totals	287.5	14.6	315.8	[3] 1,474.1	(1)	70.3	[1 4] 644.8	[2 3] 1,598.4

[1] Information on bonuses, rentals, and royalties paid to the State of Texas on offshore leases out to the 3-leagure line is not available. Annual amounts are believed relatively small.

[2] "Total Federal" includes other payments to the Federal Government: $2,100,000 in 1959 for lands off Florida, and, in 1964, $29,100,000 for lands off Oregon and $8,200,000 for lands off Washington.

[3] Payments to Federal Government include amounts paid during 1960–64 inclusive, for bonuses, rentals, and royalties from zones 2 and 3, totaling $771,200,000, which is held in escrow awaiting final decision over these zones.

[4] Includes also $8,300,000 to the State of Alaska, an average value over the period 1960–64, imputed to each year.

Sources: Environmental Science Services Administration, Coast and Geodetic Survey, U.S. Department of Commerce, compiled by Battelle Memorial Institute from statistics furnished by Bureau of Land Management, Department of the Interior; Louisiana Mineral Board; Alaska Department of Natural Resources; California State Lands Division; and supplementary sources.

TABLE IV.—*Rents and royalties on Outer Continental Shelf lands*

[Fiscal years 1961–66 actual; fiscal years 1967 and 1968 estimated, in millions of dollars]

Fiscal year	Rent	Royalties	Combined
1961	2	6	8
1962	6	6	12
1963	359	7	366
1964	6	11	17
1965	42	11	53
1966	162	86	248
1967	350	50	400
1968	365	65	430
8-year total	1,292	242	1,534

Source: The Budget of the U.S. Government, Government Printing Office, for fiscal years 1963–68, inclusive.

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TABLE V.—*Fish products manufactured in the United States, 1958 and 1960–65*

[Q=quantity in million pounds; V=value in million dollars]

		1958	1960	1961	1962	1963	1964	1965 [1]
Packaged products, fresh and frozen	Q	512.6	584.2	583.0	647.3	670.4	708.5	742.1
	V	284.5	315.8	326.9	379.5	376.0	410.4	440.7
Canned	Q	1,099.3	1,088.8	1,042.7	1,133.7	1,035.9	1,095.6	1,150.0
	V	388.6	387.6	422.8	456.9	421.6	436.7	495.2
Cured	Q	75.3	68.3	74.5	65.0	68.9	65.5	74.4
	V	41.7	42.8	52.4	46.7	48.3	47.8	54.2
Quantity of products, except industrial [2]	Q	1,687.2	1,741.3	1,700.2	1,846.0	1,775.2	1,869.6	1,966.5
Industrial	V	79.9	66.6	74.6	75.7	68.6	69.9	82.9
Total value	V	794.7	812.8	876.7	958.8	914.5	964.8	1,073.0

[1] Preliminary reports.

[2] Total quantity including "industrial" is not available since certain industrial products are not measured by weight but by count or volume.

Sources: Fishery Statistics of the United States, 1958, 1960, 1961, 1962, 1963, 1964, U.S. Department of Interior; 1965 data from unpublished figures from U.S. Department of the Interior, Fish and Wildlife Service

TABLE VI.—*World trade in fishery products, by 7 major product groups, 1964*

[Volume in million tons; value in million dollars]

	Imports		Exports	
	Volume	Value	Volume	Value
Total	5,913	1,963	6,007	1,739
Fish, fresh, chilled or frozen	1,488	527	1,501	482
Fish, dried, salted or smoked	518	224	523	195
Crustaceans and molluscs, fresh, frozen, dried, salted, etc.	318	291	296	239
Fish products and preparations	523	379	582	372
Crustaceans and molluscs products and preparations	69	93	54	70
Oils and fats, crude or refined	721	147	637	116
Meals, solubles, and similar animal feedingstuffs	2,276	302	2,414	265

Source: Yearbook of Fishery Statistics, 1964, Food and Agriculture Organization of the United Nations.

TABLE VII.—*U.S. imports and exports of fishery products, edible and nonedible, 1965*

[Quantity in million pounds; value in million dollars]

	Quantity	Value
Total imports of fishery products entered for consumption		600.9
Edible	1,398.4	(479.4)
Nonedible		(121.5)
Total exports of fishery products		69.5
Edible	96.4	(49.3)
Nonedible		(20.2)
Total exports of foreign fishery products		10.3
Edible	13.5	(9.7)
Nonedible		(.6)

Source: Imports and Exports of Fishery Products, 1964–65, U.S. Department of the Interior.

TABLE VIII.—*Reporting units, selected ocean-related industries in coastal States (including those bordering the Great Lakes), 1965*

	Selected industries, grand total	Selected industries—units with 50 and more employees	Fisheries	Manufacturing: Canned or cured seafoods	Manufacturing: Fresh or frozen packaged fish	Ship and boat building and repairs	Water transportation [1]	Wholesale trade, fish and seafood
All coastal States	10,491	967	2,686	270	433	1,612	4,009	1,481
Alabama	133	22	45	2	5	2	58	21
Alaska	64	9	25				39	
California	957	88	260	20	27	221	332	97
Connecticut	130	5	28			30	52	20
Delaware	53	4	12	2		7	32	
Florida	1,156	76	404	10	45	201	325	171
Georgia	198	16	65		13	20	43	57
Hawaii	110	4	63	6		6	25	10
Illinois	221	23	11	5	6	18	135	46
Indiana	59	12				29	30	
Louisiana	1,348	109	306	30	24	92	806	90
Maine	293	14	64	34	10	57	32	96
Maryland	366	55	21	9	56	68	145	67
Massachusetts	715	30	345	11	47	86	95	131
Michigan	244	17	46			58	100	40
Minnesota	83	9	14			32	37	
Mississippi	140	14	17	10	4	19	75	15
New Jersey	455	53	107	10	9	105	174	50
New York	964	102	57	26	21	135	512	213
North Carolina	218	19	74	6	14	30	36	58
Ohio	216	25	17		3	33	140	23
Oregon	201	25	44	14	13	28	88	14
Rhode Island	120	8	48			24	26	22
South Carolina [2]	116	16	35	6	8	15	35	17
Texas	888	86	371		19	101	317	80
Virginia	344	60	14	11	84	59	98	78
Washington	562	53	158	58	25	97	181	43
Wisconsin	137	13	35		39	39	41	22

[1] Does not include oceangoing vessels as employing organizations.
[2] These are 1964 figures; 1965 not available.

NOTE.—"All coastal States" entries do not necessarily equal total for United States, since some ocean-related industry is conducted in inland States.

"Reporting units" are establishments reporting covered employment under the Federal Insurance Contributions Act during first quarter of 1965.

Source: County Business Patterns, 1965. U.S. Department of Commerce, Bureau of the Census.

TABLE IX.—*Taxable payrolls reported to Social Security Administration by establishments in selected ocean-related industries in coastal States (including those bordering the Great Lakes), first quarter 1965*

	Selected industries total	Fisheries	Manufacturing		Shipbuilding and boatbuilding and repairs	Water transportation [1]	Wholesale trade, fish and seafood
			Canned or cured seafood	Fresh or frozen packaged fish			
All coastal States	[2] 365,493	[2] 14,864	[2] 11,506	[2] 12,820	[2] 119,356	193,738	13,209
Alabama	[2] 3,360	195	(3)	87	(3)	2,839	239
Alaska	833	54	----------	----------	----------	779	----------
California	61,780	2,988	5,314	836	19,784	32,558	1,300
Connecticut	[2] 896	154	----------	----------	(3)	734	98
Delaware	[2] 459	(3)	(3)	----------	182	277	----------
Florida	20,369	1,522	127	1,732	10,377	5,217	1,394
Georgia	3,624	70	----------	1,117	1,547	684	206
Hawaii	[2] 3,695	(3)	167	----------	(3)	3,436	92
Illinois	[2] 6,643	76	258	(3)	1,537	4,061	711
Indiana	[2] 1,085	----------	----------	----------	(3)	1,085	----------
Louisiana	[2] 20,907	959	536	334	(3)	18,641	437
Maine	6,840	420	433	285	4,779	540	383
Maryland	22,844	77	518	687	14,650	6,417	495
Massachusetts	15,214	4,723	262	3,012	2,465	3,064	1,688
Michigan	6,451	212	----------	----------	4,334	1,502	403
Minnesota	1,989	40	----------	----------	1,377	572	----------
Mississippi	[2] 1,790	96	210	27	(3)	1,349	108
New Jersey	[2] 27,082	(3)	794	250	14,479	11,193	366
New York	62,653	310	1,001	418	6,363	52,177	2,384
North Carolina	2,505	191	30	86	999	819	380
Ohio	[2] 10,962	131	----------	(3)	3,979	6,598	254
Oregon	11,708	179	569	310	3,698	6,771	181
Rhode Island	1,849	218	----------	----------	857	586	188
South Carolina [4]	2,387	34	189	44	652	1,420	48
Texas	26,769	1,156	----------	1,379	10,763	12,859	612
Virginia	[2] 5,043	42	(3)	1,107	(3)	3,353	541
Washington	30,698	925	1,098	1,109	13,426	13,565	575
Wisconsin	4,968	92	----------	----------	4,108	642	126

[1] Does not include payments to employees aboard oceanborne vessels.
[2] Does not include figures withheld to avoid disclosure of individual reporting units.
[3] Denotes figures withheld to avoid disclosure of individual reporting units.
[4] These are 1964 data; 1965 not available.

NOTE.—"All coastal States" entries do not necessarily equal total for the United States since some ocean-related industry is conducted in inland States.

Taxable payrolls is the amount of taxable wages paid for covered (under F.I.C.A.) employment during January–March 1965. This is generally the total wages paid for the first quarter, except for employees paid at rates in excess of $19,200 per year.

Section D

TABLE I.—*World catch, by major fishing areas, 1938, 1948, 1958 and 1961–65*

[Live weight in million metric tons]

	1938	1948	1958	1961	1962	1963	1964	1965
World total	21.0	19.6	32.8	43.00	46.4	47.6	52.0	52.4
Inland waters	2.2	1.9	4.8	6.0	6.3	6.4	6.6	6.6
Asia	1.3	.9	3.1	4.3	4.5	4.6	4.7	4.8
Other	.5	.6	1.7	1.7	1.8	1.8	1.9	1.8
Atlantic Ocean and adjacent areas	9.3	10.9	13.3	15.2	16.2	17.0	18.1	19.8
Atlantic, northwestern	1.3	1.6	2.0	2.4	2.6	2.9	2.9	3.2
Atlantic, northeastern [1] [2]	6.0	6.4	7.1	7.3	7.7	8.0	8.6	9.5
Mediterranean and Black Sea	.7	.7	.8	.8	.8	.9	1.0	.9
Atlantic, western-central [3]	.9	1.4	1.7	2.1	2.2	2.0	2.0	2.5
Atlantic, eastern-central	.2	.3	.5	.9	1.0	1.1	1.2	1.1
Atlantic, southwestern [4]	.1	.2	.3	.4	.5	.6	.5	.5
Atlantic, southeastern [4]	.1	.3	.9	1.3	1.4	1.5	1.9	2.1
Indian Ocean and adjacent areas	1.1	1.0	1.5	1.6	1.7	1.7	1.9	1.9
Indian Ocean, western [4] [5]	.7	.6	.9	.9	1.0	1.0	1.2	1.2
Indian Ocean, eastern [4]	.4	.4	.6	.7	.7	.7	.7	.7
Pacific Ocean and adjacent areas	8.4	5.8	13.2	20.2	22.2	22.5	25.4	24.1
Pacific, northern [1]	3.2	2.5	3.7	4.6	4.6	4.5	4.9	5.4
Pacific, western-central	4.4	2.6	7.7	9.3	9.4	9.7	9.5	9.8
Pacific, eastern-central	.7	.5	.5	.5	.5	.5	.5	.5
Pacific, southwestern [4]	.1	.1	.1	.1	.1	.2	.2	.2
Pacific, southeastern [4]	--------	.1	.2	5.7	7.6	7.6	10.3	8.2

[1] Arctic waters included in adjacent areas.
[2] Includes the North Sea and the Baltic.
[3] Includes the Caribbean area.
[4] Antarctic waters included in adjacent areas.
[5] Includes the Red Sea and Arabian Sea.

Source: Yearbook of Fishery Statistics, 1965, Food and Agriculture Organization of the United Nations.

TABLE II.—*U.S. fish and shellfish catch and value, by U.S. regions, 1964*

[Thousands of pounds and thousands of dollars]

Regions of the United States	Grand total		Fish		Shellfish		Other	
	Catch	Value	Catch	Value	Catch	Value	Catch	Value
1—New England	681, 857	67, 596	620, 508	34, 436	61, 349	33, 160	0	0
2—Middle Atlantic	370, 223	20, 897	314, 894	8, 517	55, 329	12, 380	0	0
3—Chesapeake	536, 596	35, 948	423, 886	10, 191	112, 710	25, 757	0	0
4—South Atlantic	335, 997	20, 619	260, 955	9, 079	75, 042	11, 540	0	0
5—Gulf	1, 317, 834	99, 298	1, 084, 718	26, 477	233, 116	72, 821	0	0
6—Pacific	1, 151, 612	129, 337	987, 318	111, 201	153, 285	17, 402	11, 009	734
7—Great Lakes	56, 687	5, 572	56, 687	5, 572	0	0	0	0
8—Mississippi River and tributaries	77, 131	7, 383	66, 926	6, 401	10, 205	982	0	0
9—Hawaii	12, 685	2, 848	12, 616	2, 806	69	42	0	0
Total	4, 540, 662	389, 498	3, 828, 508	214, 680	701, 105	174, 084	11, 009	734

Source: Fishery Statistics of the United States, 1964, U.S. Department of the Interior.

TABLE III.—*U.S. catch of fish and shellfish, by species, 1964*

Species	Thousand pounds	Value (thousand dollars)	Record catch (thousand pounds)	Year
Menhaden	1, 569, 965	22, 190	2, 347, 944	1962
Salmon	352, 321	55, 995	790, 884	1936
Tuna	305, 829	39, 398	391, 454	1950
Crabs	270, 442	23, 813	270, 442	1964
Industrial fish [1]	262, 247	2, 915	262, 247	1964
Shrimp	211, 821	70, 376	268, 334	1954
Flounders	176, 351	15, 006	176, 798	1963
Haddock	133, 498	11, 845	293, 809	1929
Herring	115, 929	2, 225		
Atlantic	(63, 683)	(1, 334)	200, 598	1902
Pacific	(52, 246)	(891)	263, 200	1937
Whiting	94, 233	2, 067	133, 041	1957
Jack mackerel	89, 985	2, 213	146, 522	1952
Ocean perch, Atlantic	89, 268	3, 781	258, 320	1951
Clams	64, 464	14, 890	64, 464	1964
Oysters	60, 534	27, 926	152, 046	[2] 1908
Alewives	54, 985	920	89, 978	1908
Cod	45, 160	3, 020		
Atlantic	(38, 746)	(2, 669)	294, 351	1880
Pacific	(6, 414)	(351)	32, 681	1915
All others	643, 590	90, 918		

[1] Unclassified species for bait, reduction, and animal food.
[2] First year in which an oyster survey was made in all regions.

Source: Fishery Statistics of the United States, 1964, U.S. Department of the Interior.

TABLE IV.—*Disposition of world fish catch, 1938, 1948, 1953, and 1958–64*

[In million metric tons]

	Total world catch	For human consumption					For other purposes		
		Total	Marketing (fresh)	Freezing	Curing	Canning	Total	Reduction [1]	Miscellaneous purposes
1938	20.9	18.2	11.0		5.7	1.5	2.7	1.7	1.0
1948	19.5	17.0	9.6	1.0	5.0	1.4	2.5	1.5	1.0
1953	25.7	21.8	11.6	1.4	6.5	2.3	3.9	2.9	1.0
1958	32.8	27.5	14.5	2.7	7.3	3.0	5.3	4.3	1.0
1959	36.3	29.0	15.4	3.0	7.3	3.3	7.3	6.3	1.0
1960	39.5	30.9	16.3	3.4	7.5	3.7	8.6	7.6	1.0
1961	42.9	32.2	16.5	4.0	7.7	4.0	10.7	9.7	1.0
1962	46.3	33.3	16.9	4.3	8.0	4.1	13.0	12.0	1.0
1963	47.4	34.4	17.1	4.7	8.5	4.1	13.0	12.0	1.0
1964	51.6	35.2	17.4	5.0	8.4	4.4	16.4	15.4	1.0

[1] Only whole fish destined for the manufacture of oils and meals is included. Raw material for reduction derived from fish primarily destined for marketing fresh, freezing, curing, canning, and miscellaneous purposes is excluded; such waste quantities are included under the other disposition channels.

Source: Yearbook of Fishery Statistics, 1964, Food and Agriculture Organization of the United Nations.

TABLE V.—*Disposition of U.S. fish catch, 1958, and 1961–64*

[In thousand metric tons]

	1958	1961	1962	1963	1964
Total	2,703.4	2,932.1	2,972.9	2,776.9	2,638.1
For human consumption	1,844.3	1,819.4	1,820.3	1,852.9	1,820.7
Marketing (fresh)	822.3	864.1	843.3	852.3	874.1
Freezing	302.1	296.7	313.4	317.9	294.8
Curing	38.6	36.7	36.3	35.4	32.2
Canning	681.3	621.9	627.3	647.3	619.6
For other purposes	859.1	1,112.7	1,152.6	924.0	817.4
Reduction	852.8	1,100.9	1,143.1	912.2	807.9
Miscellaneous purposes	6.3	11.8	9.5	11.8	9.5
Offal for reduction	(308.4)	(248.1)	(217.7)	(213.6)	(181.4)

Source: Yearbook of Fishery Statistics, 1964, Food and Agriculture Organization of the United Nations.

Section E

The following information is based on the synoptical tables concerning the breadth and juridical status of the territorial sea and adjacent zones prepared for the 1958 and 1960 Geneva Law of the Sea Conferences, and additional information available to the Department of State as of January 25, 1967.

TABLE I.—*Breadth of territorial sea and fishing jurisdiction claimed by members of the United Nations system*

Country	Territorial sea	Fishing limits	Other
Afghanistan	No coast		
Albania	10 miles	12 miles	
Algeria	12 miles		
Argentina	200 miles		
Australia	3 miles		
Austria	No coast		
Belgium	3 miles	12 miles [1]	
Bolivia	No coast		
Brazil	6 miles	12 miles	
Bulgaria	12 miles		
Burma	do		
Burundi	No coast		
Byelorussian, S.S.R	do		
Cambodia	5 miles	12 miles	Continental Shelf to 50 meters including sovereignty over superjacent waters.
Cameroons	6 miles		
Canada	3 miles	12 miles	
Central African Republic	No coast		
Ceylon	6 miles		Claims right to establish conservation zones within 100 nautical miles of the territorial sea.
Chad	No coast		
Chile	50 kilometers	200 miles	
China	3 miles		
Colombia	6 miles	12 miles	
Congo (Brazzaville)			
Congo (Léopoldville)			
Costa Rica		200 miles	
Cuba	3 miles		
Cyprus	12 miles		
Czechoslovakia	No coast		
Dahomey	3 miles	12 miles	
Denmark	do	do [1]	
Greenland		do	
Faroe Islands		do	
Dominican Republic	3 miles	15 miles	
Ecuador	12 miles	200 miles	
El Salvador	200 miles		
Ethiopia	12 miles		
Federal Republic of Germany	3 miles	12 miles [1]	
Finland	4 miles		
France	3 miles	12 miles	
Gabon	12 miles		
Gambia	3 miles		
Ghana	12 miles		Undefined protective areas may be proclaimed seaward of territorial sea, and up to 100 miles seaward of territorial sea may be proclaimed fishing conservation zone.

See footnote at end of table.

TABLE I.—*Breadth of territorial sea and fishing jurisdiction claimed by members of the United Nations system*—Continued

Country	Territorial sea	Fishing limit	Other
Greece	6 miles		
Guatemala	12 miles		
Guinea	130 miles		
Haiti	6 miles		
Holy See	No coast		
Honduras	12 miles		
Hungary	No coast		
Iceland		12 miles	
India	6 miles	100 miles	
Indonesia	12 miles		
Iran	do		
Iraq	do		
Ireland	3 miles	12 miles [1]	
Israel	6 miles		
Italy	do	12 miles [1]	
Ivory Coast	3 miles		
Jamaica	12 miles		
Japan	3 miles		
Jordan	do		
Kenya	do		
Korea		20 to 200 miles	Continental Shelf including sovereignty over superjacent waters.
Kuwait			
Laos	No coast		
Lebanon		6 miles	
Liberia	3 miles		
Libya	12 miles		
Luxembourg	No coast	(1)	
Malagasy Republic	12 miles		
Malawi	No coast		
Malaysia	3 miles		
Maldive Islands		6 miles	
Mali	No coast		
Malta	3 miles		
Mauritania	6 miles	12 miles	
Mexico	9 miles	do	
Mongolia	No coast		
Morocco	3 miles	12 miles	Exception—6 miles for Strait of Gibraltar.
Nepal	No coast		
Netherlands	3 miles	12 miles [1]	
New Zealand	do	do	
Nicaragua	do	200 miles	Continental Shelf including sovereignty over superjacent waters.
Niger	No coast		
Nigeria	3 miles		
Norway	4 miles	12 miles	
Pakistan	12 miles		Plus right to establish 100-mile conservation zones. Continental Shelf—including sovereignty over superjacent waters.
Paraguay	No coast		
Peru		200 miles	

See footnote at end of table.

TABLE V.—*Breadth of territorial sea and fishing jurisdiction claimed by members of the United Nations system*—Continued

Country	Territorial sea	Fishing limit	Other
Philippines	Archipelago theory.		Waters within straight lines joining appropriate points of outermost islands of the archipelago are considered internal waters; waters between these baselines and the limits described in the Treaty of Paris, Dec. 10, 1898, the United States-Spain Treaty of Nov. 7, 1900, and U.S.-U.K. Treaty of Jan. 2, 1930, are considered to be the territorial sea.
Poland	3 miles		
Portugal	6 miles	[1] 12 miles	
Romania	12 miles		
Rwanda	No coast		
San Salvador	200 miles		
Saudi Arabia	12 miles		
Senegal	6 miles		
Sierre Leone	12 miles		
Singapore			
Somali Republic	6 miles		
South Africa	do	12 miles	
Spain	do	[1] do	
Sudan	12 miles		
Sweden	4 miles	[1] 12 miles	
Switzerland	No coast		
Syria	12 miles		Plus 6 miles necessary supervision zone.
Tanzania	do		
Thailand	do		
The Gambia			
Togo	do		
Trinidad and Tobago	3 miles		
Tunisia	6 miles	12 miles	Territorial sea follows the 50-meter isobath for part of the coast (maximum 65 miles).
Turkey	6 miles	do	
Uganda	No coast		
Ukrainian, S.S.R	12 miles		
U.S.S.R	do		
United Arab Republic	do		
United Kingdom	3 miles	[1] 12 miles	
Colonies	do		
United States of America	do	12 miles	
Upper Volta	No coast		
Uruguay	6 miles	12 miles	
Venezuela	12 miles		
Vietnam		20 kilometers	
Yemen			
Yugoslavia	10 miles		
Zambia	No coast		

[1] Parties to the European Fisheries Convention which provides for the right to establish 3 miles exclusive fishing zone seaward of 3-mile territorial sea plus additional 6-mile fishing zone restricted to the convention nations.

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