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REPORT TO THE CONGRESS

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Federal Agencies Administering Programs Related To Marine Science Activities And Oceanic Affairs

Multiagency

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BY THE COMPTROLLER GENERAL OF THE UNITED STATES

U.S. General Accounting Office

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To the President of the Senate and the
Speaker of the House of Representatives

This is our report on Federal agencies administering programs related to marine science activities and oceanic affairs. We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

In connection with the National Ocean Policy Study which was authorized by the unanimous passage of Senate Resolution 222 on February 19, 1974, the Chairman, Senate Committee on Commerce, on February 28, 1974, requested that we obtain information on Federal agencies involved in administering programs related to oceanic affairs and marine science activities. In his request the Chairman stated that a comprehensive report of this nature would be most useful to the Committee and the Congress and asked that the report be addressed to the Congress.

The information contained in this report deals with funding data and describes the programs of the Federal agencies participating in marine science activities and oceanic affairs. The descriptive material is not intended to be all inclusive but is being furnished to provide a general and informative understanding of the various agencies' programs.

Representatives of each of the agencies whose activities are discussed in this report reviewed the material contained herein and their suggested changes were incorporated into the report.

We are sending copies of this report to the Director, Office of Management and Budget, and to the heads of the departments and agencies whose programs are included herein.

Elmer B. Staats
Comptroller General
of the United States

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ABBREVIATIONS

AEC	Atomic Energy Commission
COE	Corps of Engineers
DARPA	Defense Advanced Research Projects Agency
DMA	Defense Mapping Agency

DOC	Department of Commerce
DOD	Department of Defense
DOI	Department of the Interior
DOT	Department of Transportation
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
HEW	Department of Health, Education, and Welfare
IDOE	International Decade of Ocean Exploration
NASA	National Aeronautics and Space Administration
NIH	National Institutes of Health
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
OCS	Outer Continental Shelf
OE	Office of Education
R&D	research and development
U.N.	United Nations

GLOSSARY

Anadromous fish	Fish that are hatched in freshwater, migrate to the ocean for the growing stage of their life cycle, and then return to the freshwater of their birth to spawn.

Anatomical	Dealing with the structure and form of animals and plants.
Bathymetry	The science of measuring ocean depths to determine sea floor topography.
Biomass	The total mass or amount of living organisms in a particular area or volume.
Calibration	Checking, adjusting, or systematically standardizing the graduations of a quantitative measuring instrument.
Cartography	The production of maps--including construction of projections, design, compilation, drafting, and reproduction.
Circumpolar current	Current that flows in a clockwise manner around the Antarctic.
Coastal zone	The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder); strongly influenced by each other and in proximity to the shorelines of the several coastal States; and includes transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends, in Great Lakes waters, to the international boundary between the United States and Canada and, in other areas, seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters.

Contiguous fisheries zone	A zone contiguous to the territorial sea and located from 3 to 12 miles offshore. The Federal Government has authority to regulate in this zone. There is, however, no clear legal basis to exercise this Federal authority except over species which are subject to international agreement and marine mammals. Each State has authority to enforce regulations against its own citizens in this zone but not against citizens of other States.
Contiguous sea	Same definition as contiguous fisheries zone.
Ecological	Pertaining to the branch of biology that deals with the relations between living organisms and their environment.
Ecosystem	A system made up of a community of animals, plants, and bacteria and the physical and chemical environment with which it is interrelated.
Estuary	Areas where freshwater meets saltwater, i.e., bays, mouths of of rivers, salt marshes, and lagoons. Estuaries serve as nurseries and spawning and feeding grounds for large groups of marine life and provide shelter and food for birds and wildlife.
Eutrophication	The process whereby a lake becomes overfertilized from too many nutrients. As a result,

	algae and other plant life become overabundant and the lake may evolve into marshland.
Fluorescent navigation charts	Charts using fluorescent ink that respond to dark light for retaining night vision on the bridge of a ship.
Geochemistry	The branch of chemistry dealing with the chemical composition of the earth's crust and the chemical changes that occur there.
Geodetic	Pertaining to the branch of applied mathematics concerned with measuring, or determining the shape of, the earth or a large part of its surface or with exactly locating points on its surface.
Geoid	Mean sea level (the elevation of a point on land) which is one of the basic surfaces upon which geodetic quantities are measured.
Geology	The science dealing with the physical nature and history of the earth--including the structure and development of its crust and the composition of its interior, individual rock types, the forms of life found as fossils, etc.
Geomagnetism	The study of the magnetic properties of the earth.

Geophysics	The science that deals with the physics of the earth--including weather, winds, tides, earthquakes, volcanoes, magnetism, etc., and their effect on the earth.
Hydrodynamics	The branch of physics dealing with the motion and action of water and other liquids.
Hydrography	The study, description, and mapping of oceans, lakes, and rivers especially with reference to their navigational and commercial uses.
Hydrology	The science dealing with the waters of the earth; their distribution on the surface and underground; and the cycle involving evaporation, precipitation, flow to the seas, etc.
Hyperbaric exposure	Exposure to a pressure or specific gravity greater than that within the body tissues or fluids.
Intermodal distribution coordination	Providing updated information on the availability, capability, and cost of cargo handling equipment and containers.
Limnology	The science that deals with the physical, chemical, and biological properties and features of fresh waters, especially lakes and ponds.
Manganese nodules	Small mineral nodules primarily consisting of copper, nickel, cobalt, and manganese found on the deep ocean floor.

Oceanography	The study of the environment in the oceans--including the waters, depths, beds, animals, plants, etc.
Photogrammetric	Surveying or measuring by taking photographs.
Plankton	Microscopic or very small plant and animal organisims of the sea.
Salinity	The degree of dissolved solids in water.
Saturated diving	The technique of living in a dry, pressurized habitat on the ocean floor and working with free access to the sea without passing through intermediate locks or undergoing decompression.
Seismology	The study of earthquakes and the natural and artificially produced vibrations of the earth.
Sensor	A device designed to detect, measure, or record physical phenomena.
Sonar	A system of determining the distance from a point to an underwater object by measuring the interval of time between transmission of an underwater signal and the return of its echo.
Special mission doppler satellite tracking	A navigation system involving special purpose satellites in 600-mile polar orbits. Measurement of the doppler effect (the change in pitch) is made during a 6 to 16 minute period as the satellite moves across the sky.

	This information and orbital data are fed into a special purpose computer to determine a vessel's position.
Synthetic aperture sonar	A system that uses the motion of the platform on which it is mounted to extend its effective size with the result that more information can be obtained than under an ordinary sonar system.
Taxonomic	Identifying, naming, and classifying organisms.
Territorial sea	A zone from the coastline to 3 miles offshore. This zone is regulated by individual States with each having jurisdiction over fish resources within its coastal boundaries. In some States, cities and towns have jurisdiction over some fisheries within their coastal boundaries.
Topography	The science of drawing on maps and charts or otherwise representing the surface features of a region, including its relief and rivers, lakes, etc., and such manmade features as canals, bridges, roads, etc.
Tsunami	A series of traveling ocean waves of great length and long period which are generated by disturbances associated with earthquakes in oceanic and coastal regions (tidal waves).
Undersea aqueduct	Artificial channel for conducting water over a distance.

Upper mantle	The layer of the earth between the crust and the core which lies above a depth of about 1,000 kilometers.

CHAPTER 1

INTRODUCTION

On February 19, 1974, the Senate, by unanimous vote, passed Senate Resolution 222 authorizing the Senate Committee on Commerce to make a "National Ocean Policy Study" for the purpose of

"(1) determining current and prospective national capabilities in the oceans, including marine sciences and their application, oceanic research, advancement of oceanic enterprise and marine technology, interdisciplinary education, policy planning, professional career and employment needs, and overall requirements of the United States consistent with the attainment of long-range national goals;

(2) determining the adequacy of current Federal programs relating to the oceans and recommending improvements in agency structure and effectiveness to meet national needs and achieve oceans capabilities, and assessing existing policies and laws affecting the oceans for the purpose of determining what changes might be necessary to assure a strong and internationally competitive ocean policy and program for the United States;

(3) establishing policies to achieve the goal of full utilization and conservation of living resources of the oceans and recommending solutions to problems in marine fisheries and their management, rehabilitation of United States fisheries, current and future international negotiations on fisheries, as well as aquaculture and the extraction of drugs from the sea;

(4) assessing the needs for new policies for the development and utilization of the nonliving resources of the oceans, including the mineral resources of the Outer Continental Shelf and the deep seabed so that the national mineral needs can be met in an economically and environmentally sound manner;

(5) encouraging implementation of coastal zone management through the Coastal Zone Management Act of 1972 by assessing national growth policy needs, regional and interstate problems, State functions and powers in coastal zone management, information sources, recreation needs, pollution problems, population trends, and future pressures in the coastal zone;

(6) establishing comprehensive national policy for the purpose of understanding and protecting the global ocean environment through education, exploration, research, and international cooperation; and

(7) making an assessment of proposals for, and current negotiations with respect to, achieving adequate national and international jurisdiction over the oceans, developing an understanding of the relationship of the oceans to world order, and examining United States policy with respect thereto."

On February 28, 1974, the Chairman of the Senate Committee on Commerce requested that we obtain information on Federal agencies administering programs related to marine science activities and oceanic affairs. Among other things, the Chairman asked that we

--identify all Federal programs related to marine science activities and oceanic affairs,

--provide a brief description of each program or mission, and

--provide funding information on these programs for fiscal years 1972 through 1975.

In determining the Federal agencies to be included in this report, we used as our criteria those agencies that had submitted information for inclusion in the annual report to the President and the Congress on Federal agencies' participation in the field of marine sciences as required by the Marine Resources and Engineering Development Act of 1966 (33 U.S.C. 1101). They are:

Department of Commerce (DOC):
- National Oceanic and Atmospheric Administration (NOAA)
- Maritime Administration

Department of Transportation (DOT):
- Coast Guard
- Office of Pipeline Safety

Department of Defense (DOD):
- Department of the Navy
- Defense Mapping Agency (DMA)
- Defense Advanced Research Projects Agency (DARPA)
- Department of the Army, Corps of Engineers (COE)

Department of the Interior (DOI):
- Fish and Wildlife Service
- National Park Service
- Geological Survey
- Bureau of Land Management
- Bureau of Mines
- Bureau of Outdoor Recreation
- Office of Saline Water
- Office of Water Resources Research
- Office of Territorial Affairs
- Bureau of Indian Affairs
- Bureau of Reclamation

National Science Foundation (NSF)

Environmental Protection Agency (EPA)

Department of State

Department of Health, Education, and Welfare (HEW)
- Food and Drug Administration (FDA)
- National Institutes of Health (NIH)
- Office of Education (OE)

Atomic Energy Commission (AEC)

National Aeronautics and Space Administration (NASA)

Smithsonian Institution

The following table shows the amounts, as furnished to us by the departments and agencies, allocated each year to programs related to marine science activities and oceanic affairs. These figures come from appropriations for fiscal years 1972-74 and appropriations requested for fiscal year 1975.

	Appropriations		
	Total	Allocated	Percent
	(millions)		
Actual:			
Fiscal year 1972	$120,670.4	$1,635.5	1.4
Fiscal year 1973	134,669.7	1,971.9	1.5
Fiscal year 1974	140,333.8	1,844.1	1.3
Total	$395,673.9	$5,451.5	1.4
Requested:			
Fiscal year 1975	$137,692.1	$2,064.2	1.5

Appendix I contains a detailed funding breakdown by department and agency.

Chapters 2 through 12 of the report present funding data and a description of the departments' and agencies' programs. These descriptions are not all inclusive but are being furnished to provide a general and informative understanding of the departments' and agencies' involvement in marine science activities and oceanic affairs.

CHAPTER 2

DEPARTMENT OF COMMERCE

Two DOC agencies--Maritime and NOAA--conduct programs which are included in the annual report to the President and the Congress on Federal agencies' participation in the field of marine sciences.

The following table compares total DOC appropriations with the funds allocated by Maritime and NOAA to marine science activities and oceanic affairs.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total DOC appropriations	$1,515.4	$1,824.8	$1,553.7	$1,759.1
Allocated by:				
Maritime	$524.9	$750.5	$575.3	$586.2
NOAA	128.0	157.8	141.9	184.8
Total	$652.9	$908.3	$717.2	$771.0
Percent allocated	43.1	49.8	46.2	43.8

[a]In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.

MARITIME ADMINISTRATION

Maritime is responsible for implementing the President's maritime program under the Merchant Marine Act of 1936, as amended (46 U.S.C. 1101). The program objectives are to (1) provide a modern, efficient U.S. merchant fleet which is less dependent upon Government subsidies than at present, is capable of meeting emergency military requirements, and provides a stable, reliable service to American industry

and (2) maintain a strong reliable shipbuilding industry using the most advanced technology available.

Total Maritime appropriations and the amounts for marine science activities and oceanic affairs are shown below.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$524.9	$750.5	$575.3	$586.2
Marine science activities and oceanic affairs:				
Ship construction	$229.7	$455.0	$275.0	$275.0
Operating-differential subsidies	239.1	232.0	244.5	242.8
Operations and training	32.3	34.5	36.8	40.5
Research and development (R&D)	23.8	29.0	19.0	27.9
Total	$524.9	$750.5	$575.3	$586.2

Ship construction

The ship construction program provides subsidies to the shipbuilding industry to revitalize the U.S. merchant fleet to provide a shipping and shipbuilding capability adequate for the commercial and national security requirements of the United States. Emphasis under the program is placed on the construction of a series of standardized ships to achieve economies and reduce the subsidy rate. Because of their advanced design, the new ships will be less costly to operate and more productive than the ships they are replacing. In response to the country's needs the program has been limited in fiscal years 1974 and 1975 to construction of oil tankers and liquified natural gas carriers.

Operating-differential subsidies

This program promotes, through financial assistance, the continuation of vital American merchant marine services. The subsidies enable U.S. ship operators to compete with foreign operators providing passenger, general cargo, and bulk shipping services over the same essential trade areas. Maintenance of a U.S.-flag merchant fleet provides support to the foreign and domestic commerce of the United States and insures the availability of a naval and military auxiliary in time of war or national emergency.

Subsidies are provided for wages, maintenance and repair, and insurance costs. The amount of the payments is the difference between the fair and reasonable cost of these items and the cost of the same expense items for vessels operated by major foreign competitors. Subsidies are being paid to U.S. ship operators mainly on general cargo ships and bulk carriers such as tankers. Some subsidies are being provided to operators of passenger-cargo ships.

Operations and training

Funds are appropriated for this program to finance costs incurred by headquarters and field staffs for the administration and direction of the various activities established to fulfill Maritime's responsibilities and the cost of officer training at the U.S. Merchant Marine Academy at Kings Point, New York, and six State marine schools.

The following table shows appropriations allocated by Maritime for the operations and training activities.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Development of waterborne transportation systems	$ 4.5	$ 5.2	$ 4.4	$ 4.4
National security support capability	3.9	4.7	4.4	4.4
Merchant Marine Academy	7.5	7.8	8.7	10.5
State marine schools	2.2	2.1	2.6	3.0
Use of waterborne transportation systems	5.2	5.4	5.9	6.3
General administration	8.7	9.9	10.6	11.9
Transfer or carryover	.3	-.6	.2	-
Total	$32.3	$34.5	$36.8	$40.5

The activities include:

--Development of waterborne transportation systems: administrative costs of programs established to (1) promote the construction of cost-competitive U.S. merchant ships, (2) reduce the ship construction subsidy, (3) improve growth and stability in the U.S. shipbuilding industry, (4) attain sufficient shipping capacity to meet national requirements, and (5) provide guarantees to aid shipowners in obtaining private capital to expand their fleets.

--National security support capability: includes funds for maintenance of ships retained in the National Defense Reserve Fleet and planning for an evaluation of the emergency response capability of U.S. shipyards and the merchant fleet.

--Merchant Marine Academy: a 4-year program for training officers for service in the merchant fleet.

--State marine schools: grants are provided to six States for the operation and maintenance of State schools for the training of merchant marine officers. The schools are located in Vallejo, California; Castine, Maine; Buzzards Bay, Massachusetts; Traverse City, Michigan; Fort Schuyler, New York; and Galveston, Texas.

--Use of waterborne transportation systems: administrative costs of programs directed at increasing the productivity and improving the operations of the U.S. Merchant Marine in foreign and domestic trade and meeting the Nation's shipping requirements with a minimum of Government aid.

--General administration: executive direction and other administrative functions, such as accounting, budget, personnel, management, legal, and other support functions in support of substantive program efforts.

R&D

Maritime's R&D effort is directed at improving the competitive position of the U.S. Merchant Marine. Specifically,

Maritime's objective is to reduce shipbuilding and ship operation costs and make them equal to comparable foreign costs, thus reducing the need for Government subsidies. Projects are directed at developing new and more efficient types of ships, machinery, and equipment for shipbuilders and operators and improving operational practices in shipyards and aboard ships. All R&D is performed under contract, principally by industrial firms, but educational institutions and professional societies also participate.

The following table shows appropriations allocated for specific R&D programs.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Shipbuilding research	$ 2.0	$ 5.8	$ 2.4	$ 4.0
Advanced ship machinery	2.0	1.7	1.2	2.0
Competitive nuclear merchant ships	1.4	3.1	4.9	4.0
Advanced ship systems	2.2	1.5	1.9	1.7
Shipping operations information system	1.0	1.0	1.4	3.0
Ship control	-	-	1.0	1.0
Shipboard automation	1.1	1.5	1.0	2.0
Computer-aided operations research facility	-	2.4	2.0	1.4
Advanced ports and intermodal systems	.3	.6	.3	1.5
Satellite navigation-communication	2.0	1.0	1.5	2.0
National maritime research centers	5.5	3.5	3.1	3.2
Marine sciences	1.7	1.5	1.2	.9
Commercial ice transiting systems	.8	-	.5	.5
Advanced pollution abatement systems	1.2	1.3	.9	.4
Advanced tug-barge systems	.7	-	.5	.3
Shipping systems analysis and requirements	1.0	-	-	-
Transfer or carryover	.9	-.9	.2	-
Total	$23.8	[a]$24.0	[b]$24.0	$27.9

[a]Of the $29 million appropriated, $5 million was impounded for fiscal year 1973.

[b]For fiscal year 1974, $19 million was appropriated. The $5 million impounded for fiscal year 1973 was released for use in fiscal year 1974.

Shipbuilding research

The goal of this program is to develop and provide the U.S. shipbuilding industry with the technology necessary to reduce construction and operating costs and increase the industry's productivity.

The program is divided into three primary areas of research:

--Facilities improvement: the development of innovative production techniques and equipment.

--Ship productibility: the development of technical data, management aids, and industrial standards.

--Shipyard automation: the development of advanced construction technology using computerized systems.

Advanced ship machinery

This program's goal is to improve the competitive position of the U.S. merchant fleet by developing new and advanced propulsion machinery and supporting equipment which is more efficient and less costly to build, install, and operate.

Areas being pursued under the program are:

--Analyses of powerplant systems.

--Development of propulsion prime movers and energy converters (heavy duty marine gas turbine and closed cycle gas turbine).

--Development of gear transmission systems.

--Development of a mechanical-electro power generator for use in a cargo refrigeration system.

Competitive nuclear merchant ships

This program is concerned with developing safe, economical, nuclear powered commercial ships to assist the U.S.

Merchant Marine in gaining economic leadership in high-productivity ocean shipping. More specifically, the program will demonstrate, through a joint Government-industry effort, the economic merits of nuclear propulsion by constructing an initial group of nuclear merchant vessels, the first of which will enter commercial service by 1980. The experience derived from successful operation of the nuclear ship Savannah in the 1960s provided assurance that nuclear merchant vessels are technically and operationally feasible.

Maritime's efforts to date have been directed at achieving a standardized propulsion plant for use on ships needing large powerplants. The program's next major milestone will be to negotiate contracts for commercial nuclear ship construction.

Advanced ship systems

The objective of the program is to define the technology requirements of future U.S. waterborne commerce. The technological requirements of future shipping markets are being analyzed and technical and economic merits of shipping systems proposed to meet such requirements are being assessed.

Six projects are currently underway.

--Neobulk shipping: investigating the development of specialized handling methods for cargoes not transportable by the container method because of physical size limitations or economic constraints.

--Commodity form change: studying ways to reduce transportation and handling costs of bulk commodities by physically altering their form to make them more easily transportable.

--Shallow draft tankers: assessing the economics and technology associated with the development of shallow draft tankers needed for U.S. harbors with depth constraints.

--Submarine tankers: investigating the economic and technical feasibility of using submarine tankers to transport oil from Alaska's north slope.

--Liquefied natural gas systems: studying the risks associated with the construction and operation of ships to be used in the transportation of liquefied natural gas and improving design criteria for such ships and developing ship hardware.

--Technology assessment: developing forecasts of the ocean shipping technology needed to meet future requirements of marine transportation.

Shipping operations information system

This program's goal is to provide ship operators with a computer-based information service that will enable them to reduce shoreside costs and documentation, increase fleet productivity, and meet the needs of shippers. Information on cargo movement demand and ship availability can be distributed to U.S. operators through the system.

Elements of the system are in various stages of development. When fully operational it will offer the shipping community a number of ways to make their operations more efficient and competitive in (1) cargo space documentation, (2) intermodal distribution coordination, (3) fleet resources management, and (4) maritime industry reporting.

Ship control

The objective of this program is to improve communications and navigation services to ships which, in turn, will improve the operation of ships and ship control systems. Most of the work involves applying existing technology to new applications, but some basic research is also included.

The communications projects are designed to provide new services, such as data transmission, to ships which will enable better operational control. The navigation projects are aimed at (1) providing better positional control to ships in a form readily usable to reduce groundings and collisions and (2) formulating workload and equipment requirements.

Shipboard automation

This program's goal is to automate shipboard operations involving bridge, machinery, and cargo control. Anticipated

accomplishments of the program include (1) developing a one-man bridge operation at sea for ship control and an unattended mode in the future, (2) improving machinery control through automation, and (3) reducing port time by improved shipboard cargo control.

Computer-aided operations research facility

This program's goals are to improve (1) the operation of ships through research designed to support other maritime programs, (2) ship control and maneuverability, (3) harbor features and aids, and (4) operating procedures. The program will provide a simulation center and a high quality contractor research staff to investigate maritime operational problems, evaluate innovative hardware and concepts, and facilitate the application of these developments to the maritime industry. The facility will include the necessary computer-based equipment to provide a physical and visual simulation of variously arranged ship control spaces creating an environment comparable to that in real situations.

Construction of the simulation center was begun in fiscal year 1973 and when completed in June 1975 will be the world's most advanced center for testing and evaluating new marine equipment and operations.

Advanced ports and intermodal systems

This program's purpose is to assist the U.S. port and terminal industry in developing the required backup capability for the U.S. fleet and the deepwater terminal capability that will be necessary for future bulk imports and exports.

The program is divided into the following areas.

--Advanced terminals: developing new technology in the design of offshore terminals and a network of roll-on and roll-off terminals for domestic traffic.

--Cargo handling: developing cargo systems that can keep pace with increases in ship productivity.

--Emergency service operations: developing a system by which commercial containerships and roll-on and roll-off ships can be adapted quickly for military use.

Satellite navigation-communication

The program objectives are to (1) extend to ships the quality communication services now provided between shore locations and (2) enable continuous, accurate ship location information to be available for use both by ship and shore stations. Such capabilities could result in improved management techniques such as automation, lower manning requirements, and control of ship movements with greater efficiency and safety.

The U.S. space program has provided a capability for global communications which is well beyond existing surface-to-surface links. Through use of existing satellites, shipboard satellite equipment is being developed to improve communications between a vessel at sea and its owner or operator on shore.

National maritime research centers

Research centers have been established at Kings Point, New York, and Galveston, Texas. The staffs at the centers do not perform in-house research. Their principal duties are to monitor research contracts awarded by Maritime.

The Kings Point Center's staff monitors (1) contracts for the development of operational marine system requirements and (2) contractors' tests. It also evaluates operational systems and equipment before at-sea use on commercial ships. The systems include improving the efficiency of maritime personnel, developing automated ship equipment for ship control and navigation, and studying ways to improve ship productivity and port management.

The Galveston Center's staff monitors research by contractors in the development of test and evaluation capability in ship maintenance and repair, pollution control, commercial nuclear propulsion, cargo handling, tug-barge systems, and marine systems aspects of liquefied natural gas.

Marine sciences

This program's objective is to develop advanced technology which will improve the performance of ship systems. This technology will provide the improvements and innovations necessary to attain the goals of other Maritime programs and industry research programs. Areas investigated include (1) new concepts in propeller design to improve propulsive efficiency, (2) the effect of sea loads on ship structures, (3) techniques for powering and controlling ships, and (4) designs which will reduce ship motion.

Commercial ice transiting systems

The purpose of this program is to develop the analytical and technological capabilities to assess the needs and provide for maritime transportation services and port facilities in ice-affected regions. The objective in the Great Lakes and major rivers is to extend the shipping season to 12 months a year and in the Arctic region to a major part of the year.

Advanced pollution abatement systems

The objective of the program is to develop equipment and systems to enable ships to operate within scientifically established standards resulting in pollution-free ship operations. Projects have included developing an improved shipboard oil-water separator and studies of shoreside disposal of ship-generated oily wastes.

Advanced tug-barge systems

This program's purpose is to identify existing and new transportation opportunities where use of advanced tug-barge concepts for ocean transportation could be economically superior. Current work is involved with solving the technical problems which will make these large tug-barge systems feasible. In particular the present concern is the development of linkages which will permit safe operation of these large tug-barge combinations in the ocean environment.

Shipping systems analysis and requirements

The goal of this program was to develop requirements for new competitive shipping systems requiring no Government

support. The work was absorbed into other Maritime programs after fiscal year 1972.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NOAA was established in October 1970 pursuant to Reorganization Plan No. 4 and Executive Order 11564. Its basic mission is to organize a unified approach to the problems of the ocean and atmosphere and create a focal point within the civilian sector of the Federal Government for this purpose.

The table below shows NOAA's total appropriations and the portion allocated to programs which are included in the annual report to the President and the Congress.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$330.0	$370.4	$383.4	$459.7
Amounts allocated:				
Nautical chart services	$ 15.9	$ 17.8	$ 17.1	$ 22.2
Coastal mapping services	4.1	5.4	4.2	5.8
Ocean mapping investigations	8.1	8.8	4.0	4.7
Ship bases and program support	1.8	2.4	.8	4.6
Oceanographic instrumentation and development	.7	.7	1.0	1.0
Data buoy	13.0	13.8	8.5	8.5
National Oceanographic Instrumentation Center	1.9	2.0	2.2	2.4
Coastal zone management	-	-	12.0	12.0

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Amounts allocated: (Continued)				
Sea grant	$ 17.7	$ 21.2	$ 18.1	$ 24.3
International Field Year for the Great Lakes	2.4	3.4	2.2	2.2
Global Atmospheric Research Program	.2	.4	.6	.7
Modeling of oceanic circulation	.4	.8	.7	.9
Structure and motions of the ocean	-	-	1.6	2.1
Marine mining research	1.2	1.4	1.0	1.0
Marine ecosystems analysis	-	2.1	1.0	3.9
Ocean remote sensing research	1.1	1.1	1.5	2.1
Marine prediction research	1.0	1.1	1.1	.5
Research Flight Facility	.8	1.7	2.6	4.0
Manned undersea science and technology	1.5	3.0	1.0	1.4
Ocean dumpsite survey and monitoring	-	-	-	.3
National Environmental Satellite Service	2.6	3.2	4.7	5.3

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Amounts allocated: (Continued)				
National Oceanographic Data Center	$ 2.6	$ 2.9	$ 2.6	$ 2.9
Environmental documentation and information services	.4	.4	.4	.4
National Climatic Center	.1	.1	.1	.1
Biological investigations	11.4	15.3	3.9	7.5
Marine resources monitoring, assessment, and prediction	4.9	5.9	7.2	11.3
Financial assistance	.4	.5	.8	1.0
Fish product and gear development	2.9	2.9	.9	4.7
Statistical and economic services	2.3	2.8	4.7	5.5
Aquaculture research	.7	.9	1.1	1.7
Marine mammals	-	-	1.2	2.9
Environmental impact analyses	.2	.6	1.3	2.4
Anadromous fisheries restoration and enhancement	4.6	4.7	3.6	5.2
Pribilof Islands	3.0	3.2	3.6	3.9

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Amounts allocated: (Continued)				
State-Federal fisheries management	$ 7.3	$ 8.9	$ 9.6	$ 3.9
Enforcement and surveillance	1.1	1.2	1.8	2.4
Ecological investigations	3.6	7.8	1.5	5.6
Basic weather observations	2.6	3.0	4.4	5.3
Basic communications	.6	.6	.9	.9
Basic weather analysis and prediction	.9	.9	1.1	1.2
Public weather services	.3	.3	.9	.5
Marine prediction services	1.9	2.5	1.6	2.7
Hurricane and tornado warning services	1.8	2.1	2.8	2.9
Total	$128.0	$157.8	$141.9	$184.8
Percent of total appropriations allocated	38.8	42.6	37.0	40.2

Nautical chart services

Nautical charts are the basic navigation tool required for the safe and efficient conduct of waterborne commerce. NOAA collects and evaluates marine navigational data and compiles nautical charts and related publications.

To collect marine navigational data, NOAA conducts hydrographic surveys and field investigations to (1) determine bottom configurations, (2) locate both physical obstructions and aids to navigation, (3) compile Coast and Great Lakes Pilot information, and (4) produce a graphic description of navigable water areas. Near the coast and on the Great Lakes, the survey work is done from launches which operate from larger vessels or from shore bases. In the open ocean the work is done from survey ships. Approximately 31,000 square miles of ocean area are surveyed each year.

Data collected through hydrographic surveys and field investigations is used to develop nautical charts and other publications. These documents are then reproduced and available for dissemination and sale to interested parties. The documents include

--sailing charts used as course plotting charts for sailing between coastal ports and the open ocean;

--general charts used to determine visual and radar position location from shore references;

--coast charts for near-shore navigation;

--harbor charts for navigation in harbors and restricted channels;

--small craft charts, which provide safety items, such as the location of marine facilities, tide and current information, and marine weather services to be used by recreational boaters; and

--Coast and Great Lakes Pilot volumes which contain a wide variety of descriptive navigational data, such as navigation regulations, port facilities, and tidal characteristics, that cannot be presented adequately on nautical charts.

Under this program NOAA conducts research to develop new or improved hydrographic systems to increase the productivity and effectiveness of its marine surveying and charting activities. Specifically efforts are directed at improving (1) survey equipment and instrumentation, such as depth sounders and tidal current sensors (2) radio positioning of ships, (3) communications, and (4) data handling and engineering support. In 1972 a major effort was begun to automate nautical chart data acquisition, processing, compilation, and reproduction.

Coastal mapping services

This program's objectives are to (1) provide basic seaward boundary maps of the total U.S. tidal shoreline, (2) provide storm evacuation maps for the Atlantic and Gulf coastal zone areas subject to hurricanes and severe storms, (3) provide tidal information for all coastal areas, including the complete automation of the tide gauge data transmission network by 1978, (4) acquire additional tidal current data at various offshore terminal sites, as well as in Alaska and Puget Sound, for use in navigation and protection of the environment, and (5) provide data essential for the efficient management of Great Lakes' resources and restoration of their water quality.

To accomplish these objectives, the following activities are undertaken by NOAA.

--Coastal mapping: consists of photogrammetric field surveys and supporting office compilation to delineate shorelines, locate near-shore and inshore features, and establish geodetic control for hydrographic surveys.

--Marine boundary surveys: consist of the demarcation, delineation, and graphic portrayal of the high and low water tidal baselines for the United States and its possessions. Principal products resulting from the surveys include special baseline coastal zone maps and reports which are essential for resolving jurisdictional problems in the administration of the Continental Shelf and planning future coastal activities.

--Estuarine and lake investigations: performed to provide measurement, analysis, prediction, and information dissemination services for tides, currents, lake levels, and river flows of the U.S. coastal and estuarine areas, including the Great Lakes and interconnecting waterways. Investigations also provide data relevant to beach erosion and pollution control and abatement.

Ocean mapping investigations

Program objectives which, for the most part, relate directly to some phase of the preparation of geophysical maps include surveying and mapping the sea floor of the Continental Shelf, establishing pollution baseline measurements, and investigating large-scale oceanic phenomena.

Under the program, charts depicting ocean bottom features are produced, environmental assessments to support the development of oil and gas resources are made, the history and structure of ocean basins are analyzed, the character of ocean sediments and mineral deposits are described, and ocean currents and their relationship to pollution problems are investigated. The program is geared to satisfy the data needs of those associated with marine engineering projects, coastal zone management problems, environmental quality investigations, marine life studies, and mineral resource evaluations.

Specific investigations include

--research on ocean waves, from both ships and aircraft, to understand the dynamics of water motion and interaction of atmospheric forces on sea state;

--investigations of selected estuaries to describe circulation, sedimentation, and mixing cycles to understand the effects upon water quality of pollutants entering the ocean; and

--investigations of the dynamics of sediment movements and their effect on the transport of pollutants in the coastal zone and Outer Continental Shelf (OCS) and margin.

Ship bases and program support

Included in this category are the costs of developing, coordinating, monitoring, and managing the operation and use of the NOAA fleet and shore facilities which support other NOAA programs. NOAA provides ship time to all its organizational components; prepares ship operational schedules; supervises ship logistics activities; and directs vessel repair, construction, and replacement.

NOAA operates two major marine centers. The Atlantic Marine Center in Norfolk, Virginia, provides docking facilities and logistic support for NOAA ships operating in Atlantic waters. The Pacific Marine Center in Seattle, Washington, provides similar facilities and support for NOAA ships operating in Pacific waters.

At the time of our review, NOAA had 20 active ships which were used for

--hydrographic surveys (9 ships),

--biological investigations (8 ships),

--ocean investigations (2 ships), and

--estuarine investigations (1 ship).

NOAA is reactivating three vessels in fiscal year 1975 for offshore energy environmental studies.

Oceanographic instrumentation and development

The objective of this program is to provide specialized data acquisition and processing systems for use in field operations. Major oceanographic development activities are centered in

--tidal and current measuring systems,

--nautical charting systems, and

--water quality systems.

Items currently under development include (1) current meters which can measure accurately in areas where speeds approach 12 knots as opposed to available meters with a 3.5 knot current speed limit, (2) reliable shipboard sensors interfaced with available data recording and processing systems, and (3) remote instrumentation, such as bottom-anchored current meters with telemetric capability. These are only a few examples of the advanced oceanographic instrumentation systems presently being developed.

Data buoy

This program, originally established in the Coast Guard in 1967, was transferred to NOAA in 1970. The Data Buoy Program was established to provide a centralized activity wherein the technical requirements of a number of Federal agencies could be considered together to provide efficient and cost-effective development. The objective of the program is to advance the technology of buoy systems to provide the capability for acquiring reliable ocean data at the lowest cost.

In pursuing these objectives NOAA has, through fiscal year 1974, acquired approximately 20 experimental buoys of various sizes for testing and evaluation. These buoys are deployed in varying ocean environments under experimental conditions to test progress made in technology and reliability. During these tests operationally usable data is received and applied. The data buoys are being developed for weather forecasting, storm warnings and public advisories, studies of the marine environment, ground truth for earth observation satellites and to provide information required by transportation, fishing, and marine mineral and marine recreational industries.

National Oceanographic Instrumentation Center

The National Oceanographic Instrumentation Center, established in 1969, acts as the national focal point for the dissemination of technology relating to the testing, evaluation, and calibration of ocean sensing systems.

Its objectives are to

--operate a laboratory to evaluate oceanographic instruments;

--establish techniques and standards to assess the performance of oceanographic instruments;

--conduct cooperative programs among government agencies, academic laboratories, and the industrial community for the purpose of compiling governmentwide requirements on instruments to support the development of standards;

--perform laboratory and field testing and calibration of oceanographic instruments for government, academic, and industrial interests;

--collect and disseminate data on instrument performance and deterioration as a means of acquiring statistically significant samples on which to base design criteria for improved systems;

--generate a central proposal and specification file and disseminate information about ongoing development efforts for oceanographic instruments;

--encourage the coordination of national specifications for oceanographic instrument development; and

--develop ocean measurement instruments and the equipment needed in the testing and calibration of these instruments when they cannot be obtained from other sources.

Coastal zone management

The objective of the program is to promote the preservation; protection; development; and, where possible, the restoration or enhancement of the Nation's coastal zone resources for present and future generations. This is to be accomplished by providing assistance--financial and technical--to coastal States and territories to develop and implement comprehensive management programs which will provide for more rational use of land and water resources by giving full consideration to ecological, cultural, historic, and esthetic values as well as the need for economic development.

The following types of financial assistance are available under the program.

--Management program development grants: to develop a management program.

--Management program administrative grants: to implement an approved management program.

--Estuarine sanctuary grants: to acquire, develop, and operate estuarine sanctuaries.

In addition, NOAA is responsible for providing technical and research assistance to States and territories and coordinating its efforts with other related Federal activities.

Nonfunding efforts to date have consisted of (1) developing guidelines and criteria for administering the program, (2) establishing Federal relations procedures to insure consistency, and (3) defining what the national interest is in the coastal zone.

Funding for the program became available in December 1973. Since that time 31 of the 34 coastal States and territories have applied for management program development grants. Twenty-eight such grants were awarded in fiscal year 1974 and 100-percent participation is expected during fiscal year 1975. One estuarine sanctuary grant was also awarded.

Sea grant

This program, formerly administered by NSF, provides Federal financial support, in the form of matching grants, mainly to colleges and universities to stimulate development, conservation, and use of the marine environment and its resources and to advance related physical and social sciences. Principal activities under the program are research, education and training, and advisory services. The thrust of the program is toward applied research as opposed to basic research.

Areas of research undertaken include:

--Marine resources development: to assist and accelerate the development of new marine business and industry, or aid in improving the productivity of existing marine business and industry through

scientific and technical research directed to management and use consistent with conservation and environmental protection of living and mineral marine resources and their products.

--Socioeconomic and legal studies: to identify and characterize economic factors involved in the development and use of specific marine and coastal resources and to inventory, classify, and analyze international and domestic laws, conventions, agreements, regulations, and decisions affecting marine and coastal resource development and preservation.

--Marine technology research and development: to expand the technological research base on which industry and government can develop more efficient equipment and techniques; explore and evaluate new methodologies for use of the sea and of marine products; upgrade the economic position of existing marine business and industry through improved technology; and provide the technological base for new marine business and industry.

--Marine environmental research: to provide information to coastal zone and resource managers on the effects and consequences of natural events and human activities in the marine environment and develop means of alleviating environmental degradation and preserving the environment.

Appendix II provides a breakdown of the types of research undertaken in these areas.

At the college level the objective of education and training under the program is to insure the availability to the Nation of scientists and engineers with the highest quality of education and skills necessary to meet national, State, and regional marine resource development and environmental goals. This is to be accomplished through improvement and development of college and graduate level courses in the various marine specialties and professional fields. Another education and training objective is to train technical personnel qualified in the various marine specialties through vocational programs designed to impart specific skills necessary to achieve national, State, and regional resource development and marine environmental goals and to meet the specific manpower needs of industry and government.

Marine advisory services provide the link between research and its ultimate application. The objectives are to (1) assist industry and government in the development of marine resources and protection of the marine environment and coastal zone through timely transfer of information generated by research and studies through all appropriate means of communication, including personalized extension services and demonstrations, and (2) inform the public of problems, opportunities, and progress in marine affairs.

International Field Year for the Great Lakes

The International Field Year for the Great Lakes--a part of the International Hydrological Decade (1965-75)--is an experimental program being undertaken by the United States and Canada. The program is designed to improve knowledge of the limnology, hydrology, and meteorology of Lake Ontario and the Ontario basin. This knowledge will provide a scientific basis for improved Great Lakes management activities related to water quality and quantity and environmentally sensitive operations.

Examples of such activities are the

--provision of municipal, industrial, and rural water supply;

--protection of water quality;

--optimization of commercial and recreational navigation;

--control of water levels and flows;

--provision of hydropower;

--control of shore use and erosion; and

--warning of hazardous and destructive conditions.

Global Atmospheric Research Program

The objectives of the Global Atmospheric Research Program--an international research program--are to provide knowledge of the (1) physical processes in the atmosphere that may lead to improvements in the range and accuracy of

weather forecasts over periods of from a day to several weeks and (2) factors that determine the statistical properties of atmospheric general circulation that would lead to a better understanding of the physical basis of climate. The program focuses on two parallel action plans. One plan relates to the design and testing by computational methods of a series of theoretical models of physical processes in the atmosphere; the other relates to observational and experimental studies of the atmosphere to provide the data required for the design of such theoretical models and testing of their validity. The program's Atlantic Tropical Experiment is its first major observational field experiment.

The objectives of the Atlantic Tropical Experiment are to study the structure and evolution of weather systems in the tropical eastern Atlantic and assess the extent to which these tropical disturbances affect the circulation of the whole atmosphere. Because tropical weather systems are closely coupled to related oceanic processes and circulation features, oceanographic studies are integral to the design of the experiment. Oceanographic studies focus on the equatorial current system and interaction of the ocean's upper layers with the atmosphere. U.S. activities in the Atlantic Tropical Experiment began in fiscal year 1972 and are expected to be concluded in fiscal year 1979.

Other regional program experiments planned or in process include the

--Air Mass Transformation Experiment to clarify the transfer processes by which energy and momentum are supplied from the sea to the air,

--Polar Experiment to determine the energy exchange between the temperate latitudes and polar regions, and

--Monsoon Experiment to study the effects of monsoons on global circulation.

In addition, planning for the program's First Global Experiment is underway. Its purpose will be to assemble a complete data set appropriate for the study of the behavior of the global-scale motion of the atmosphere for periods of from a day to a season. U.S. activities are expected to include scientific planning, computer modeling and processing,

data analyses, archiving, and development and procurement of sophisticated technological observing systems.

Modeling of oceanic circulation

Oceanic circulation modeling is a mathematical technique to predict or describe various oceanic conditions such as movements of currents. The purpose of this program is to gain as complete an understanding as possible of the structure and circulation of the earth's oceans.

The basic objectives of the program are (1) understanding the forces that move all the oceans of the world (World Ocean) and their interaction with each other, (2) performing oceanic observational studies by systematically processing the historical data available on temperature, salinity, and tracer chemicals dissolved in the water, (3) developing detailed models of the World Ocean and its regional components and uniformly interpreting this in terms of forces and motions, (4) developing a capability to predict the large-scale behavior of the World Ocean in response to changing atmospheric conditions, and (5) identifying practical applications of oceanic models to man's marine activities.

Structure and motions of the ocean

In this program the water temperature and density; speed, direction, and extent of ocean currents; and sediments and structure of the ocean floor are investigated. Major efforts undertaken include (1) research related to ocean waves to define the forces of water motion and understand the interaction of atmospheric forces with the sea surface, (2) investigations of selected estuaries to describe circulation, sedimentation, and mixing cycles, (3) investigations of the forces of sediment movements and their effect on the transport of pollutants in the coastal zone and OCS, and (4) studies of the corridor of the deep ocean between Cape Hatteras and Cap Blanc to establish a model of the crust across the Atlantic Ocean floor and to increase understanding of the ocean basin geophysical processes. Since these investigations are basic to environmental studies, an effort is made to conduct projects that contribute directly to other projects. For example, studies of selected estuaries can be directly applicable to marine ecosystems-analysis programs.

Marine mining research

The goal of this program is to develop methods to assess the environmental impact of marine mining activities to assist decision makers in regulating these activities.

The first major effort at assessing mining environmental impact was the New England Offshore Mining Environmental Study. This study was to deal with the impact of an actual sand and gravel mining operation in Massachusetts Bay. Although some preliminary studies were completed, the project was cancelled early in fiscal year 1974 before any actual dredging because of difficulties involved in the disposal of dredged material. Currently a 3-year study is underway to investigate the potential effects of manganese nodule mining in the Pacific.

Marine ecosystems analysis

The purpose of marine ecosystems analysis is to (1) describe, understand, and monitor the physical, geological, chemical, and biological processes of distinct marine environmental systems, (2) analyze the impact of natural phenomena and manmade alterations on marine environments, and (3) provide information and specialized support required for effective management of marine areas and the rational use of their resources.

The potential problems caused by ocean dumping, siting of large offshore structures, waste water disposal, and petroleum pollution pose differing impacts in different regions. This program, therefore, is composed of a series of regional projects chosen on the basis of need for environmental data. Major projects in process and planned follow.

--The Marine Ecosystems Analysis New York Bight Project has produced results contributing to the solution of problems dealing with dumping of sewage sludge in this area. Later emphasis will be shifted from ocean dumping to a quantification of the environmental factors involved in the location, design, construction, and operation of major offshore facilities.

--A second project is to deal with the impact of treated municipal and industrial discharges and the fate and effects of crude oil and refined petroleum products on the ecosystem of Puget Sound. Consideration is being given to similar studies in Prince William Sound, Alaska, and the southeast Florida area.

Ocean remote sensing research

Remote sensing is the ability to observe surroundings by passively listening or watching or by probing with a burst or beam of energy. Ocean remote sensing research develops and applies remote sensing techniques to oceanographic research with greater accuracy and in a shorter time than the more expensive and traditional methods of data collection.

Current work includes acoustic probing of both the (1) structure of the water mass and (2) first kilometer of air above the ocean surface (the atmospheric boundary layer). A possible means for measurement of sea surface roughness is being investigated through the use of active microwave and laser techniques. Light detection techniques provide useful data on chemical compounds in the top several meters of the ocean. Satellites provide for regular broad coverages of the entire earth. Sea surface color is being used for the location of current boundaries. An over-the-horizon high frequency radar is being developed which will be capable of providing sea state and current information at ranges from 500 to 2,000 nautical miles.

Marine prediction research

The goals of this program are (1) understanding the exchange processes between the ocean and atmosphere, i.e., involving the air-sea interaction of heat, moisture, and momentum and (2) developing models suitable for predicting tsunami (tidal wave) development from various geological events and the movement of the wave and its build-up based on open ocean tsunami measurements.

Current objectives are to define the impact of a layer of cool freshwater, resulting from a shower, on the warm tropical ocean. Another study will investigate the effect of wind on waves. Tsunami research is concentrating on de-

veloping a model to predict tsunami wave build-up into a harbor with a known depth structure. A system of open ocean tide gauges will be emplaced near Hawaii to detect tsunami waves.

Research Flight Facility

The Research Flight Facility in Miami, Florida, conducts operations with scientifically equipped aircraft in support of NOAA research programs.

The facility is upgrading its equipment to support Project Stormfury in the Pacific during the summer of 1976. Two new aircraft are being procured and will be equipped with modern sensors and data management systems; one of the two existing aircraft has been improved with sensor and data handling equipment.

Manned undersea science and technology

The basic objectives of the program follow.

--Provide manned underwater and operational support to NOAA investigations involving marine resources and environmental problems for which subsurface observations and data collection by man are required.

--Manage the NOAA diving program to insure safe diving and more efficient operations for prolonged manned missions on or near coastal regions and on the Continental Shelf.

--Foster and coordinate manned undersea science projects with other Federal and State agencies, industry, institutes, and universities.

--Encourage and coordinate the transfer of undersea technology, including advances in diver technology, from the Navy when this is in the best interest of the Navy and NOAA and keep abreast of general scientific and technological developments, both civilian and military, from the United States and foreign countries.

--Develop scientific and technical criteria for characteristics of civilian undersea facilities and platforms through the experience gained by using available habitats and submersibles.

This program provides manned underwater support to NOAA research investigations on resource evaluation and management and environmental assessment. Underwater platforms are leased as required to support field research projects. On-site diver and submersible investigations support such projects as studies of herring spawning off the New England coast and the mating and migratory behavior of deep water lobsters.

Studies from ocean floor laboratories are supported to determine coral reef ecology and to establish the effects of pollutants on reef metabolism as an indicator of the health of the ocean environment. The ocean floor laboratories are also used to support marine scientist training in conjunction with the Sea Grant Program, provide field verification of safer and more efficient diving excursion limits developed jointly with the Navy, and provide a means of calibrating and extending the utility of in-situ (positioned) instrumentation. Research submersibles are used to ascertain the physical, chemical, and ecological effects of dumped wastes on the marine environment.

Ocean dumpsite survey and monitoring

The Marine Protection, Research, and Sanctuaries Act of 1972 (Public Law 92-532) established a permit system to regulate ocean dumping, which is administered by EPA and COE. Under the act NOAA is responsible for monitoring and researching the effects of ocean dumping.

The objectives of the program are (1) assessing the environmental effects of ocean dumping by conducting detailed baseline surveys and periodic monitoring of dumpsites, (2) conducting surveys to describe possible alternate dumpsites, and (3) developing the equipment, techniques, and analytical methods necessary to describe dumpsites and assess the environmental effects of ocean dumping.

National Environmental Satellite Service

The National Environmental Satellite Service operates satellite systems designed to obtain environmental data and analyzes and disseminates environmental information based on this data. Oceanographic information obtained from satellites is provided to other NOAA components and government agencies dealing in oceanographic activities and services.

The objectives of the National Environmental Satellite Service program are

--providing imagery of the entire earth and its environment on a 24-hour basis including direct broadcast of this information to ground stations within radio range of the satellites;

--obtaining global measurements of environmental changes, such as temperature, moisture, radiation, and winds, needed for forecasting;

--monitoring continuously the earth's surface, atmosphere, and solar environment for disaster warning and also collecting data from remote platforms such as buoys, ships, aircraft, and balloons; and

--providing satellite-derived information to operational users and developing practical techniques so that the users can apply this information in their programs.

The ocean-related activities of the program are directed mainly toward developing applications for remote sensing technology in five major aspects of the marine environment: ocean dynamics, ocean color, fisheries, coastal processes, and sea ice. Examples of these activities include (1) obtaining sea surface temperature data from satellites for use in developing techniques for the selection of good fishing areas and in the study of fish migration, (2) applying remote sensing techniques for coastal marine water mass and circulation analysis in the New York Bight area, and (3) providing satellite-derived oceanographic data to the Navy for computing sonar ranges for antisubmarine warfare purposes and to the Coast Guard as ocean current detectors for input to its computerized search and rescue programs.

National Oceanographic Data Center

The National Oceanographic Data Center is concerned with the development of a national marine data base, including the acquisition, processing, storage, and retrieval of marine data and information generated by domestic and foreign sources. The Center maintains liaison with Federal, State, academic, and industrial oceanographic activities.

The Center provides oceanographic and selected marine climatological data, data products, and information to domestic and foreign marine science communities. It acts as an interface with ongoing and planned marine environmental programs to (1) establish data management practices, acquisition procedures, and exchange channels, (2) acquire data program information, and (3) compile data base indexes. A major effort of the Center is to describe all existing environmental data bases from which services are available within the United States.

Environmental data and information services

This program is designed to provide information, primarily through scientific and technical publications and bibliographic references, on available environmental data and results and applications of research and technology developments. It acquires, indexes, archives, and disseminates scientific and technical publications, reports, and abstracts from various domestic and international sources of information. Its Environmental Data Index and Oceanic and Atmospheric Scientific Information System projects provide direct computer access and referral service to national and international sources of environmental data and information.

National Climatic Center

The marine programs of the National Climatic Center are designed to (1) assemble, compile, and publish marine climatological summaries of the open ocean, coastal areas, and ports for use by mariners and airmen and provide summary data for the marine publications of other agencies, (2) support the World Meteorological Organization's marine publication program through contributions to international data exchange, and (3) acquire, process, archive, and disseminate

U.S. climatological data assembled from NOAA's National Weather Service, the DOD weather service, the research community, and volunteer weather observers.

Biological investigations

These investigations are performed for fish and shellfish of commercial and recreational importance to understand their basic life requirements and provide information in support of proper allocation and management. In addition, investigations are performed on marine mammals and fish classified as endangered so that such resources can be preserved and protected.

Studies concerning fish and shellfish are performed to determine such things as the factors which influence production and abundance of fish populations, age and growth, distribution, location of spawning areas, and migratory paths.

Marine mammal activity involves researching such things as growth and reproduction rates and behavior and population changes. Assessment and monitoring activities are performed to determine mortality rates and population sizes and trends. Efforts are also underway to develop fishing gear which will reduce the mortality of marine mammals inadvertently caught.

Endangered species activity involves (1) reviewing the status of species already classified as endangered and determining the potential for listing new species, (2) determining critical aspects of life cycles or habitat requirements, and (3) establishing programs for their protection and rehabilitation.

Marine resources monitoring, assessment, and prediction

The goal is to provide information on the status of exploitable fishery resources for international and domestic fishery management. Specific objectives include obtaining information on the composition, extent, and condition of fishery resources; predicting the distribution, abundance, and availability of these resources; and preparing analyses adequate for policy decisions and management actions.

To accomplish these objectives surveys are conducted to (1) measure the distribution and abundance of fish eggs and larvae, (2) assess the distribution and abundance of juvenile and adult fish and shellfish found on or near the ocean bottom (demersal species)--such as haddock and shrimp--and (3) assess the distribution and abundance of fish which actively swim throughout water masses (pelagic species)--such as tuna. In addition, fish catch analysis draws data from the above surveys and uses sport and commercial catch data and data obtained from other NOAA programs for management purposes.

Financial assistance

Financial and management assistance is provided to improve the efficiency and productivity of the U.S. fishing fleet and promote the wise use of fish resources.

This is accomplished by (1) increasing the availability of private capital to finance the construction, reconstruction, or reconditioning of fishing vessels by guaranteeing loans made by private lenders and through deferral of Federal tax, (2) providing direct Federal loans to improve the efficiency, productivity, and/or safety of fishing vessels and encourage participation in underutilized fisheries, and (3) providing indemnification against the risk of seizure of high seas fishing fleets operating in international waters.

Fish product and gear development

The goals are to increase the productivity of the U.S. fishing industry, promote a larger flow of higher quality fishery products to the American consumer, and conserve certain protected fish species under intensive management.

This will be accomplished by (1) increasing supplies of fishery products by developing underutilized fisheries, (2) developing the technology necessary to economically harvest underutilized species, (3) improving technology to reduce waste and costs in harvesting, handling, and processing of popular fish species, and (4) improving the quality and wholesomeness of all fishery products.

Activities include (1) developing new product processes and forms for underutilized species, (2) defining the nutritional value of fish and fishery products, (3) identifying and defining microconstituent problems, such as mercury concentrations in certain fish, (4) providing voluntary inspection services on a fee-for-service basis, and (5) researching, designing, and testing methods of harvesting underutilized species.

Statistical and economic services

The objective is to improve productivity within the harvesting, processing, and distribution sectors of the fishing industry and improve the ability of the consumer to better use seafood.

The objective includes (1) insuring that an adequate data and informational base exists on commercial fishing and market activity and marine recreational fishing activity, (2) providing periodic analyses of economic trends and conditions in the industry's harvesting, processing, and marketing sectors and in international trade of fishery products, (3) providing analytical support on the economic implications of significant NOAA policy or program positions, (4) increasing consumer awareness through educational materials and demonstrations of the economical, nutritional, and high quality aspects of fishery products, and (5) demonstrating the commercial feasibility of producing fish-protein concentrate both domestically and abroad.

Activities include (1) collecting, compiling, and publishing data on such things as the volume and value of catch by species, region, and State as well as according to type of gear used to make the catch, (2) conducting feasibility studies to determine the potential of underutilized species and fish-protein concentrate in domestic and foreign markets, (3) studies of market structure to assist in increasing market efficiency through mechanizing and quality control, and (4) studying the economic impact of alternative fishery management schemes both on the fishing industry and the associated communities involved.

Aquaculture research

The objectives are to (1) strengthen the U.S. domestic and international economic position in marine fisheries,

(2) maintain and/or increase the productivity and competitiveness of the U.S. fishing industry, and (3) conduct the R&D needed to demonstrate to private industry the economic viability of aquaculture for certain fish species.

The objectives include (1) providing the basic background knowledge necessary to implement development of commercial aquaculture for marine shrimp, (2) removing the barriers currently limiting the profitability of aquaculture for freshwater shrimp, blue crab, mollusk, and catfish, (3) developing gravel incubation hatcheries for the new salmon ocean ranching industry, (4) accelerating the commercial viability of saltwater rearing of salmon, (5) increasing salmon production through use of thermal effluent waste, and (6) transferring the developing technology to industry.

Activities include conducting studies of the nutritional requirements of marine and freshwater shrimp and blue crab; studying problems of disease and sexual maturation of marine shrimp; improving spawning, growing, and harvesting methods for catfish; and evaluating and refining rearing systems for salmon.

Marine mammals

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361) establishes, with certain exceptions, a moratorium on the harvesting of marine mammals.

The goal is to protect and conserve marine mammals to maintain the health and stability of marine ecosystems. This is to be done by (1) reducing marine mammal mortality connected with commercial fishing operations, (2) establishing protective fishing regulations, and (3) implementing protection and management programs.

Activities include reviewing permit applications for catching the mammals, issuing permits, and conducting enforcement and monitoring activities.

Important research conducted to accomplish these goals includes the development of techniques to properly assess the status of stocks, determine population trends, and monitor the stocks and the development of new gear to reduce marine mammal mortality.

Environmental impact analyses

Environmental impact analyses are performed to facilitate decisions involving environmental-economic trade-offs in marine areas. More specifically the objectives are to insure full, equitable consideration of living marine, estuarine, inland commercial, and certain anadromous resources and their habitats in (1) Federal legislative, regulatory, and adjudication processes, (2) federally constructed, permitted, or licensed activities causing, or which may cause, environmental alterations, and (3) long-range planning activities.

Activities include reviewing, commenting, and making recommendations on projects or programs which affect marine resources. Examples of these projects and programs are Federal legislation, procedures, guidelines, studies, standards and criteria and projects constructed and/or operated under Federal license or permit. Other activities include (1) participating throughout the planning, construction, and operation of federally constructed water resource development projects to insure the minimization and mitigation of damages to resources, (2) reviewing and commenting on environmental impact statements prepared by other Federal agencies on major projects affecting marine resources and, when requested, assisting in the preparation of these statements, and (3) participating in long-range planning activities such as coastal zone and comprehensive river basin planning.

Anadromous fisheries restoration and enhancement

The objective is to increase the supply of anadromous fish by using hatcheries, aquaculture, and habitat improvement.

The objective includes (1) maintaining or increasing existing production levels of salmon and steelhead trout from hatcheries, (2) continuing fish ladder and screen operations to prevent loss of salmon and steelhead trout during migrations, and (3) determining what pollution abatement facilities will be needed to bring hatchery effluents into compliance with the Water Pollution Control Act (33 U.S.C. 1151).

Activities include (1) constructing and operating hatcheries, fishways, and fish screens, (2) studying hatchery pollution problems for abatement purposes, and (3) providing grants to States, universities, and other non-Federal organizations on a matching basis for enhancement and conservation of fish resources.

Pribilof Islands

The goals are to (1) manage the northern fur seal herd in accordance with the Interim Convention on Conservation of North Pacific Fur Seals and (2) provide, in conjunction with the Alaska Native Land Claims Settlement Act, for the economic and social well being of the Aleut natives until such time that they are self-sufficient.

This is to be accomplished by (1) maintaining the fur seal herds at current levels and (2) providing employment to able-bodied native men to maintain the local economy.

State-Federal fisheries management

The goal is to assist the States in creating a mechanism for cooperative Federal-State management of fisheries to resolve the split jurisdiction and common property problems which restrict or endanger the continuing use of fishery resources for the economic and social benefit of the Nation.

The objectives include (1) developing an effective system and program policy that provides timely management action, (2) developing and promoting appropriate legislation that provides the necessary regulatory authority to effectively manage fisheries, and (3) developing and implementing, on a rationally devised priority basis, management plans that will restore and maintain fisheries of common State-Federal interest.

Activities include developing uniform fishery management planning and implementation guidelines, and management plans for six fisheries have been developed in cooperation with the States.

Enforcement and surveillance

A law enforcement and surveillance capability exists for marine conservation. Objectives include (1) insuring compliance by foreign and domestic fishing vessels with the provisions of various international treaties and agreements or domestic fisheries' statutes and regulations governing fishing activity and (2) providing information on foreign fishing fleet activity off the U.S. coasts needed for future international negotiations.

Activities include working with the Coast Guard on its patrols of coastal and international waters and seizing foreign and domestic vessels suspected of violating laws and regulations.

Ecological investigations

The goal is to understand the impact of natural or man-induced changes in the marine environment on commercial fish stocks and their food chains.

These investigations include (1) quantitatively describing the composition and biomass of components of resource food chains, types and rates of feeding interactions in the resource food chains, and circulation of ocean currents which have an effect on the fishery resources in ocean areas, (2) determining seasonal and annual primary reproduction rates of fish species contributing to the total resource, (3) identifying and modeling those water properties which significantly affect the distribution and abundance of fishery resources, and (4) determining the effects of petroleum products, contaminants, and environmental stress on marine organisms and of cycling of contaminants in an estuary.

Activities include analyzing the stomach contents of fish species collected from resource assessment surveys and identifying and developing conceptual models of food-chain interactions from resource stomach analyses and zooplankton collections. Activities also include determining the (1) physiological and biochemical effects of petroleum products on marine organisms and the mechanisms of petroleum transport, (2) mutagenic (changes in cell forms) effect of cadmium, silver, copper, and other heavy metals on molluskan (oysters,

clams, mussels, squid, etc.) larvae, and (3) effects of nitrogen supersaturation on juvenile salmon and thermal stress on Atlantic mackerel.

Basic weather observations

The goal is to obtain oceanic and atmospheric observations in sufficient density, frequency, and quality to provide a three-dimensional description of the state of the ocean-atmosphere system over the Northern Hemisphere and, to a lesser extent, over the globe for use in prediction models.

The goal is to be accomplished by expanding and improving the collection of ocean and land surface environmental data and developing and implementing improved methods for remotely sensing the atmosphere and oceans by radar and satellite.

Activities include making land surface, marine, radar, and upper-air observations at frequent intervals and various locations and by different facilities such as ships, data buoys, and coastal and offshore manned facilities. Such observations include readings of barometric pressure, wind velocity, humidity, precipitation, and wind direction. Radar is important for tracking severe thunderstorms and heavy rains and detecting and measuring hurricanes and severe winter storms.

Marine observation data is used for preparing forecasts and warnings for inland areas of the United States and, conversely, surface and upper-air data over inland States is needed for preparing warnings and forecasts for the oceans.

Basic communications

The goal is to provide a communications network for collecting and distributing data for use in the preparation of weather forecasts and warnings and furnishing this data to processing offices so that timely forecasts and warnings can be made.

Activities include maintaining and operating numerous circuits for transmitting the information collected to data processing offices. These circuits distribute radar information, severe weather warnings, hydrologic reports and

warnings, general weather information not available on regularly scheduled national networks, and graphic form information such as charts and pictures.

Basic weather analysis and prediction

Weather and sea observations taken daily by stations and ships throughout the world are transmitted to the National Meteorological Center, Suitland, Maryland, where the data is put into mathematical models for prediction of the atmosphere and ocean at specified times in the future. Computers are used to perform the calculations. NOAA conducts continuing research aimed at developing more precise prediction models.

The three-dimensional state of the atmosphere is analyzed several times daily as the starting point for forecasts and predictions. Primary emphasis is placed on producing forecast guidance for 12 to 72 hours in the future. Field forecasters add their knowledge of local conditions to come up with the forecasts. The National Meteorological Center also produces longer-range forecasts covering 3 to 5 days. A 30-day weather outlook, which gives expected departures from normal temperature and precipitation, is issued twice monthly.

Public weather services

The goal is to provide timely and accurate warnings, forecasts, and planning information to meet the needs of the general public.

Improved services to the public is to be accomplished by (1) developing new forecast techniques and models, (2) developing and implementing an automated field operations and services system to improve accessibility to weather information and warnings, and (3) improving dissemination of weather information through expansion of the NOAA Weather Wire Service, automatic telephone answering systems, the NOAA Weather Radio, and cable television.

Activities include local offices preparing warnings and forecasts for their areas for flash floods, heavy rains, blizzards, heavy snow, cold waves, ice storms, hazardous

driving conditions, high winds, and sand storms. Warnings and forecasts are disseminated by radio, telephone, and cable and commercial television.

Marine prediction services

The goal is to provide timely and accurate warnings and forecasts of marine weather and conditions at sea to (1) insure the safety of life and property and (2) increase the efficiency of marine operations such as fishing, offshore drilling, and oil spill cleanup. In addition, improved prediction techniques are being developed.

Activities include providing forecasts and warnings in Great Lakes and coastal water areas regarding severe storms and wind and ice conditions and tsunami warnings in the Pacific.

Research is undertaken to improve the preciseness of storm and weather pattern descriptions. The research includes (1) air-sea interaction studies to better understand the energy exchange processes involving heat, moisture, and momentum, (2) the effects of shoreline and bottom topography on storm surges, and (3) the relation of wind to wave generation on the Great Lakes.

Hurricane and tornado warning services

The goals, to provide timely and accurate warnings of hurricanes and tornadoes and help communities prepare plans for responding to such warnings, include developing models that will reduce the error in the 24-hour predicted position of a hurricane while improving the prediction of hurricane intensity; developing hurricane prediction methods that will reduce by 50 percent the size of tornado watch areas; and improving the detection, tracking, and prediction of thunderstorms.

Activities include preparing position, intensity, and movement analyses of hurricanes and issuing appropriate advisories to the general public and military. Hurricane research is conducted to improve techniques for predicting their formation, motion, intensity, and structure.

Activities concerning tornadoes include issuing watches for severe thunderstorms and tornadoes at designated areas. Warnings are also disseminated as a result of either actual sightings or radar indications. The warnings describe the location, area that could be affected, and the time covered.

Community preparedness activities are also performed for the purpose of developing preventative and protective planning.

CHAPTER 3

DEPARTMENT OF TRANSPORTATION

COAST GUARD

The Coast Guard's main mission is to insure the safety of life and property at sea and to enforce maritime laws and treaties, particularly as they relate to pollution prevention and fisheries conservation.

The following table shows total appropriations and the portion related to marine science activities and oceanic affairs.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total DOT appropriations	$2,087.8	$2,343.1	[b]$5,520.5	$2,195.7
Total Coast Guard appropriations	$ 727.2	$ 820.1	$ 802.5	$ 913.2
Related to marine science activities and oceanic affairs:				
Search and rescue	$193.0	$186.9	$208.7	$239.6
Aids to navigation	113.2	132.5	142.8	174.4
Marine safety	39.6	48.5	48.6	54.8
Marine environmental protection	38.7	34.2	52.2	56.3
Ocean operations	77.6	119.5	79.0	86.5
General and program support	96.9	116.0	122.2	132.6
State boating safety assistance	3.0	4.5	3.5	7.5
Pollution fund	-	-	2.4	10.0
Total	$562.0	$642.1	$659.4	$761.7
Percent of funds for marine science activities and oceanic affairs to appropriations for:				
DOT	26.9	27.4	11.9	34.7
Coast Guard	77.3	78.3	82.2	83.4

[a]In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.

[b]Estimated.

Search and rescue

The purpose of this program is to minimize loss of life, injury, and property damage by rendering aid to persons and property in distress on, over, and under the high seas and waters under U.S. jurisdiction. The following table shows the program funds for operating expenses; acquisition, construction, and improvements; and R&D.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$150.7	$165.0	$192.6	$207.5
Acquisition, construction, and improvements	40.8	21.0	15.3	29.5
R&D	1.5	.9	.8	2.6
Total	$193.0	$186.9	$208.7	$239.6

The Coast Guard is charged with the responsibility to perform any and all acts necessary to rescue and aid persons and save property placed in jeopardy at sea due to marine and aircraft accidents, floods, and ice conditions. Coast Guard activities in this area fall under the national search and rescue plan and other agreements. Other responsibilities include icebreaking operations in domestic harbors and waterways to facilitate the movement of waterborne commerce and assist in the prevention of flooding caused by ice accumulation.

The acquisition, construction, and improvement funds are used for the construction of small search and rescue boats; procurement of medium-range surveillance aircraft for replacement purposes; and replacement, renovation, or construction of shore facilities, such as rescue stations and air stations.

Research projects undertaken in support of the search and rescue program include:

--Icebreaking technology and supporting research: increasing the availability of the Nation's waterways to maritime transportation by extending the navigation season in ice-bound regions of the United States and assisting other Federal agencies, such as NOAA and COE, in the prevention of flooding caused by ice accumulation. Specific projects to be undertaken in fiscal year 1975 include the design completion of a full-scale mechanical ice cutter, operational design completion of bubbler systems (hull friction reducing system for icebreakers), investigation of ice-flushing systems (channel clearing device), and development of an optional polar icebreaker routing system. Effective May 1974 domestic icebreaking activities and polar operations (see p. 59) were merged into a single program titled icebreaking operations.

--Search and rescue vehicle development: providing the Coast Guard with experimental small, high-speed watercraft (air cushion vehicles, etc.) which can increase effectiveness of search and rescue and law enforcement missions at lower cost than existing craft.

--Equipment and technique development: developing and evaluating new concepts and equipment to improve efficiency and safety in the performance of search and rescue; this includes helicopter wide-area illumination prototype system tests for night searches, the testing and evaluation of ship-helicopter systems, and analysis of the rapid personnel recovery system.

--Detection system: developing improved vessel identification and location systems for use in search and rescue missions.

--Command and control: providing improvements in communication systems including area coverage, circuit quality, and reliability and capability to meet future growth requirements; also includes developing new communications equipment for Coast Guard ships and planes and obtaining the necessary data for a maritime satellite system.

Aids to navigation

This program is concerned with facilitating the safe and expeditious passage of marine traffic in coastal areas, inland waterways, and harbors through a system of audio-visual and electronic navigational aids. The Coast Guard establishes and maintains aids to navigation. These aids include light structures, lightships, buoys, daybeacons, long-range electronic aids, short-range radiobeacons, and fog signals. This system of aids extends to the Western Pacific, Arctic, Europe, and Middle East. The following table shows the program funds for operating expenses; acquisition, construction, and improvements; and R&D.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$100.7	$109.3	$119.7	$130.7
Acquisition, construction, and improvements	10.5	20.2	22.6	42.6
R&D	2.0	3.0	.5	1.1
Total	$113.2	$132.5	$142.8	$174.4

A network of manned and unmanned aids to navigation is maintained along our coasts and inland waterways through the use of tenders and shore facilities. Long-range electronic aid stations are operated in the United States and abroad to serve the needs of the armed services and marine and air commerce. In addition, administrative control is exercised over the construction, maintenance, and operation of bridges across the navigable waters of the United States to insure that navigation is not unreasonably interfered with.

The acquisition, construction, and improvement funds are used for the procurement of aids to navigation boats, construction of replacement inland construction tenders, renovation and improvement of several buoy tenders, and modernization of outdated vessel communications equipment

on buoy tenders, the construction and renovation of Coast Guard bases, and establishment of navigation facilities such as lighthouses. In addition, these funds are used to establish new and improve existing waterway aids to navigation, continuing the lighthouse automation and modernization program, and replacing equipment for long-range electronic aid stations.

R&D projects undertaken to support the program include:

--Advanced navaid (navigational aid) technology: developing an all-weather precision navigation system to permit mariners to operate during darkness and periods of low visibility with the same accuracy as during clear daylight.

--Buoy systems development: using new materials and designs to achieve lightweight, easily maintained buoys and moorings which can be serviced by fewer and smaller vessels and developing long-life subsystems, including nonpolluting and efficient power sources, lamps, sound signals, colorants, coatings, and moorings.

Marine safety

The objective here is to minimize, through prevention, the risk of loss of life, personal injury, property loss or damage, and damage to the marine environment which is associated with vessels or facilities engaged in commercial, scientific, or exploratory activities. The table below shows the program funds for operating expenses and R&D.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$38.7	$46.8	$45.8	$51.7
R&D	.9	1.7	2.8	3.1
Total	$39.6	$48.5	$48.6	$54.8

The Coast Guard insures compliance with Federal statutes and regulations pertaining to the merchant marine industry by (1) reviewing plans and specifications for the construction or alteration of merchant vessels, (2) periodic inspections, (3) licensing and documenting vessels, (4) conducting marine casualty investigations, and (5) setting standards, procedures, and practices under which merchant marine personnel are licensed and regulated. It also participates with the Coast Guard Auxiliary and State and local agencies in carrying out a boating safety program.

Research projects undertaken to support the Coast Guard's marine safety objective are shown below.

--Boating safety: identifying specific problems affecting safety and developing solutions to those problems through improved engineering standards, educational programs, and demonstration hardware.

--Vessel safety technology: providing technical knowledge needed to support the establishment of regulations and their effective enforcement, including the areas of collisions and groundings, structural failure, capsizing and foundering, fire and explosions, and crew-passenger safety.

--Cargo safety technology: supporting the establishment and enforcement of regulations pertaining to handling and stowing cargoes to reduce accidents and casualties.

Marine environmental protection

Program funds for operating expenses; acquisition, construction, and improvements; and R&D are presented in the following table.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$24.7	$25.1	$33.3	$40.2
Acquisition, construction, and improvements	10.8	3.3	12.1	9.8
R&D	3.2	5.8	6.8	6.3
Total	$38.7	$34.2	$52.2	$56.3

The Coast Guard's efforts in this area are directed at preventing damage to the marine environment from intentional and unintentional acts and enhancing environmental quality. Other efforts are aimed at safeguarding and securing U.S. ports and waterways against environmental harm, accidental or intentional loss, and damage or injury--thus improving the economic use of ports and waterways while insuring their availability in time of national emergency.

The acquisition, construction, and improvement funds are used for the procurement of boats for port safety and harbor pollution patrols, alteration of Coast Guard vessels to eliminate the discharge of oily and nonoily wastes into U.S. waters, and contruction of a vessel traffic system.

R&D programs in support of this program cover control and removal of pollutants, surveillance and regulatory activities, and environmental observation and prediction.

The following research projects have been undertaken in connection with the control and removal of pollutants:

--Pollution spill response: providing efficient, effective action to minimize oil and hazardous substance spills into navigable waters or adjacent high seas by developing containment and removal systems capable of rapid deployment and operation under various environmental conditions and fostering

development of private spill-response capability by industry. These systems include midrange barriers for semiprotected waters (floating booms, some of which can be air dropped), high seas and tank oil tests of prototype recovery systems, special techniques required to handle oil pollution in Arctic regions, midcurrent and fast-current oil control systems, and high-speed oil pollution equipment delivery systems.

--Pollution abatement systems: reducing or eliminating water pollution from Coast Guard vessels and shore stations by developing treatment for oily waste water, treatment for sanitary waste water, and solid waste management systems and reducing or eliminating air pollution from Coast Guard facilities by developing exhaust gas control and monitoring devices.

--Vessel traffic systems: providing port safety and security by preventing damage and sabotage to U.S. port facilities, including piers, warehouses, and bridges, and protecting the environment from damage due to vessel collisions or groundings by providing navigation position fixes and traffic conflict information to mariners.

--Vessel pollution abatement systems: funds amounting to $3.3 million were used to purchase this system which is employed when a tanker collides or goes aground; under the system large sausage-like bags with pumps are used to transfer the remaining cargo from the vessel and reduce the amount of pollutant released to the sea. The transferred cargo is then loaded into tanks on other vessels or ashore.

Under its surveillance and regulatory activities, the Coast Guard has an R&D project of pollution prevention and enforcement. The project's objectives are to (1) improve the Coast Guard's capability for detecting from airborne and positioned platforms pollution law violations by developing improved all-weather means of detecting, identifying, and quantifying discharges of oil and hazardous polluting substances, (2) provide scientific data for techniques

to determine the impact of pollutants on waters, and (3) develop devices to assist and determine the effectiveness of cleanup operations.

The Coast Guard's effort in environmental observation and prediction also includes the acquiring, processing, and disseminating of marine science data concerning the environment. This includes (1) using vessels and planes for gathering data to develop successful current prediction models, (2) using a percentage of funds for processing environmental data, quality control, and instrument calibration, and data buoy support, and (3) entering into cooperative services with other agencies and educational institutions. Cooperative services with other agencies and educational institutions allow them to make observations using Coast Guard multimission vessels, aircraft, and shore facilities. In addition, the Coast Guard provides the full-time vessel support to NOAA's Data Buoy Center.

Ocean operations

Included in this category are the operation of ocean weather stations, polar operations and oceanographic activities, and offshore law enforcement. The table below shows the program funds for operating expenses; acquisition, construction, and improvements; and R&D.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$67.6	$ 81.0	$72.8	$78.1
Acquisition, construction, and improvements	9.5	38.2	6.2	8.4
R&D	.5	.3	-	-
Total	$77.6	$119.5	$79.0	$86.5

Oceanographic research undertaken includes (1) conducting the International Ice Patrol, which tracks icebergs in the shipping lanes and warns mariners of iceberg locations and probable drifts, (2) improving marine environmental measurement and prediction in furtherance of all Coast Guard programs which would encompass measuring various ocean parameters, such as temperature, salinity, oxygen, currents, wave heights, shifts in polar area ice masses, and drift of survivors in a disabled vessel, craft, or life jacket, and (3) assisting other Government agencies and non-Federal scientific organizations in support of national marine science objectives, such as providing DOD and NSF with icebreakers for polar research and observation data to the Navy for anti-submarine warfare purposes and to NOAA for weather forecasting.

In addition, under the polar operations program, icebreaking services are provided in support of domestic marine commerce and military operations and scientific data is collected to enhance understanding of the polar regions.

Also included is enforcement of international agreements and Federal laws, except those related to pollution, traffic control, and port and vessel safety. For example, enforcement of fishery treaties involves protecting and preserving natural fish resources and national interests in territorial waters, the contiguous fisheries zone, international agreement areas, and other special interest areas of the high seas. Coast Guard patrols enforce laws and monitor international agreement areas to insure compliance of all parties with established regulations.

The acquisition, construction, and improvement funds are used for replacement of radio-teletype communications equipment for icebreakers, modernization of communications equipment on medium endurance cutters, and re-engining of several icebreakers to extend service life.

R&D projects undertaken to support the program included (1) feasibility tests concerned with adopting side-looking airborne radar for use in the International Ice Patrol and (2) research into icebreaker hull coatings to reduce ice friction.

General and program support

The following table shows the program funds for operating expenses; acquisition, construction, and improvements; and R&D.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Operating expenses	$76.8	$ 94.1	$ 99.7	$110.7
Acquisition, construction, and improvements	17.9	18.9	19.3	18.1
R&D	2.2	3.0	3.2	3.8
Total	$96.9	$116.0	$122.2	$132.6

The operating expenses include the cost of operating the training stations, supply facilities, communications services, and nonoperational services at headquarters and district offices which provide overall direction and support of all Coast Guard programs.

The acquisition, construction, and improvement funds are used for the construction, purchase, renovation, and expansion of Coast Guard facilities not included under any of the previous categories.

The R&D funds are used to provide for administrative and project management research personnel at headquarters and for the operation, maintenance, and personnel costs of laboratory facilities.

State boating safety assistance

Financial assistance, as authorized by the Federal Boat Safety Act of 1971 (46 U.S.C. 1474), is provided State boating safety programs. This act provides for a coordinated national boating safety program to improve boating safety and foster greater development, use, and enjoyment of all U.S.

waters by encouraging and assisting participation by the States, the boating industry, and the boating public in development of more comprehensive boating safety programs.

Pollution fund

The fund was established to insure immediate cleanup of oil or other hazardous polluting substances spilled into the navigable waters of the United States, adjoining shorelines, or waters of the contiguous zone. The fund will be used when a spill occurs and the owner or operator of a vessel, an onshore facility, or an offshore facility does not provide immediate cleanup with his own resources. Expenditures from the fund are to be reimbursed by the owner or operator responsible for the spill.

OFFICE OF PIPELINE SAFETY

The Office of Pipeline Safety is under the direction of DOT's Assistant Secretary for Environment, Safety, and Consumer Affairs. One of the Office's responsibilities is to establish and enforce standards necessary to insure safe construction and operation of offshore pipelines used to transport hazardous materials, such as natural gas, petroleum, and petroleum products, to shore facilities.

The Office's offshore activities in fiscal years 1972 through 1974 have consisted principally of conducting studies needed to publish safety regulations. The studies were continued in fiscal year 1975.

No offshore enforcement functions have been performed, but plans have been made to substantially increase the enforcement staff with a view toward potential expansion of offshore gas and oil drillings and establishment of deepwater ports. In addition to the Office's existing field office in Houston, Texas, the Office plans to create and staff additional field offices in Atlanta, Georgia; Kansas City, Missouri; Philadelphia, Pennsylvania; and San Francisco, California.

The Office does not recieve direct appropriations to carry out its offshore responsibilities. An official of the

Office estimated that less than $100,000 was spent by the Office for offshore activities in each of fiscal years 1972 through 1974, and this would also be true for fiscal year 1975.

CHAPTER 4

DEPARTMENT OF DEFENSE

Four DOD agencies--the Navy, DMA, DARPA, and COE--conduct programs in the areas of marine science activities and oceanic affairs. The programs conducted by the Navy, DMA, and DARPA are oriented to support DOD's national security mission. In many instances the results of this work are applicable to nonmilitary efforts in the oceans and are available for dissemination to other Government departments and agencies and private institutions and users. The ocean-related programs of COE are of a nonmilitary nature.

The table below compares total DOD appropriations (exclusive of the Military Assistance Program) with the funds allocated by Navy, DMA, DARPA, and COE to the programs included in the annual report to the President and the Congress on Federal agencies' participation in the field of marine sciences.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total DOD appropriations	$76,654.2	$79,840.0	$83,072.0	$83,801.5
Allocated by:				
Navy	$211.7	$173.9	$188.8	$185.6
DMA (note b)	-	20.9	23.2	27.0
DARPA	18.6	17.6	13.3	10.6
COE	23.4	33.7	28.2	35.0
Total	$253.7	$246.1	$253.5	$258.2
Percent allocated	(c)	(c)	(c)	(c)

[a]In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.
[b]DMA did not become operational until July 1, 1972. Funds shown for fiscal year 1973 are actual obligations.
[c]Less than 1 percent.

DEPARTMENT OF THE NAVY

On August 19, 1966, the Secretary of the Navy issued instructions (SECNAV Instruction 5430.79) which defined the Navy's oceanographic program as

> "* * *that body of science, technology, engineering, operations, and the personnel and facilities associated with each, which is essential primarily to explore and to lay the basis for exploitation of the ocean and its boundaries for Naval applications to enhance security and support other national objectives."

The Navy's oceanographic program, rather than being the title of a separately identifiable program, is the description given to a conglomeration of individual tasks, projects, and support operations--exceeding 200 in number--accumulated for the purpose of intra-Navy monitoring and coordinating and reporting in the annual report to the President and the Congress on Federal agencies' participation in the field of marine sciences. Funds for these tasks, projects, and support operations are spread throughout the full range of the various Navy appropriations. As a result the Navy's oceanographic program budget is not reviewable at any level above the Chief of Naval Operations. Further, the Navy's oceanographic program funding level increases or decreases not because of a conscious decision to that effect but rather in response to the general fiscal climate concerning the Navy's total funding level.

In general, the Navy's oceanographic program includes:

--Oceanographic operations: the collection, analysis, and publication of ocean environmental data, oceanographic environmental prediction services, and related activities.

--Ocean science: R&D undertaken to advance the Navy's knowledge of the physical, geological, chemical, and biological nature of the oceans.

--Ocean engineering: R&D undertaken to increase the Navy's capability to conduct search, location, and

rescue and salvage operations; construct, maintain, and repair underwater emplacements; and conduct diving operations in the ocean.

Not included as part of the Navy's oceanographic program are fleet resources and programs employed in day-to-day naval operations.

Total Navy appropriations and the portion allocated to its oceanographic program are shown below.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations (note a)	$20,983.9	$22,724.3	$23,136.2	$26,496.7
Allocated to Navy's oceanographic program:				
Oceanographic operations	$ 97.0	$ 75.8	$ 82.1	$ 85.9
Ocean science	65.7	60.0	61.5	61.7
Ocean engineering	49.0	38.1	45.2	38.0
Total	$211.7	$173.9	$188.8	$185.6
Percent of total Navy appropriations allocated to its oceanographic program	1	(b)	(b)	(b)

[a]Does not include appropriations for the Marine Corps.
[b]Less than 1 percent.

Oceanographic operations

Oceanographic operations include the collection, analysis, and publication of ocean environmental data; prediction of ocean environmental conditions; training and education of military and civilian personnel in oceanography and the marine sciences; and funding the related capital investment.

The following table shows appropriations allocated to oceanographic operations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Deep ocean bathymetry surveys	$ 9.6	$12.5	$14.2	$16.8
Coastal hydrography surveys	4.1	5.7	6.1	7.2
Undersea surveillance surveys	8.3	8.0	8.9	9.7
Tactical systems surveys	3.2	3.2	4.6	5.3
Analysis and publication of survey results and other data	53.7	30.9	32.7	30.2
Environmental prediction services	9.7	9.6	10.1	10.0
Training and education	4.1	2.1	2.0	2.0
Capital investment	4.3	3.8	3.5	4.7
Total	$97.0	$75.8	$82.1	$85.9

Deep ocean bathymetry surveys

The program goal is to provide for fleet needs in secure positioning and weapon system accuracy. Geodetic and bathymetric data is collected worldwide in the deep ocean to provide for the safe navigation of the fleet, particularly the strategic submarine force. Data collected is provided to DMA

for publication and distribution. The data collected is also available for dissemination to the civilian maritime fleet.

In addition, development of a prototype system to advance the state of the art in deep ocean precise bottom surveys is underway.

Coastal hydrography surveys

Hydrographic data is collected in foreign coastal waters to satisfy defense requirements for combat and amphibious charts and provide for the safe navigation of the military and civilian maritime fleets. DMA publishes and distributes the data collected. No U.S. coastal waters are surveyed by the Navy. This responsibility rests with NOAA.

Undersea surveillance surveys

These surveys provide data on the geophysical character of the ocean as it affects the operation of naval weapon systems and data which can be used to determine the precise geodetic positioning for defense systems. Specific efforts undertaken include

--providing bathymetric and geophysical measurements necessary for the installation of undersea acoustic surveillance systems;

--providing gravity measurements for the safe navigation of the combat fleet and for weapon system accuracy;

--observing special mission doppler satellite tracking data for earth gravitational field measurements;[1]

--determining the precise positioning of navigational aid installations and ground truth of nautical charts through geodetic surveys;

--providing for nautical chart variation through aircraft geomagnetic surveys;

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[1]Although this data is furnished DMA for its satellite geophysics program, DMA does not consider that program as part of the annual report to the President and the Congress.

--providing magnetic data to the DOD world magnetic data library for use by Government, private, and institutional interests; and

--conducting joint coastal surveys with foreign nations.

Tactical systems surveys

In these surveys environmental data is collected on the water column and on the composition of the ocean floor and its sub-bottom as they relate to the performance of operational sonar and surveillance systems. The data is compiled into atlas or chart form and provided to fleet operators and planners to assist them in determining the influence the ocean environment will have on warfare systems and how this influence will vary geographically. Specific products developed include acoustic station brochures, antisubmarine warfare prediction area charts, and mine warfare pilots (publication providing environmental data for use by mine warfare forces).

Analysis and publication of survey results and other data

This includes the efforts to analyze, interpret, and publish the data collected in the surveys described above with the exception of that furnished to DMA for this purpose. Also included is the publication of

--National Intelligence Studies, which terminates in fiscal year 1975,

--long-range ice forecasts to support polar operations,

--environmental planning guides to be used in evaluating the environmental impact of planned future Navy programs, and

--special forecasts and studies to meet the one-time needs of special operations.

Environmental prediction services

Over 50 percent of the effort in this area is devoted to collecting and analyzing oceanographic data, such as on

the ocean thermal structure, and providing forecasts of underwater acoustic conditions to support sonar and surveillance system operations.

Also included are efforts to improve prediction techniques and capabilities, such as wave forecasting, and to develop a shipboard prediction capability for tactical purposes. In addition, included under the program are the operational costs of two aircraft. One of the aircraft conducts observations of Arctic ice conditions to provide data in support of ice forecasting for resupply operations. The other aircraft serves as a platform from which to make observations of oceanographic conditions for use in developing air deployable (dropped from aircraft) or airborne oceanographic sensors.

Training and education

This category includes efforts to establish and maintain a cadre of military and civilian personnel with advanced education in oceanography. Selected naval officers are assigned to attend the Navy Postgraduate School at Monterey, California, to major in oceanography or to attend civilian institutions for advanced degrees in oceanography and related fields. Federal civilian employees may apply and be selected to attend civilian institutions for advanced training. In addition, Navy enlisted personnel who have jobs as sonar technicians or aerographer mates receive some training in oceanography at military service schools.

Capital investment

Most of the funds made available are for shipboard survey equipment modification and replacement.

Ocean science

R&D in this area is conducted to obtain knowledge about selected environmental parameters--in underwater acoustics, physical oceanography, geology and geophysics, chemical oceanography, biological oceanography, and engineering research--to enable the design, evaluation, and optimum use of naval systems (see app. III) for a variety of military missions. More than 80 percent of the effort in ocean science is devoted to developing an effective antisubmarine capability.

The following table shows appropriations allocated to ocean science activities.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Underwater acoustics	$26.7	$24.3	$25.3	$25.5
Physical oceanography	20.7	19.0	19.3	19.3
Geology and geophysics	9.3	8.5	8.6	8.6
Chemical oceanography	2.2	2.0	2.0	2.0
Biological oceanography	3.7	3.4	3.4	3.4
Engineering research	3.1	2.8	2.9	2.9
Total	$65.7	$60.0	$61.5	$61.7

Underwater acoustics

Within the ocean, sound remains the only practical means of transmitting or receiving information beyond a few hundred feet. Research concerned with sound transmission (propagation) loss is directed to identifying and evaluating the paths by which sound travels from a source to a receiver. A combined theoretical and experimental effort is underway to understand these sound paths through experiments at sea and computer simulations.

Computer models--simulations that have been validated by actual at-sea measurements--enable the Navy to predict environmental effects on system performance without actually having to visit the ocean sites. This is accomplished by varying the input parameters to the computer. With the costs of going to sea increasing rapidly, the development and use of computer models is a key part of ocean science activities. The most important computer models in use or being developed are those which pertain to sound propagation.

Another important area of study in underwater acoustics is ambient (background) noise. Because sonar systems must detect a target signal against a background of oceanic noise, it is necessary that the noise field be as well understood as transmission phenomena. Present investigations are concerned with identifying possible noise sources, measuring their strength, and statistically describing their fluctuation in time. Measurements of ambient noise as a function of depth and horizontal and vertical directionality are other important aspects considered. Computer models for predicting ambient noise are also being developed and tested.

Physical oceanography

Physical oceanography is concerned with the physical processes of the ocean and their direct and indirect effects on naval operations. To understand, exploit, and predict the capabilities of these processes, the Navy needs to understand the structure of the sound speed profile in the ocean from surface to bottom, temporal and spatial (time and space) variability of the structure, nature of the surface and bottom, and effect of these on sound.

The Navy's efforts in physical oceanography are directed at describing, measuring, and modeling the ocean's physical phenomena, which include currents and waves, mass and energy exchange between the atmosphere and ocean surface (air-sea interaction) and within the water column, and coastal and inshore processes. This work interfaces with the Navy's efforts in chemical and biological oceanography.

The Navy's study of the air-sea interaction process constitutes a major part of its efforts in the physical oceanography area. Specifically this study is directed to understanding and describing the physical and chemical processes of energy exchange through the sea surface, determining air-sea exchange rates, and understanding the influences of the atmosphere upon the sea and the sea upon the atmosphere to make accurate predictions. This information is needed by the Navy because the complex interaction between the sea and atmosphere frequently dominates near-surface antisubmarine warfare. In this connection waves generated by the wind stir the near-surface waters and alter their sound speed

structure. The same wind sets the surface water in motion as a wind-driven surface current and the waves scatter sound at the surface.

In addition, instruments and techniques are being developed to better measure and assess oceanographic parameters, such as currents, waves, temperatures, and densities. Numerical modeling for weather prediction; Arctic ice drift; and oceanographic phenomena, such as general ocean circulation, are also being studied.

Geology and geophysics

In this area the Navy is studying the structure and properties of the sea floor, oceanic crust, and upper mantle; natural processes active there (ocean floor effects); and variations in the earth's gravitational and magnetic fields. Obtaining this information involves the development of scientific methods and instruments, sampling techniques, and methods of analyzing and interpreting data.

With these tools the Navy can acquire the information which it needs to fulfill new developmental system requirements and improve geological and geophysical surveying capabilities, ocean bottom engineering, magnetic anomaly detection (identifying the cause of changes in magnetic properties of the earth's crust), inertial navigation, and charting.

Chemical oceanography

Research in chemical oceanography is directed at understanding the controls and mechanisms giving rise to and maintaining the chemical characteristics of the ocean environment and properties of natural chemical balance. This information is needed by the Navy to solve the diverse operational problems with which it is faced.

Specific studies undertaken concern organic and inorganic chemical composition, geochemistry, trace element chemistry, physical chemistry, radioactive isotope chemistry, and the exchange of chemicals at the air-sea interface. The results of these studies will not only have a direct bearing on specific problems, but the understanding gained on the

chemical processes occurring in the marine environment will contribute significantly to solving chemically related problems which will arise in the future.

Biological oceanography

The biology and ecology of marine organisms are of interest to the Navy in connection with the fouling and deterioration of equipment and their effect on the activities of underwater swimmers. Knowledge of the nature of marine organisms, their physiology and seasonal and geographic distribution, and means for their control are needed to predict and prevent or minimize their adverse effects on Navy operations.

As a result of its investigations, the Navy can now predict the kinds of infestations which will occur in waters of known properties and particular geographic regions. Worldwide collections are being made of marine boring and fouling organisms and their characteristics are being studied and catalogued.

A major effort being undertaken concerns the acoustical properties and behavior of marine organisms which actively or passively alter the operational efficiency of the Navy's acoustic signal emissions. The passive components are large mammals, schools of fish, and plankton that scatter sound and thus appear as false targets or background reverberation or lessen the intensity of the acoustic signal.

Another effort is directed at recording and analyzing sounds produced by marine animals and their geographic and temporal distribution and behavior as it relates to sound production. Recently a 15-year study on sounds made by 206 fish species along the U.S. Atlantic coast and in the Caribbean Islands was published.

Research is also being done on how to protect naval personnel against attacks from predatory sea animals. Specifically the research is directed to determining how to avoid needless exposure to danger, escape an attack or threatened attack, and drive away the predators.

Engineering research

The engineering research that is performed is generally directed to improving the Navy's capability in the ocean science area, although, in many instances, the results of the research may be used to improve the operational capabilities of the fleet. Efforts undertaken include

--developing minimum size, maximum strength, corrosion-free deep ocean rigging;

--increasing the sensitivity and aerial coverage of optical, magnetic, and acoustic sensors; and

--decreasing biological fouling of equipment subjected to long-term underwater exposure.

Ocean engineering

R&D in this area is directed to developing the systems and engineering technology necessary to increase the Navy's capability to conduct operations at any depth in any ocean.

The following table shows appropriations allocated to ocean engineering activities.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Rescue	$13.7	$ 7.6	$ 5.8	$ 3.6
Salvage	.8	.9	1.0	1.7
Diving equipment	8.2	10.4	10.5	11.3
General applications	23.9	16.5	18.4	21.4
Capital investment	2.4	2.7	9.5	-
Total	$49.0	$38.1	$45.2	$38.0

Rescue

The Navy is directing its efforts in this area to developing a capability to rescue personnel from disabled combat submarines. The major emphasis has been on designing, constructing, and testing a deep-submergence rescue vehicle. In this regard such items as motor controllers, electrical distribution systems, buoyancy materials, and hull penetrators require extensive development and testing.

The deep-submergence rescue vehicle has been designed to be transported by aircraft, combat submarine, or a salvage-rescue ship. Upon arrival at the rescue site, it descends as many times as necessary to mate with the distressed submarine and rescue trapped personnel.

Except for one research submersible, the operational costs of submersibles are not reported as part of the Navy's oceanographic program.

Salvage

The emphasis in this area is on developing the systems and techniques to recover objects of military interest or economic value from the ocean floor. One of the Navy's projects in this area is directed at developing a system for recovering large objects from continental shelf depths. The system will include large pontoons capable of lifting 100-ton objects. Other work has included the development of pontoon propulsion motors and techniques for controlling the ascent of the item being recovered. This project is nearing completion.

Another project involves developing the capability to salvage smaller objects (5 to 15 tons) from depths of 20,000 feet. Initiation of the project was delayed until fiscal year 1974 to permit application of the technology that was developed for the shallow-water salvage project. Initial efforts have been directed to designing and fabricating a small lift pontoon.

In addition, the Navy has developed a device--referred to as an acoustic transponder--for use in searching for lost objects. This device will be attached to certain weapons and

equipment, such as nuclear bombs, which, if lost, will transmit a signal to guide search personnel to the recovery point.

Operational costs related to the salvage program are not reported by the Navy as part of its oceanographic program.

Diving equipment

In this area the Navy is developing improved life support systems and gear and tools for divers to increase their efficiency, depth and work capability, and safety. Specific projects underway have as their goal the development of systems for nonsaturated diving to depths of 300 feet and saturated diving to depths of 1,000 feet.

Conducting safe working dives requires that a diver be unencumbered by his life support equipment and working tools. For this to be accomplished, it is necessary that fins, mask, wrist watch, depth guage, air supply, regulator, clothing, communications equipment, navigation equipment, physiological monitoring equpiment, heating device, and breathing gas purifier be designed as an integrated system. The major effort presently is on developing the physiological monitor, a device which will measure and transmit to a medical officer on the support ship such data as the diver's heart and respiration rates and body temperature. Also being developed is a carbon dioxide sensor which will sense the amount of carbon dioxide in the breathing gas and regulate the amount of oxygen accordingly.

In addition, commercial diving platforms, which are little more than elevators open at the bottom, are being purchased and evaluated for safety and applicability to Navy diving. The Navy intends to select the best features from these commercial platforms and write a Navy specification.

The Navy has also developed a helium recovery system to purify helium--one of the gases frequently mixed with oxygen to produce a nontoxic breathing gas--and permit its reuse.

The salary, training, and equipment costs of the Navy's 4,000 divers in the fleet are not reported as part of the Navy's oceanographic program.

General applications

The objective of deep ocean engineering is to develop engineering components and techniques, such as (1) electromechanical cables, (2) an underwater acoustic imaging system, (3) improved deep ocean search equipment, (4) pressure-tolerant electronics, (5) a lithium-seawater battery, (6) underwater lights, and (7) manipulator arms. These components and techniques can then be used in existing engineering systems--for example, rescue and salvage activities--and/or new engineering systems, such as the remote unmanned work system which is designed to perform a variety of engineering and scientific tasks at 20,000 foot ocean depths.

The objective of diving medical support is to ascertain what influence the ocean environment has on divers' physical and psychological condition.

A major project being undertaken is directed at eliminating or minimizing the health and safety hazards of diving while determining man's safe physiological diving limits. Ongoing work includes conducting dives in high-pressure chambers to test decompression schedules and breathing gas mixtures, determine metabolic requirements, evaluate diver performance capabilities, and evaluate diver-worn life support equipment. A device has been developed to measure bubbles in a decompressing diver's blood stream. Further research is required to equate bubble formation with decompression sickness. A study has been undertaken to evaluate the use of neon-helium breathing gas mixtures for use in short-term dives to intermediate depths.

Other efforts undertaken include

--studying the cause and means for prevention of aseptic bone necrosis, which may cause pain and loss of function of weight bearing joints;

--studying a pressure induced central nervous system disturbance, referred to as high pressure nervous syndrome, which is characterized by incoordination preceding convulsion;

--seeking to improve personnel screening for swimmer-diver duty;

--developing improved procedures for determining changes in psychophysiological functions and task performance capabilities under different conditions of workload and work schedule, sleep loss, and physical environment; and

--studying the alterations of commonly used drugs induced by hyperbaric exposure.

Capital investment

Funds made available are used to construct facilities for ocean engineering purposes.

DEFENSE MAPPING AGENCY

Effective July 1, 1972, DMA became the sole agency within DOD responsible for the production and distribution of topographic, nautical, and aeronautical maps and charts to the Army, Navy, and Air Force. This function was previously performed by each service. The data for the maps and charts is supplied by the services. DMA also participates in R&D programs.

Funds allocated by DMA to ocean-related activities follow.

	Fiscal year		
	1973 (note a)	1974	1975
	(millions)		
Total appropriations	$154.4	$176.2	$193.1
Allocated to ocean-related activities:			
Production and distribution of charts and maps	$ 17.2	$ 19.6	$ 22.4
R&D programs	3.7	3.6	4.6

	Fiscal year		
	1973 (note a)	1974	1975
	(millions)		
Total	$ 20.9	$ 23.2	$ 27.0
Percent of total appropriations allocated to ocean-related activities	13.5	13.2	14.0

[a]DMA did not receive an appropriation for fiscal year 1973. Funds were transferred from the three military services and the Defense Intelligence Agency. The figures shown are actual obligations.

Production and distribution of charts and maps

DMA furnishes the Navy with nautical charts, sailing directions, and related navigation publications and special charts for use in antisubmarine and undersea warfare. Certain nautical charts and safety-at-sea information is also provided to the U.S. merchant marine and mariners in general. DMA produces charts of the coastal waters of foreign nations and the deep ocean. NOAA produces and distributes charts of the coastal waters of the United States, its territories, and possessions.

R&D programs

DMA participates in R&D programs to the extent that these programs relate to DMA's mapping and charting mission. For the most part R&D is performed by the Navy with DMA functioning as the program manager and providing the funds. The following table shows DMA funds allocated for R&D.

	Fiscal year		
	1973	1974	1975
	(millions)		
Bottom Topography Survey System	$ 2.9	$ 1.6	$ 1.4
Hydrographic Survey and Charting System	.2	.6	.5
Automated cartography system	.6	.4	.4
Other	-	1.0	2.3
Total	$ 3.7	$ 3.6	$ 4.6

Bottom Topography Survey System

This is a system to develop topography data about the deep ocean bottom. The system, with computer assistance, will provide a chart, in strip form representing several miles width, showing the shape of the ocean bottom. Testing of the system will be completed in fiscal year 1976.

Hydrographic Survey and Charting System

This is a system to speed the gathering, correcting, and use of mapping and charting data. The system is designed to provide data primarily about remote coastal areas not contiguous to the United States--under hostile conditions--where shore support would not be available or expected. It will be able to survey and provide charts on board ship in about 16 days, but usable hydrographic data can be developed in 24 hours. Since parts of the system would be applicable to a system that NOAA could employ, NOAA is kept informed of the progress being made in the system's development.

Automated cartography system

This system was designed to automate the production of maps and charts. DMA is in the final stages of installing

the system. Future efforts will be directed at increasing the system's capability, capacity, speed, and product response.

Other

This category consists of DMA R&D funds furnished to the Navy for such activities as (1) the development of fluorescent navigation charts, (2) the development of systems for collecting shallow and deep water data, (3) geodetic and geophysical support of satellite activities, and (4) development of ocean readiness capability information for data base and data bank activities.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

DARPA's mission is to conduct high-risk, high-payoff R&D in areas where defense technology appears to be falling behind or where the risk of falling behind cannot be afforded. In this regard, it initiates, sponsors, and funds R&D programs with military potential until the feasibility of concepts is demonstrated and then transfers responsibility for sponsorship and support of these programs to one or more of the military services. DARPA uses the military services or other Government agencies as agents for its programs to perform in-house R&D or to contract for R&D.

Total DARPA appropriations and the portion allocated for ocean-related R&D programs are shown below.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$209.8	$199.7	$194.3	$202.3
Allocated to ocean-related R&D programs:				
Stable floating platforms	.7	.1	-	-
Surface effect vehicle	4.1	2.5	1.0	.2

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Undersea power systems	1.2	2.5	.6	.7
Nonacoustic detection techniques	3.7	5.0	3.5	4.8
Underwater acoustics	3.4	4.3	3.7	2.5
Underwater viewing and imaging	1.6	.9	1.1	.5
Acoustic communications	.9	1.0	1.8	.9
Other	3.0	1.3	1.6	1.0
Total	$18.6	$17.6	$13.3	$10.6
Percent of total appropriations allocated to ocean-related R&D programs	8.9	8.8	6.8	5.2

Stable floating platforms

DARPA's goal was to conceive, design, build, and demonstrate the feasibility of large stable floating platforms in open seas. The concept was directed toward a design that could be expanded into a platform with large area and load handling capabilities. Specifically investigation was focused on large floating airfield size platforms and developing and demonstrating techniques for coupling large platform sections in the open sea under adverse weather conditions. Completion of scale model tests during two separate sea operations in 1973 proved the validity of the preliminary design from which a full-scale platform could be developed to support various military missions, such as small submersible operations, large object salvage, and saturated diving operations. DARPA's participation in the program was completed in calendar year 1973.

Surface effect vehicle

This program was directed at developing the technology required to exploit the potential of the surface effect vehicle as a high performance military platform for Arctic operations. Major tasks undertaken included

--defining and quantifying the Arctic environment as it related to surface effect vehicle design and operation,

--developing vehicle system and subsystem technology for effective operation and maintenance,

--developing critical technologies by means of design studies of 150-ton and 500-ton surface effect vehicles,

--developing an obstacle avoidance system responsive to ice and conventional terrain obstacles, and

--defining long-range communication and navigation systems compatible with the Arctic operation.

Surface effect vehicle technology and design developments have been transferred to the military services. DARPA's program involvement will terminate at the end of fiscal year 1975.

Undersea power systems

R&D on unconventional, closed cycle, chemically fueled power systems that show promise of increasing the operating capability of small unmanned submersibles was undertaken in this program. Considerable effort has been devoted to determining the most promising type of engine and fuel for undersea applications. The closed Brayton cycle gas turbine and a classified fuel system were selected for development. A laboratory version has been built and is under evaluation.

Nonacoustic detection techniques

Although the characteristics of the ocean dictate that underwater acoustics will continue to provide the primary means of detecting and localizing submarines, the potential

impact of developing a viable nonacoustic detection or localization technique dictates the careful determination of the limits and applicability of physically plausible concepts. Accordingly, investigations have been made of such submarine produced effects as the (1) small but ordered underwater and surface displacements produced by vehicle motions, (2) possible modifications to wind-driven surface waves, (3) trail of possible contaminants, (4) disturbances in the earth's electric and magnetic fields, and (5) distortion of the ocean's natural thermal structure caused by vehicle passage.

Underwater acoustics

In this program R&D is conducted to determine the physical limits imposed on undersea acoustic sensors by the ocean medium in which they must operate. The key factors which limit the performance of undersea acoustic systems are the

--space and time stability of natural and manmade background noise,

--direction and intensity of that noise, and

--degree to which that noise and signals from potential targets remain correlated as they propagate over ranges of interest.

Experiments are being performed with linear arrays of acoustic sensors to measure these phenomena. The results of these experiments are providing the basis for design of advanced undersea acoustic systems.

Other work performed by DARPA in underwater acoustics includes the following.

--Advanced sound sources have been investigated, developed, and tested to determine the feasibility of using them in future sonar systems. An example of these sources is a vertical line of explosive charges carefully sized and shaped and simultaneously set off to produce reenforced sound waves.

--Synthetic aperture sonar has been experimented with to determine the feasibility of an underwater system

corresponding to an airborne synthetic aperture radar system for ocean and ocean bottom inspection and surveillance.

--A suite of acoustic transmitting, receiving, and recording equipment is being developed for deep submersibles which will allow measurement of acoustic parameters of midwater scatters, measurement of small bottom features, and detailed area surveys.

--A two dimensional large-size acoustic array is being developed to study the limits imposed on sonar performance by the oceanic noise field.

Underwater viewing and imaging

A program for extensive measurements of underwater light scattering and absorption has provided the basis for significant improvements to existing undersea viewing systems as well as for the design, development, and evaluation of an advanced undersea viewing system using a laser light source and specially arranged optical components. Underwater imaging using an acoustic sound source to produce sound from the object of interest has been attempted through investigating the feasibility of a system based on the principles of diffraction of a laser light beam by the reflected sound. Preliminary experiments show that fair quality images of submerged structures can be obtained with good resolution, exterior materials can be identified, and dimensions of objects can be determined.

Acoustic communications

The stability of the sound transmission path affects the performance of an undersea acoustic communication system. If the transmission path is not carefully characterized, it is often not possible to design a reliable communications system. DARPA is conducting experiments and making analyses to determine the design parameters for undersea acoustic communications systems which can adapt readily to changes in the properties of the transmission path, thereby eliminating the requirement for a prior knowledge of the path.

Other

Arctic operational technology

This program addressed the environmental factors influencing naval operations in the marginal sea ice zone, where sea ice is present for part of the year. Measurements and analyses of physical properties of these waters have provided insight into time and space variations influencing the propagation, scattering, and absorption of sound. Data on swell and sea ice and the noise created have been studied. Techniques to provide stereo-photographs and sequential infrared maps of the sea ice canopy from aircraft have been developed. The relationship of top and bottomside pressure ridges have been studied based on data gathered simultaneously from above and below the sea ice surface. Statistical analysis of the data is establishing the validity of predictions of bottom and total ice thickness profiles made just from topside measurements. A sea ice penetrometer to determine sea ice thickness when dropped from an aircraft also was successfully developed.

An unmanned Arctic research submersible system was developed and tested and is now being used by the Navy. This system has two major elements: (1) an unmanned submersible vehicle which serves as a mobile instrument carrier and (2) a remote tracking, guidance, and recovery system. The program developed and demonstrated a capability to conduct under-ice research with unmanned, untethered vehicles. This permits work in support of Arctic environmental submarine and weapon programs to be conducted with a high degree of control at relatively economical support costs compared to operations using manned submarines.

Advanced marine technology

This program explores new avenues of small-submersible technology as it applies to the Navy's military needs. The research is directed to developing advanced instrumentation, equipment, and techniques for use by deep-diving submersibles. The deep-diving submersible Alvin is the platform used in proving the feasibility of the advanced capabilities sought. The program has developed a precision navigation system which permits return to the same spot in the ocean to an accuracy

of 5 meters and an automatic work package which can perform tasks such as taking core samples while unattended. Current improvements in the navigation system will increase position accuracy to 1 meter or less. The goal is to improve the data collection capabilities of manned and unmanned small submersibles by improving navigation accuracy; magnetic, visual, and acoustic search or positioning systems; vehicle operating characteristics, such as better handling, endurance qualities, and data storage and by increasing weight lifting capacity.

Advanced submarine concepts

This program examines the technologies that are limiting the development of advanced submarine systems. The majority of the effort has been confined to conceptual studies and trade-off analyses of the technical and operational problems associated with small submarines. The problems and utility of unusual submarine concepts, such as separate or special mission vehicles, have also been investigated.

CORPS OF ENGINEERS

COE (Department of the Army) is responsible for development of the Nation's water and related land resources. Marine-related activities are undertaken basically in the coastal zone and estuaries of the United States including the Great Lakes.

The following table shows total COE appropriations and the portion allocated to marine-related activities.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$1,589	$1,952	$1,770	$1,706
Allocated to marine-related activities (note a):				
General investigations:				
Navigation studies in coastal zone	$ 4.2	$ 5.0	$ 3.8	$ 3.9
Flood control studies in coastal zone	.7	.7	.7	.9
Beach erosion control studies	.5	.6	.5	.7
Special and comprehensive studies	3.7	9.0	5.7	6.3
R&D in coastal zone	4.1	3.2	3.7	3.4
Construction planning:				
Advance engineering and design	5.0	8.1	3.0	3.8
Engineering and design of construction projects	1.0	1.2	.9	1.4
Operation and maintenance:				
Engineering on maintenance in coastal zone	.9	.9	.9	1.0
Regulatory functions-permits in coastal zone	3.0	3.4	5.0	5.4

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Dredged material research program	.3	1.6	4.0	8.2
Total	$23.4	$33.7	$28.2	$35.0
Percent of total appropriations allocated to marine-related activities	1.5	1.7	1.6	2.1

[a]Programs listed include funds for collecting basic environmental data and predicting the environmental effects of projects.

General investigations

Studies made are generally for (1) improving coastal and Great Lakes waterways and harbors, (2) protecting shores against tidal and hurricane flooding, (3) halting beach erosion, (4) developing general information which can later be used for specific studies and projects, and (5) investigating coastal phenomena.

Navigation studies are made in the coastal zone and estuarine areas. They include commercial and small-craft harbor studies, deepwater port studies, inlet and estuary studies, and structural control studies of channels and harbors for navigation purposes. Flood control studies are also conducted in the coastal zone and in estuaries and involve hurricane protection, flood plain management services, storm surge and tsunami protection, and estuarine flooding protection. All of COE's beach erosion control studies are made in the coastal zone. These are usually multipurpose studies for recreation, shore protection, and navigation purposes.

Four special studies undertaken, which have as their general purpose the development of information which can later be used for specific studies and projects, follow.

--Chesapeake Bay: this study will consider the entire water and related land resources of the Chesapeake Bay and develop information on navigation; flood control; water supply and quality; recreation; living resources; nonliving resources; and the social, economic, environmental, and political processes that influence water and land use.

--Great Lakes navigation season extension: this study will examine the physical, environmental, social, and economic consequences of ice control for a longer season for Great Lakes' carriers.

--Water levels of the Great Lakes: this study will investigate water level fluctuations on shore property, navigation, power production, and resources development and will consider alternative means for regulating the levels and their consequences for users of the Lakes.

--Texas coast hurricane: this study will investigate the array of alternatives and implications for various types and degrees of hurricane protection on the human and natural resources of the entire Texas coastline and associated bays.

COE also performed the Long Island Sound comprehensive study to develop the physical, social, economic, and environmental data required to select specific projects to be undertaken at a later time.

R&D in the coastal zone investigates coastal phenomena, such as waves, tides, currents, and sedimentation, in response to the need for information for project purposes. This includes such things as collection and analysis of data on shore processes and determining the effects of construction on coastal ecology. Other R&D in the coastal zone involves inlet forces, harbor water movement, and the stability of coastal structures.

Construction planning

Advance engineering and design work is performed after a study has been completed and a project authorized for

construction. This work is needed to complete the preconstruction planning of flood control, navigation, and beach erosion control projects in the coastal zone. For example, planning efforts have been undertaken for projects related to the deepening, widening, and maintaining of harbors and waterways and to providing safe entrance channels.

Engineering and design changes may be needed after construction of a project has started. This additional work during the construction period is considered part of construction planning.

Operation and maintenance

The two important areas under this activity are the (1) regulatory function regarding permits for private construction in the coastal zone and (2) the dredged-material research program. Some engineering planning in connection with the operation and maintenance of projects considered marine-related is also included.

About one-half of the permits for construction in navigable waters are for structures in coastal estuarine or adjacent wetland areas. Over 4,000 permits were applied for in fiscal year 1974 in the Great Lakes region, a region with about 5 percent of the Nation's shoreline.

Under the dredged material research program, studies are being made of the environmental effects of dredging and disposal and of methods to more economically handle and use the materials. Dredging of the Nation's waterways, channels, harbors, and inlets produces a vast volume of material that is not economically efficient or environmentally sound for disposal in the traditional ways. Construction of artificial wetlands appears to be a promising alternative to the traditional dumping at sea of dredged sand and silt. Methods for replenishment of beaches with suitable dredged sand are also under study.

CHAPTER 5

DEPARTMENT OF THE INTERIOR

Eleven of the 19 DOI constituent organizations, as part of their overall missions, participate in marine science activities and oceanic affairs. Generally the 11 organizations consider that only those activities conducted on the oceans and in coastal counties have a relationship to marine science activities and oceanic affairs. Those activities conducted in the coastal counties which the organizations considered as having no relationship to coastal zone management or marine science are not included in this chapter. In some instances the National Park Service, the Bureau of Indian Affairs, and the Fish and Wildlife Service carry out programs which are primarily within, but may extend beyond, coastal county boundaries and such programs are considered to be related to marine science activities and oceanic affairs, i.e. management of national parks and anadromous fish programs.

The following table compares the total DOI appropriations with the funds allocated by the 11 constituent organizations to marine science activities and oceanic affairs.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations	$2,484.8	$2,630.9	$2,554.9	$3,453.9
Allocated to marine science activities and oceanic affairs:				
Fish and Wildlife Service	$18.8	$20.9	$28.6	$22.0
National Park Service	13.1	16.9	28.9	29.8
Geological Survey	14.2	17.0	23.5	42.5
Bureau of Land Management	.7	1.5	3.5	18.6

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Bureau of Mines	1.5	1.5	1.8	1.8
Bureau of Outdoor Recreation	2.5	.4	1.5	(c)
Office of Saline Water	2.1	1.1	-	-
Office of Water Resources Research	.6	.9	1.0	.7
Office of Territorial Affairs	.5	.6	.6	.9
Bureau of Indian Affairs	.4	.4	.4	2.0
Bureau of Reclamation	.4	.3	(b)	-
Total	$54.8	$61.5	$89.8	$118.3
Percent allocated	2.2	2.3	3.5	3.4

[a] In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.

[b] Less than $50,000.

[c] The Bureau was unable to furnish the amount.

FISH AND WILDLIFE SERVICE

The following table compares funds allocated by the Fish and Wildlife Service to marine science activities and oceanic affairs with its total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$150.9	$158.6	$180.6	$207.5
Allocated to marine science activities:				
Fish hatcheries	$ 3.7	$ 4.9	$ 5.5	$ 4.9
Wildlife refuges	7.7	6.5	12.5	[a]5.3
Federal aid for fish and wildlife restoration	2.8	3.0	3.0	3.5
Law enforcement for fish and wildlife species	.3	.3	.6	.7
Fishery and wildlife research	2.9	3.4	4.1	4.6
Ecological assessment	.9	2.0	2.0	2.5
Technical assistance for management and development of fish and wildlife resources	.5	.8	.9	.5
Total	$18.8	$20.9	$28.6	$22.0
Percent allocated	12.5	13.2	15.8	10.6

[a]Excludes funding for land acquisition.

Fish hatcheries

The goal is to restore, maintain, and enhance anadromous and Great Lakes fishery populations for sport and food.

This is to be accomplished by (1) increasing the annual production of recreational and commercial marine and Great

Lakes fish, especially those whose natural populations and ability to propagate have been affected adversely by man, (2) improving rearing techniques and facilities to produce high quality fish adapted to survival, and (3) coordinating with and providing technical support to other Federal agencies, States, and local organizations to avoid duplicate efforts and developing unified programs designed to produce optimal sport and commercial fishing opportunity.

Activities include (1) operating fish hatcheries, a spawning channel, a fish screen facility, and a development center for coastal anadromous fish, (2) developing and applying improved rearing techniques, diets, and disease-resistant strains for hatchery stocks, (3) distributing fish to streams and lakes in accordance with established priorities and recommendations, (4) conducting and participating in fish tagging programs to determine success of stocking efforts, and (5) coordinating activities with those of States.

Wildlife refuges

The objective is to provide, manage, and protect a national network of Federal lands and waters including the coastal zone. This is to be accomplished by (1) planning for and acquiring suitable lands for addition to the National Wildlife Refuge System, (2) managing existing wildlife refuges within the coastal zone and along the Great Lakes, and (3) providing and regulating wildlife-oriented public use of the refuges.

The program includes developing acquired and existing lands, including construction of facilities; managing public use activities, including hunting, fishing, bird watching, and nature appreciation; interpreting gamefish-wildlife-wildlands conservation objectives for the public; and coordinating activities with States, pollution control agencies, and others.

Federal aid for fish
and wildlife restoration

The goal is to encourage and support State fish and game agencies to develop approved fish and wildlife restoration programs. This includes distributing funds obtained from various sources for use by State fish and game agencies

to (1) purchase land for wildlife habitat and hunting areas, (2) construct facilities for these areas, (3) support fish and wildlife restoration programs and conduct the necessary research, and (4) evaluate the effects of differing kinds of management activities.

The activities consist of reviewing and evaluating proposals from State agencies for fish and wildlife restoration programs; providing matching funds to support approved State fish and wildlife restoration programs; insuring compliance of State project activities with Federal laws and regulations; and coordinating project activities among the States with other divisions of the Fish and Wildlife Service and various Federal agencies, and with interested national and regional organizations.

Law enforcement for fish and wildlife species

The goal is to protect fish and wildlife species and coastal marine habitats from violations of various laws of the United States.

Program activities include monitoring ports-of-entry for illegal import of endangered wildlife or wildlife products; maintaining surveillance of coastal marine habitats to detect, document, and report suspected violations of laws; and coordinating activities and cooperating with Federal, State, and other agencies.

Fishery and wildlife research

The goals are to (1) improve sport and commercial fisheries of the Great Lakes, stocks of coastal anadromous fish species, and migratory bird populations and the habitats in which they live, (2) insure that all mammals, nonmigratory birds, and other wildlife remain viable parts of the natural ecosystems, and (3) develop a centralized national biologic information system to provide data on key species and environments that are essential for making biologically sound planning and management decisions.

Research is conducted to provide the scientific, technical, and planning support to the operations, assistance,

and regulatory divisions of the Fish and Wildlife Service and other cooperating organizations.

Activities generally include (1) field and laboratory research on anadromous and Great Lakes fish species focusing primarily on fish husbandry, pest control, and ecosystem studies and (2) research devoted to endangered wildlife species, migratory bird habitats, and the effects of pollutants on them.

Ecological assessment

The goals are to (1) protect, preserve, and enhance natural ecosystems associated with fish and wildlife which are affected by activities of man and (2) insure full consideration of fish and wildlife resources in the planning and implementation of land and water development projects where a Federal responsibility or interest exists.

This is to be accomplished by (1) determining potential effects of development activities on fish and wildlife resources and (2) providing technical assistance to other DOI organizations, other Federal agencies, States, and local governments in planning, evaluating, and acting on proposed projects that involve fish and wildlife interests.

Activities include (1) participating in environmental impact studies and assessments of coastal ecosystems, (2) reviewing applications made to COE for approval to dredge, fill, or undertake other work in navigable waters and make recommendations for acceptance, denial, or changes in submitted plans, (3) making recommendations for water use and waste discharge permits, (4) maintaining a national surveillance system to identify apparent illegal construction activities in navigable waters that are damaging to estuarine and related resources, and (5) coordinating the foregoing activities with other Federal agencies, States, local conservation agencies, and concerned private groups and individuals.

Technical assistance for management and development of fish and wildlife resources

The objective is to provide technical assistance to other Federal agencies, States, and private interests for

the management and development of fishery and wildlife resources. This includes (1) cooperating with various groups to develop programs that will enhance fishery and wildlife values of Indian lands, the national parks, military reservations, timber lands, and other regions of wildlands and (2) increasing fishing benefits to Indians and others.

NATIONAL PARK SERVICE

Only one National Park Service program concerns marine science activities and oceanic affairs. The following table compares funds allocated to this program with total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$200.2	$232.7	$286.7	$332.4
Allocated to marine science activities:				
Coastal zone national parks, monuments, lakeshores, seashores, and recreation areas	$13.1	$16.9	$28.9	$29.8
Percent allocated	6.5	7.3	10.1	9.0

The program's goal is to manage national parks, monuments, lakeshores, seashores, and recreation areas in coastal areas and plan for additions to the National Park System.

This is to be accomplished by (1) promoting and regulating the use of the National Park System to conserve the scenery, natural and historic objects, and wildlife and providing for their enjoyment by the public in a manner that will protect their values for future generations, (2) identifying and recommending acquisition of suitable coastal areas for addition to the National Park System, and (3) promoting complementary activities of the States and others.

Activities include (1) supporting research such as that related to pollution abatement, (2) planning for further development of existing parklands and additions to the system which includes site investigations and preparation of environmental impact statements, (3) constructing facilities and roads, and (4) coordinating with and assisting Indians and States in recreation and park planning.

GEOLOGICAL SURVEY

Six Geological Survey programs are concerned with marine science activities and oceanic affairs. The following table compares the funds allocated for these activities with total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$131.0	$150.5	$170.9	$230.9
Allocated to marine science activities:				
OCS resource evaluation	$ 2.7	$ 2.7	$ 4.6	$13.0
OCS lease management	5.0	5.2	6.3	10.2
Offshore geological surveys	2.5	4.5	4.9	10.2
Coastal zone investigations and general marine resource appraisal	.9	1.1	1.3	1.9
Topographic mapping of coastal areas	.6	.6	.7	1.1

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Development of coastal water supply	2.5	2.9	5.7	6.1
Total	$14.2	$17.0	$23.5	$42.5
Percent allocated	10.8	11.3	13.8	18.4

OCS resource evaluation

The objectives are to (1) insure a fair value return to the Federal Government from OCS lease sales, (2) identify and assess potential geologic hazards of proposed OCS lease areas, and (3) supply information that will help attain efficient and maximum recovery of OCS mineral and fossil fuel resources with minimum adverse effects on the environment and future resource values.

Activities include acquiring, mostly from industry, basic geologic and geophysical data on potential OCS lease sales areas; preparing reports for use in planning lease sales and reviewing lease bids; and granting or denying preleasing exploration permits.

OCS lease management

This program involves supervising and regulating the activities of OCS lease holders involved in the exploration, development, and production of oil, gas, and minerals from OCS. Its objectives are to (1) insure safety of industry operations, (2) attain the most efficient recovery of resources, (3) maintain a clean OCS environment, and (4) collect revenues due from OCS operations.

Activities include establishing performance standards, specifications, and production rates for industry operations; reviewing industry plans and designs for OCS tract developments

for approval or disapproval; making announced and unannounced inspections to insure industry compliance with rules, regulations, and operating plans; maintaining an alert system to warn of potential accidents; collecting revenues due from industry operations; and compiling and publishing data relating to OCS oil, gas, and mineral operations.

Offshore geological surveys

The purpose of the program is to (1) determine and assess geologic conditions and mineral resource potentials of offshore areas and (2) provide knowledge of geologic phenomena needed to insure safe and efficient resource development and to protect the environment.

The program objectives are to (1) identify and determine the distribution of geologic conditions and resources, including identifying target areas for mineral exploration and development and specific geologic hazards, and (2) obtain fundamental knowledge of marine geologic conditions and processes involved in the formation of mineral deposits to better predict resource occurrences and potential for development.

Activities include conducting field geologic and geophysical investigations to collect samples and data for analysis and reporting of results and mapping the continental shelves and adjacent marine regions of the United States.

Coastal zone investigations and general marine resource appraisal

The goals are to (1) supply basic geologic and mineral resource knowledge required for wise development and conservation of the coastal zone and interpretation of offshore conditions and (2) predict the potential effects of onshore and offshore earthquakes, volcanic eruptions, and other catastrophic geologic phenomena on the coastal zone.

The program objectives are the same as those noted in the previous program; however, they apply to the coastal zone rather than offshore areas. In addition, this program is concerned with (1) maintaining a worldwide seismology and geomagnetism network, (2) keeping an up-to-date inventory of

national and worldwide resource knowledge, and (3) developing guides and improving techniques for mineral exploration and prediction of geologic catastrophes and their effects.

Some program activities include conducting geologic and geophysical field investigations of coastal zones, compiling and analyzing data on marine mineral resources, monitoring and analyzing seaquakes and other geophysical activity, and providing supporting library and laboratory services to coastal and marine programs.

Topographic mapping of coastal areas

The purpose of the program is to provide accurate maps of land areas of the United States and its territories, including maps of the coastal zone, offshore islands, and adjacent waters. The maps show configuration of the land surface, the location of manmade features, and present land use.

Some of its activities include (1) compiling new maps and updating existing maps using photography and field information, (2) maintaining the National Cartographic Information Center which provides referral services for maps and related materials of coastal and marine areas as well as land areas, (3) investigating new techniques and developing equipment for acquiring more rapid map information of greater accuracy, and (4) maintaining the National Atlas.

Development of coastal water supply

The goal is to assess the quantity and quality of the Nation's water resources and perform associated research on the occurrence and distribution of surface and ground waters. This includes (1) maintaining a continuous record of freshwater stream discharges into estuaries, bays, oceans, and the Great Lakes, (2) identifying and inventorying the availability of ground water in coastal regions, (3) determining the quality and changes in quality of ground waters in coastal zone waters, and (4) ascertaining and developing the capability to predict changes in the quantities and quality of coastal zone waters resulting from natural processes and man-induced activities.

Activities include (1) conducting periodic measurements of sediment discharges at some of the stream-gaging stations located at or near the mouths of streams entering marine areas and the Great Lakes, (2) studying the dynamics of bay and estuarine systems to determine the effects of circulation, pollution dispersal, dredging, and other phenomena on the availability of water, (3) performing research on the movement of ground water to the coast and offshore, (4) maintaining a close liaison with State and municipal water agencies, and (5) making flood frequency analyses for low-lying coastal areas.

BUREAU OF LAND MANAGEMENT

Only one Bureau of Land Management program is concerned with marine science activities and oceanic affairs. The following table compares funds allocated to the program with the Bureau's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$118.9	$134.0	$162.6	$206.3
Allocated to marine science activities:				
OCS leasing system	$ .7	$1.5	$3.5	$18.6
Percent allocated	(a)	1.1	2.2	9.0

[a]Less than 1 percent

The program's goals are to insure orderly and timely resource development, protect the environment, and receive fair market values from OCS leases.

The program is concerned with (1) developing and maintaining tentative lease schedules, (2) issuing bid calls,

(3) making tract selections, (4) evaluating industry interest and other social and economic factors, (5) preparing environmental analyses for tract offerings, (6) assisting the Geological Survey in making presale evaluations, (7) conducting sales and issuing leases, (8) reviewing results of sales, and (9) granting right-of-way permits for common carrier pipelines.

Efforts are also underway to establish environmental baseline data for existing and proposed frontier lease areas and pipeline corridors. This constitutes the first phase of a planned program to monitor and evaluate the environmental effects of OCS oil and gas development.

BUREAU OF MINES

The Bureau of Mines has one program related to marine science activities and oceanic affairs. The following table compares funds allocated to this program with the Bureau's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$82.5	$92.8	$105.6	$212.6
Allocated to marine science activities:				
Mining and metallurgical research	$1.5	$1.5	$1.8	$1.8
Percent allocated	1.8	1.6	1.7	(a)

[a]Less than 1 percent.

The program's goals are to conserve mineral resources and promote safety and health in the mineral and fuel producing industries.

This is to be accomplished by (1) conducting metallurgical and mining research for the advancement of mineral technology and aiding effective pollution abatement and (2) collecting and analyzing data needed for determining existing mineral supply and demand and making future projections.

Some of the program activities include (1) reevaluating the potential of various methods for extracting manganese, nickel, copper, and cobalt from certain sea floor nodules, (2) conducting metallurgy research which has a bearing on and may have direct application to future ocean mining and processing of nodules, and (3) collecting and analyzing data for maintaining minerals and consumption models, commodity studies, and production and processing analyses.

BUREAU OF OUTDOOR RECREATION

Only one Bureau of Outdoor Recreation program is related to marine science activities and oceanic affairs. The following table compares funds allocated to the program with the Bureau's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations (note a)	$365.4	$304.2	$80.6	$305.2
Allocated to marine science activities:				
Land and water conservation	$2.5	$.4	$1.5	(b)
Percent allocated	(c)	(c)	1.9	-

[a]Includes funds authorized by the Land and Water Conservation Fund Act of 1965 (16 U.S.C. 460).
[b]The Bureau was unable to furnish the amount.
[c]Less than 1 percent.

The program's goal is to encourage and support the development of the Nation's recreational resources to provide greater recreation opportunity to the American people.

This is to be accomplished by (1) maintaining a nationwide plan for the development of recreation resources, (2) coordinating the planning and development of recreational resources, (3) managing the disposition of surplus U.S. property for park and recreational use, and (4) managing the Land and Water Conservation Fund which is used for acquiring lands for federally administered recreation areas and providing matching grants to States for recreation planning and State and local land acquisition and development.

Program activities include conducting and coordinating studies of potential natural, scenic, and recreational areas for preservation and use; providing reviews of recreation permit applications and environmental impact statements; and assisting States and local jurisdictions in the planning and development of outdoor recreational resources.

OFFICE OF SALINE WATER

One Office of Saline Water program was related to marine science activities and oceanic affairs. The following table compares the funds allocated to this program with the Office's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$27.0	$27.0	$10.7	$4.9
Allocated to marine science activities:				
Desalting of seawater	$2.1	$1.1	-	-
Percent allocated	7.8	4.1	-	-

This program's goal was to develop an economical and environmentally acceptable technology for producing freshwater from ground water brines and seawater.

The program attempted to (1) develop efficient and economic processes for separating salts and purifying seawater, (2) determine the effects of brine disposal on estuarine and oceanic environments, (3) investigate the potential of mineral recovery from concentrated brines, and (4) study and develop resistant, noncorrosive desalting materials.

This included the support of research on subjects such as the effects of corrosion products on marine organisms, surveys of coastal ecology, and development of salt resistant alloys and coatings. Research on the development and testing of membrane and thermal desalting techniques was also conducted.

OFFICE OF WATER RESOURCES RESEARCH

The Office of Water Resources Research identified one of its programs as being related to marine science activities and oceanic affairs. (On July 26, 1974, the Office of Water Resources Research and the Office of Saline Water were integrated into the Office of Water Research and Technology.) The following table compares funds allocated to the program with the Office of Water Resources Research's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$14.3	$14.3	$13.7	$12.7
Allocated to marine science activities:				
Water resources research and training	$.6	$.9	$1.0	$.7
Percent allocated	4.2	6.3	7.3	5.5

The program's goal is to

> "* * * stimulate, sponsor, provide for, and supplement present programs for the conduct of research, investigations, experiments, and the training of scientists in the fields of water and of resources which affect water."

The purpose of performing the above is to assist in assuring the Nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population.

This was to be accomplished by (1) developing new technology and more efficient methods for resolving water resource problems, (2) training water scientists and engineers through on-the-job participation in research work, and (3) facilitating water research coordination and the application of the research results through the dissemination of information about ongoing and completed research. The Office of Water Resources Research did not maintain its own laboratories or perform in-house research. The program is funded by (1) annual allotments to approved State water resources research institutes, (2) matching grants to these same institutes on a competitive basis, and (3) grants, contracts, or other arrangements with universities, public agencies, private research firms, and other qualified organizations.

Some of the program activities include research concerned with problems related to development and conservation of the coastal zone including studies of pollution dispersion; sedimentation; and effects of pollutants on aquatic organisms, estuarine food chains, and aquatic ecology. A few studies deal with development of improved estuarine and Great Lakes planning and management methodologies, while others deal with the development and protection of freshwater supplies and means of retarding saltwater intrusion.

OFFICE OF TERRITORIAL AFFAIRS

The Office of Territorial Affairs has one program that is concerned with marine science activities and oceanic affairs. The following table compares funds allocated to the program with the Office's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$125.9	$104.0	$96.0	$102.9
Allocated to marine science activities:				
Trust territory assistance	$.5	$.6	$.6	$.9
Percent allocated	(a)	(a)	(a)	(a)

[a]Less than 1 percent.

Programs in the trust territories are geared toward making such territories economically and politically self-sufficient.

Marine-related activities are primarily concerned with developing mariculture (aquaculture) and commercial fishing operations including the development of dockside facilities in support of fishing activities.

BUREAU OF INDIAN AFFAIRS

The Bureau of Indian Affairs has one program concerned with marine science activities and oceanic affairs. The following table compares funds allocated to the program with the Bureau's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$455.5	$560.9	$572.5	$643.1
Allocated to marine science activities:				

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Protection of Indian rights	$.4	$.4	$.4	$2.0
Percent allocated	(a)	(a)	(a)	(a)

[a]Less than 1 percent.

The goal is to protect Indian hunting and fishing rights which are secured by treaty by (1) obtaining a declaratory judgment to reaffirm the Indian's treaty rights to fish on reservations at usual and accustomed places, (2) restraining the States from harassment actions which prevent Indians from exercising treaty rights, (3) developing technical and biological capabilities within the tribes which will enable them to become self-regulatory in regard to fishery resources, and (4) obtaining for the tribes a fair and equitable share of the fishery resources.

Some of the activities are (1) gathering and analyzing biological fish data essential in legal proceedings to protect Indian off-reservation treaty fishing rights, (2) surveying river systems to assess size and productivity of spawning areas, number of fish spawning, number of fish returning to hatcheries, Indian catches, total catch, and habitat problems, and (3) conducting training programs with treaty tribes to enable them to have the capabilities of self-regulation.

BUREAU OF RECLAMATION

The Bureau of Reclamation had one program relating to marine science activities and oceanic affairs. The following table compares the funds allocated to the program with the Bureau's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$404.1	$523.7	$423.6	$460.7
Allocated to marine science activities:				
California undersea aqueduct	$.4	$.3	(a)	-
Percent allocated	(b)	(b)	(b)	-

[a]Less than $50,000.
[b]Less than 1 percent.

This program's goal was to determine the potential for subsurface offshore conveyance of water from a certain river area of northern California to appropriate terminals in central and southern California.

The program was to determine the feasibility of an offshore aqueduct and compare results to a proposed high dam system in northern California and an on-land aqueduct as alternative means of meeting the future water needs of central and southern California.

Activities included (1) data collection and basic research on hydrodynamics, marine geology, marine soils, materials, and offshore system design and (2) reconnaissance studies of right-of-way.

CHAPTER 6

NATIONAL SCIENCE FOUNDATION

NSF is authorized by the National Science Foundation Act of 1950 (42 U.S.C. 1861) to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences and to support such research through contracts and grants. NSF is a source for financial support for the scientific study of the oceans. NSF fulfills its responsibilities primarily by sponsoring scientific research, encouraging and supporting improvements in science education, and fostering scientific information exchange. NSF does not itself conduct research or carry out education projects.

NSF's goals related to oceanography are to

--initiate and support basic and applied research,

--strengthen research potential,

--foster interchange of scientific information,

--foster and support development of scientific methods and techniques,

--evaluate the status of oceanography,

--initiate and support scientific activities relating to international cooperation,

--support applied research relevant to national problems,

--initiate and support research and education relating to development of marine resources, and

--encourage and develop marine advisory programs.

The following table compares the total NSF appropriations with the amounts allocated to support oceanographic activities.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total NSF appropriations	$622.0	$645.7	$577.4	$788.2
Allocated to oceanographic activities:				
Office for International Decade of Ocean Exploration	19.7	17.0	14.1	15.6
Office for Oceanographic Facilities and Support	16.6	13.8	18.2	15.0
Division of Environmental Sciences	13.7	14.0	15.1	17.3
Office of National Centers and Facilities Operations	8.5	9.6	10.5	11.0
Office of Polar Programs	5.5	4.3	4.2	4.4
Division of Environmental Systems and Resources	2.6	1.9	1.3	1.3

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Education Directorate	1.3	.7	.7	.8
Total allocated to oceanographic activities	$67.9	$61.3	$64.1	$65.4
Percent of total appropriations allocated to oceanographic activities	10.9	9.5	11.1	8.3

[a]In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.

INTERNATIONAL DECADE OF OCEAN EXPLORATION (IDOE)

The IDOE concept is one of

> "* * * intensified collaborative planning among nations and expansion of exploration capabilities by individual nations, followed by execution of national and international programs of oceanic research and resource exploration so as to assemble a far more comprehensive knowledge of the sea in a reasonably short time."

The success of the effort depends largely on the extent of effort contributed and fulfillment of responsibilities by all nations participating in the projects. In fiscal years 1973 and 1974, 36 nations participated in U.S.-led IDOE programs and the United States participated in 8 of the IDOE programs initiated by other nations. The program began in fiscal year 1971 and is administered by the NSF Office for the International Decade of Ocean Exploration.

The following table shows the amount of appropriated funds allocated by the IDOE Office to its major program areas.

	Fiscal year			
	1972 (note a)	1973 (note a)	1974	1975
	(millions)			
Programs:				
Environmental quality	$ 5.8	$ 5.1	$ 5.0	$ 5.0
Environmental forecasting	8.7	5.9	3.6	5.0
Seabed assessment	3.8	3.6	3.1	3.0
Living resources	1.1	1.9	1.8	2.0
General support	-	-	.1	.1
Total programs	$19.4	$16.5	$13.6	$15.1
Other (see p. 118)	.3	.5	.5	.5
Total	$19.7	$17.0	$14.1	$15.6

[a]Includes ship support costs of $2.3 and $2.8 million for fiscal years 1972 and 1973, respectively. Ship support costs for fiscal years 1974 and 1975 are reported under activities of the Office of Oceanographic Facilities and Support.

The program areas were established to accomplish the following goals.

--Preserve the ocean environment by accelerating scientific observations of the natural state of the ocean and its interaction with the coastal margin.

--Improve environmental forecasting to help reduce hazards to life and property and permit more efficient use of marine resources.

--Expand seabed assessment activities to permit better management--domestically and internationally--of marine mineral exploration and exploitation.

--Develop an ocean monitoring system to facilitate prediction of oceanographic and atmospheric conditions.

--Improve worldwide data exchange.

--Increase opportunities for international sharing of responsibilities and cost for ocean exploration and insure better use of limited exploration capabilities.

Environmental quality

Environmental quality effort is directed to assessing, understanding, and predicting man's impact on the marine environment. Studies are made to determine (1) sources of pollutants and the rate at which they enter the environment, (2) mechanisms and principles governing pollutant transfer to and dispersion within the marine environment, (3) pollutant effects on marine organisms, communities, and ecosystems, and (4) existing concentrations of pollutants and trace compounds in the environment.

Environmental forecasting

Work in this area is designed to provide the scientific base necessary for an improved capability in predicting changes in the environment. It includes studies of ocean circulation, air-sea interaction, and climate variations. According to NSF, an understanding of the state of the oceans as well as conditions in the atmosphere is necessary for long-range and accurate environmental forecasting. Therefore, to enhance forecasting capabilities, data on processes at work in the air and sea must be incorporated into predictive models. Because knowledge of these processes is incomplete, major emphasis has been placed on studies of the ocean surface and its interaction with the

lower atmosphere (air-sea interaction) and determining the dynamic processes in the deep ocean that influence the interaction.

Seabed assessment

Seabed assessment effort is designed to support studies of continental margins, deep seabeds, and midoceanic ridges in an attempt to identify new areas of natural resources, particularly petroleum and hard minerals, and to enhance understanding of the natual processes which produce these resources. For example, the continental margins are both economically and scientifically important because rich deposits of sulfur, heavy minerals, sand, and gravel are dredged from the bottom and the area is a potential location for oil field development. In addition, investigations on the origin and distribution of concentrations of manganese nodules, which occur extensively on the deep plains of the ocean, are conducted. These nodules contain high percentages of iron and manganese and sometimes contain economically attractive amounts of copper, nickel, and cobalt.

Living resources

Work in this area is designed to provide improved understanding of the processes and relationships that exist between the biological aspects of marine organisms and the chemical, physical, and geological environment in which they live. Such knowledge is necessary for the intelligent use and management of living marine resources. Currently this area has concentrated on marine ecosystems analysis--primarily the coastal upwelling ecosystem. This ecosystem is being studied because an estimated 50 percent of the world's fish supply comes from major upwelling areas.

In addition, the IDOE Office provided an estimated $50,000 a year during fiscal years 1974 and 1975 for the general support of films, publications, and printing, etc., which are considered part of the total costs associated with its oceanographic research activities.

--expand man's knowledge of the distribution of sea floor structures and the processes that form them, and

--describe and predict the behavior of marine organisms and ecosystems in the marine environment.

The following table shows the amount of appropriated funds allocated by the Division of Environmental Sciences to the program areas of the Oceanographic Research Program.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Programs:				
Physical oceanography	$ 3.0	$ 2.5	$ 3.1	$ 3.6
Marine chemistry	.8	1.5	1.1	1.5
Biological oceanography	4.3	4.3	4.5	5.4
Submarine geology and geophysics	4.1	4.5	5.0	5.4
Total programs	$12.2	$12.8	$13.7	$15.9
Other (see p. 122)	1.5	1.2	1.4	1.4
Total	$13.7	$14.0	$15.1	$17.3

Physical oceanography

This program area is concerned with understanding the physical properties and movements of water in the ocean and large lakes, including estuarine and coastal waters. It includes studies of deep ocean circulation, current meanders

lower atmosphere (air-sea interaction) and determining the dynamic processes in the deep ocean that influence the interaction.

Seabed assessment

Seabed assessment effort is designed to support studies of continental margins, deep seabeds, and midoceanic ridges in an attempt to identify new areas of natural resources, particularly petroleum and hard minerals, and to enhance understanding of the natual processes which produce these resources. For example, the continental margins are both economically and scientifically important because rich deposits of sulfur, heavy minerals, sand, and gravel are dredged from the bottom and the area is a potential location for oil field development. In addition, investigations on the origin and distribution of concentrations of manganese nodules, which occur extensively on the deep plains of the ocean, are conducted. These nodules contain high percentages of iron and manganese and sometimes contain economically attractive amounts of copper, nickel, and cobalt.

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Other

Although not specifically identified as separate programs, IDOE contributes funds to international organizations and other Federal Government entities for oceanographic-related activities. The IDOE Office, for example, provides or has provided funds to the (1) Intergovernmental Oceanographic Commission, an international organization, for the planning of an IDOE program, (2) Environmental Data Service, NOAA, for the training of foreign nationals in the handling of oceanographic data and storage and dissemination of data collected during the course of NSF-sponsored research, and (3) the National Oceanographic Instrumentation Center, NOAA, for instrument calibration and instrumentation.

The following table shows the amount of appropriated funds contributed by the IDOE Office to these organizations.

	Fiscal year			
	1972	1973	1974	1975
	(000 omitted)			
Intergovernmental Oceanographic Commission	$ -	$ 50	$ 50	$ 50
Environmental Data Service	300	390	400	400
National Oceanographic Instrumentation Center	40	20	30	30
Total	$340	$460	$480	$480

OCEANOGRAPHIC FACILITIES AND SUPPORT PROGRAM

This program is administered by the Office for Oceanographic Facilities and Support. Under the program, grants or contracts are awarded to support construction, modification, conversion, purchase, and operation of oceanographic facilities which lend themselves to shared use by the oceanographic community. Facilities supported are those required for research in the open ocean, in near-shore and estuarine areas, and on the Great Lakes.

The objectives of the program are to (1) maintain and improve oceanographic facilities and operational capabilities at key institutions, (2) promote shared use of facilities, and (3) promote effective management of oceanographic facilities.

NSF grants for oceanographic research are distributed among some 60 academic and private nonprofit research institutions. Seventeen of these 60 institutions operate NSF-funded facilities, principally ships comprising the academic fleet.

This program provides to these institutions funding support required for facilities' operations in support of NSF-funded oceanographic research programs. NSF is the primary source of Federal support for the operation of academic oceanographic facilities and, in 1973, contributed about 70 percent of the costs to operate those facilities.

The program works with the University National Oceanographic Laboratory System, a voluntary association, to insure access to these facilities by NSF grantees from any institution. The association has the major role in coordinating the shared use of the academic fleet and other specialized facilities.

DIVISION OF ENVIRONMENTAL SCIENCES

The Division of Environmental Sciences supports a basic oceanographic research program with the overall goal of increasing the understanding of the marine environment. The goal is accomplished by providing financial support (through grants) to oceanographers at universities in the United States and providing these oceanographers with equipment and observational tools, if funds permit, to make their work productive.

The program plans to

--increase man's knowledge of the physical and chemical processes occurring in the ocean,

--improve understanding of motions of ocean waters and the forces that drive them,

--expand man's knowledge of the distribution of sea floor structures and the processes that form them, and

--describe and predict the behavior of marine organisms and ecosystems in the marine environment.

The following table shows the amount of appropriated funds allocated by the Division of Environmental Sciences to the program areas of the Oceanographic Research Program.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Programs:				
Physical oceanography	$ 3.0	$ 2.5	$ 3.1	$ 3.6
Marine chemistry	.8	1.5	1.1	1.5
Biological oceanography	4.3	4.3	4.5	5.4
Submarine geology and geophysics	4.1	4.5	5.0	5.4
Total programs	$12.2	$12.8	$13.7	$15.9
Other (see p. 122)	1.5	1.2	1.4	1.4
Total	$13.7	$14.0	$15.1	$17.3

Physical oceanography

This program area is concerned with understanding the physical properties and movements of water in the ocean and large lakes, including estuarine and coastal waters. It includes studies of deep ocean circulation, current meanders

(wandering of the ocean current), diffusion, and air-sea interactions in the ocean as well as the Great Lakes. During fiscal years 1972 through 1974, the Division funded 158 projects in this program area, and the Division plans to fund 70 during fiscal year 1975.

Marine chemistry

This area is concerned with understanding chemical properties of and processes in seawater; biochemical processes in seawater and related waters; the distribution and transportation of naturally occurring and manmade chemical compounds in the waters of the ocean, lakes, and related bodies of water; and chemical aspects of ocean-atmosphere interactions.

Studies include research on environmental problems and man-induced radioactive substances to improve understanding and for controlling and possibly preventing deleterious effects of pollution, including wastes and spills from energy generation and fuel production. These man-induced substances and dissolved gases are studied to provide tracers for studies of water movements in the oceans and lakes. Studies of major chemical constituents of seawater are studied to understand cycles of materials moving between the ocean, atmosphere, ocean bottom, and continents. Minor constituents are studied to understand movements and behavior of biologically active substances needed for growth and development of marine organisms. Organic matter in the ocean is studied to increase understanding of the substances produced by living organisms and to understand the fate of such organisms resulting from petroleum spills. Between fiscal years 1972 and 1974, the Division funded 76 projects in this program area, and the Division plans to fund 31 in 1975.

Biological oceanography

This area is concerned with basic research on the nature and distribution of life in the ocean and marine ecosystems. Research includes studies on the kinds of organisms in the ocean and their distribution, abundance,

behavior, interaction, nutrition, genetics, and population dynamics. Included also are studies of (1) interactions between marine organisms and their environment, (2) transfer processes for metals and other contaminants into and within marine ecosystems, (3) functions of marine ecosystems and development of simulation models that can predict marine organisms and their environment, and (4) tolerances and responses of marine ecosystems and their components to thermal stresses and toxic substances. Between 1972 and 1974 the Division funded 257 projects in this area, and the Division plans to fund 95 in fiscal year 1975.

Submarine geology and geophysics

This area includes basic research to increase understanding of the history of seawater and ocean basins, of their sediment deposits, and of ancient marine life. Studies are conducted on the physical, chemical, and biological processes involved in the formation and alteration of sediments or rocks of the ocean floor and continental margins. Studies of crustal structures, minerals and fossil remains, deep ocean currents, processes that form and alter the rocks, chemical processes and transformation occurring between sediments and marine organisms and deep sea deposits are conducted to aid in the understanding of the historical development and makeup of the ocean floor. Between fiscal years 1972 and 1974, the Division funded 328 projects in this area, and the Division plans to fund 113 in fiscal year 1975.

Other

In addition to its Oceanographic Research Program, the Division's atmospheric research is related to oceanography, specifically, air-sea interaction studies and studies funded in participation with NOAA's Global Atmospheric Research Program. About $1.4 million a year was allocated to these activities for fiscal years 1972, 1974, and 1975; $1.2 million was allocated for fiscal year 1973.

During fiscal year 1972 the Division also contributed $100,000 to the World Data Center for the storage and dissemination of selected data collected during the course of research sponsored by the Division.

OCEAN SEDIMENT CORING PROGRAM

The objective of the Ocean Sediment Coring Program, as administered by the Office of National Centers and Facilities Operations, is to increase man's knowledge of the history, age, and structure of the ocean basins and evolution of marine life. The program objective is to be accomplished through two major phases: (1) deep sea drilling to obtain core samples and (2) detailed analyses of the core material. The drilling phase, known as the Deep Sea Drilling Project, is carried out by the Scripps Institution of Oceanography, University of California, in San Diego under a 1966 negotiated-cost contract. The contract covers through June 30, 1976, and provides for 84 months of drilling operations. Scripps is also responsible for preparing preliminary descriptions of the core materials, storing the cores, and distributing core samples to qualified scientific investigators. Core samples are obtained by conventional drilling methods from the Atlantic, Pacific, and Indian Oceans and adjacent seas.

The detailed analysis phase is the principal means of developing the fundamental knowledge concerning the constitution and history of the deep ocean basins. The analyses are primarily the responsibility of individual scientific investigators. From the core samples collected during the drilling phase, preliminary descriptions of the cores are made and published in bound reports. Not all core samples collected and described during the drilling phase are analyzed in detail. The preliminary descriptions provide the basis for interested scientists to select those cores which the scientists want to analyze in detail. Funding for detailed analyses is available to scientific investigators through various sources, including NSF research grants.

ARCTIC AND U.S. ANTARCTIC RESEARCH PROGRAMS

The Office of Polar Programs, through its Arctic and U.S. Antarctic Research Programs, conducts oceanographic research as part of its overall program objectives.

The following table shows the amount of appropriated funds allocated by the Office of Polar Programs to the oceanographic activities of these programs.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Programs:				
Arctic Research Program	$1.7	$1.8	$2.2	$2.2
U.S. Antarctic Research Program	3.5	2.2	1.7	1.9
Total programs	$5.2	$4.0	$3.9	$4.1
Other (see p. 126)	.3	.3	.3	.3
Total	$5.5	$4.3	$4.2	$4.4

Arctic Research Program

The objectives of the Arctic Research Program are to (1) increase man's knowledge of the Arctic environment and its dynamic parameters and make intelligent use of the resources of the region, (2) provide increased coordination of the Arctic research programs of Federal agencies, (3) increase cooperation in research with other nations having Arctic interests, and (4) develop mechanisms for the exchange of scientific data and research plans--nationally and internationally.

There are seven areas of concentration in the program: marine research, terrestrial biology, Man in the Arctic (social science research on the impact of current activities such as oil development in Alaska on Native Alaskan communities), atmospheric science, glaciology, geology and geophysics, and information services. Coordination of Federal agency research is to be accomplished through the

Interagency Arctic Research Coordinating Committee which is composed of 12 agencies sponsoring research in the Arctic or Subarctic.

Oceanographic research activities in the Arctic through this program primarily include investigating the response of the pack ice and underlying ocean to the forces exerted by the atmosphere. This is done in an effort to understand and predict ice movement and deformation. Through this effort investigations of fundamental problems of air-sea interaction are also performed.

U.S. Antarctic Research Program

The objective of this program is to promote U.S. scientific studies of the Antarctic Ocean in cooperation with other nations under the Antarctic Treaty as one phase of the U.S. National Program in the Antarctic.

This program supports projects in all relevant sciences--human behavior, biology, cartography, geology, glaciology, meteorology, oceanography, solid-earth geophysics, and upper atmosphere physics.

That part of the program which has been considered as contributing to oceanographic research involves physical oceanography, biological oceanography, and marine geology and geophysics. Physical oceanography focuses on the study of sea ice; the heat and salt contents of the ocean; and the formation, composition, and movement of bottom water and circumpolar currents. These studies are performed in an effort to understand the composition and flow of Antarctic currents and bottom water, clarify their interactions with the world's oceans, and determine the nature and extent of air-sea-ice interactions.

Biological oceanography focuses on ecosystems analysis for a better understanding of the biological cycle and distribution of marine organisms and of possible effects of pollution and other stresses on the food web of the Antarctic ecosystem.

Marine geology and geophysics focus on increasing knowledge of the earth's crustal structure and forces that produce changes in it and sea floor spreading. The Antarctic Ocean area contains an abundance of potentially exploitable resources, including probable petroleum deposits and manganese nodules. In this connection studies are performed to increase knowledge of sea floor spreading, provide information on past climatic changes, and assess the economic potential of the Antarctic Ocean regions.

Other

The Office of Polar Programs also provides funds to the Smithsonian Oceanographic Sorting Center for the classification of and publications of biological specimens collected during the research activity. In addition, funds are provided to the Florida State University Core Laboratory for storage and preliminary analysis of cores taken from the Antarctic sea floor. The following table shows the amount of appropriated funds allocated by the Office of Polar Programs for these purposes.

	Fiscal year			
	1972	1973	1974	1975
	(000 omitted)			
Smithsonian Oceanographic Sorting Center	$200	$200	$200	$200
Florida State University Core Laboratory	56	63	100	105
Total	$256	$263	$300	$305

REGIONAL ENVIRONMENTAL SYSTEMS PROGRAM

The Division of Environmental Systems and Resources, under its Regional Environmental Systems Program, supports research (through grants) relating to the environmental aspects of coastal zone management. The goal of the program is to provide the data base for intelligent planning for uses of the coastal shoreline. The program attempts to

--provide management specifications for engineering construction in regions of the costal zone,

--analyze waste disposal alternatives in harbors and estuaries, and

--develop management guidelines for preserving and using coastal ecosystems.

Specific users of the research results take part in the design and conduct of the research investigations for the benefit of giving reality to objectives and practicality to the results. Research relating to the coastal zone has been targeted on (1) understanding and alleviating estuarine effects of waste discharges and dumping, (2) effects of engineering activities, particularly dredging, (3) management strategies for ecologically important areas, and (4) methods of restoring damaged areas.

Coastal zone management research efforts have included (1) identifying operating criteria for Texas coastal zone management along the Gulf Coast, (2) developing criteria for the siting and design of waste water treatment plant outfalls in the Chesapeake Bay, (3) evaluating dredging and spoil disposal in the Pacific Northwest for the purpose of developing operational criteria for maintenance of coastal and port channels, and (4) assessing environmental problems associated with the Delaware Bay.

SCIENCE EDUCATION PROGRAM

The Education Directorate conducts a Science Education Program encompassing all major scientific disciplines.

The major objectives of this program are to

--help assure the Nation of an appropriate variety, flexibility, quality, and number of scientific and technological personnel with greater participation of minorities and women;

--improve science education to meet the needs of a broader range of students and increase the number of persons who make effective use of the processes and results of science in their work;

--improve the effectiveness and efficiency of science education through the application of improved programs involving modern educational technologies, new instructional strategies and methodologies, and knowledge gained from research on the processes of learning and education; and

--find ways to increase the impact and effectiveness of NSF's education programs through research and problem assessment which can point to necessary future program directions.

That part of the Science Education Program related to marine sciences involves supporting educational activities (through grants and contracts) at the precollege, undergraduate, and graduate levels. Projects are supported, for example, to (1) develop alternative instructional methods and materials, (2) demonstrate new educational materials and methods to prospective users, (3) train educational personnel to implement new science education programs, such as new and improved science curricula and teaching modes, (4) help various educational institutions organize their resources for more efficient use, (5) allow students to gain experience through participation in research, and (6) provide fellowships and traineeships to insure a continuous flow of highly talented individuals into science careers.

CHAPTER 7

ENVIRONMENTAL PROTECTION AGENCY

EPA conducts numerous programs, principally in the Great Lakes system, involving marine science activities. The following table compares EPA's total appropriations with the funds allocated for marine science activities.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations	$2,448.4	$7,427.1	$4,628.6	$881.2
Allocated to marine science activities:				
Great Lakes programs:				
Great Lakes initiative	$ .2	$ 5.6	$ 9.0	$ 6.1
Surveillance and analysis activities	.1	.1	.1	.1
Construction grants	.9	1.5	2.0	1.5
Planning	-	.2	1.4	14.9
Manpower development	-	.1	.1	.1
Permit and enforcement	.1	1.5	2.3	2.3
	1.3	9.0	14.9	25.0
Estuarine and coastal zone research	6.6	5.4	5.6	5.8
Oil and hazardous materials spills research	6.3	3.9	1.9	1.4

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Monitoring systems R&D	-	-	.2	.2
Ocean disposal permit	-	.3	.9	.9
Total	$14.2	$18.6	$23.5	$33.3
Percent of total appropriations allocated to marine science activities	(b)	(b)	(b)	3.8

[a]Fiscal year 1975 funds represent requested appropriations.

[b]Less than 1 percent.

GREAT LAKES PROGRAMS

Great Lakes initiative

This program provides the principal Federal agency support to the United States-Canada Great Lakes Water Quality Agreement. Its specific objectives are to provide a coordinated approach to understanding and solving the water quality problems of the Great Lakes and technical support and advice to the United States-Canadian International Joint Commission in relation to its responsibilities under the United States-Canada agreement.

Research is conducted to provide a scientific basis for assessing the source, fate, effects, and importance of pollutants in large lakes, particularly the Great Lakes, and develop and improve predictive mathematical models for lake water quality management.

Some of the principal efforts in the Great Lakes system include

--studying pollution resulting from agricultural, forestry, and other land use activities;

--developing an understanding of water quality problems peculiar to the Great Lakes and recommending solutions to these problems;

--demonstrating new methods and techniques and developing preliminary plans for eliminating or controlling pollution within all or any part of the watersheds of the Great Lakes; and

--studying specific pollution problems such as (1) eutrophication, (2) thermal pollution and related power production problems, (3) hazardous materials, including industrial wastes, and (4) disposal of dredging spills.

Surveillance and analysis activities

This program consists of harbor dredging, Lake Erie water intake studies, and navigation season extension efforts.

The harbor dredging activity includes collecting samples of sediments from each harbor scheduled to be dredged by COE and analyzing them to determine if the proposed dredging areas are polluted and, if so, where the dredged spoils could be disposed to prevent harm to the quality of Great Lakes water.

Lake Erie water intake studies are undertaken to document water quality trends. The activities include biweekly sampling of 10 Lake Erie water intakes and their analysis for 25 chemical and physical parameters and microbiological life forms.

Navigation season extension efforts involve reviewing the environmental effects of extending the Great Lakes navigation season through the winter. This is done to determine if an extended season is beneficial or harmful to the water quality and related environment of the Great Lakes.

Construction grants

Under the program EPA awards grants to States for the construction of cost-effective, environmentally compatible waste water treatment facilities which will meet the effluent limit goals of the Federal Water Pollution Control Act (33 U.S.C. 1151). Program responsibilities include (1) reviewing and approving all grant applications and awards and (2) drafting or reviewing State drafts of National Pollutant Discharge Elimination System permits for municipal discharges.

Planning

The overall goal of the program is to develop a coordinated water quality plan for the water resources of the Great Lakes. Objectives include (1) working with the United States-Canadian International Joint Commission to develop the framework for such a plan, (2) promoting and requiring adequate planning activity in the Great Lakes States to allow compliance with water quality requirements, and (3) supporting local activity, through grants when applicable, to insure coordinated regional-local plans.

Program activities include

--assisting States in establishing water quality standards,

--overviewing the States' continuing planning process to insure development of water quality management plans,

--promoting and reviewing facilities planning,

--developing water resources plans,

--providing coordination of Federal water resources projects, and

--assessing the economic effects of pollution control programs.

Manpower development

This program's goal is to determine priority environmental manpower training needs and assist State and local governments in meeting those needs.

Specifically, the program is directed at providing an adequate number and type of skilled personnel to properly operate and maintain waste water treatment plants and assisting in developing State and local capabilities to perform such duties by awarding grants to State and municipalities for training purposes.

Permit and enforcement

This program regulates the discharge and dumping of pollutants, via outfalls, into waters to protect human health and welfare; marine life; wildlife; shorelines; beaches; and esthetic, recreational, and economic values.

Its specific intent is to bring all industrial, municipal, and other sources that discharge pollutants into Great Lakes waters under permits specifying the conditions under which such discharges may be made. Such permits are being issued in conjunction with the National Pollutant Discharge Elimination System. EPA monitors the permitted discharges to assess compliance with requirements of the system and takes appropriate enforcement measures in cases of violations.

ESTUARINE AND COASTAL ZONE RESEARCH

This program's goal is to provide a scientific basis for assessing the source, fate, effects, and importance of pollutants in marine waters, primarily in estuarine and coastal zone areas. Objectives include developing (1) scientifically and legally defensible water quality criteria, (2) information to assess damage to marine ecosystems from acute and chronic exposure to pollutants, (3) criteria for the disposal of pollutants in the ocean resulting from outfalls and dumping, and (4) models for predicting the long-term effects of pollutants on marine ecosystems.

Major activities undertaken include determining the impact of synthetic organic compounds and ocean discharges on marine ecosystems and developing water quality criteria.

OIL AND HAZARDOUS MATERIALS SPILLS RESEARCH

The purposes of this program are to eliminate spills, reduce discharges resulting from operational practices (such as loading and unloading materials on and off vessels), and minimize the environmental impact of the over 100,000 spills which occur annually in the United States.

The program is geared primarily to developing control technology for the prevention and cleanup of spills in inland waters; however, there is some spinoff in technology for use in ocean areas. Because of this technology transfer, EPA has considered the program marine related.

Efforts include evaluating alternative devices to contain spreading oil slicks on water and rehabilitating sandy beaches contaminated by oil. The Coast Guard is responsible for R&D activities for the cleanup and control of spills in ocean areas. The development of on-board treatment devices to prevent the discharge of untreated sewage from vessels--formerly carried out by EPA--has been transferred to the Coast Guard.

MONITORING SYSTEMS RESEARCH AND DEVELOPMENT

The emphasis in this program is to insure the availability and use of equipment specifications, methodologies, and systems needed by EPA and the States for the operation of efficient, effective, and feasible environmental monitoring and technical information systems.

Objectives include (1) developing, demonstrating, and standardizing improved monitoring equipment, analytical methods, and data collection techniques, (2) implementing and managing an agencywide quality control program from the use of the standardized methods to insure uniform application of procedures, and (3) developing and demonstrating

improved methods and systems for storing, processing, and displaying scientific and technical data. This effort is intended to support the EPA's ocean monitoring activities as well as other environmental monitoring efforts.

OCEAN DISPOSAL PERMIT

The Marine Protection, Research and Sanctuaries Act of 1972 prohibits the dumping of radiological, chemical, or biological warfare agents or high-level radioactive wastes in the ocean.

The objective of the program, implemented in April 1974, is to regulate the ocean dumping of all wastes, except dredged material, in such a manner as to prevent any permanent damage to the marine environment at any dump site and allow only temporary, minor disturbances during actual dumping operations. Specific activities include

--developing criteria for evaluating permit applications,

--developing procedures for issuing or denying waste dumping permits,

--evaluating and designating waste disposal sites,

--developing surveillance and enforcement procedures and conducting such enforcement and surveillance, and

--conducting research to evaluate the impact of waste dumping on the marine environment.

CHAPTER 8

DEPARTMENT OF STATE

State formulates and implements U.S. policy in international ocean affairs with the assistance of other Federal departments and agencies having responsibilities relating to the ocean. Participation by State in the field of marine science activities and oceanic affairs consists principally of financial support provided to United Nations (U.N.) international organizations and international fisheries commissions. In addition, State involves itself in oceanic affairs such as conducting negotiations with foreign governments on international problems and representing U.S. interest at the U.N. Law of the Sea Conference. Some assistance is also provided to developing nations through the Agency for International Development.

The following table compares State's total appropriations with amounts allocated to the areas discussed above.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
State appropriations	$ 510.8	$ 587.2	$ 692.9	$ 694.8
Agency for International Development appropriations	1,718.2	1,664.3	1,548.6	2,568.1
Total appropriations	$2,229.0	$2,251.5	$2,241.5	$3,262.9
Amounts allocated:				
Support for international organizations	$ 6.3	$ 7.3	$ 7.8	$ 8.4

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Support for international fisheries commissions	3.1	3.3	3.6	4.0
Departmental involvement in ocean affairs	.6	.7	1.4	1.7
Assistance to developing nations	.1	.1	.6	.6
Total	$10.1	$11.4	$13.4	$14.7
Percent of total appropriations allocated	(b)	(b)	(b)	(b)

[a]Fiscal year 1975 funds represent requested appropriations.
[b]Less than 1 percent.

International organizations

State contributes the U.S. share of the expenses of 10 international organizations of the U.N. involved in marine-related activities. Because of the degree of technical knowledge often required for meaningful participation in the activities of these organizations, State often draws upon the expertise of other Federal departments and agencies possessing special competence.

The following is a description of the marine-related activities of these international organizations.

--The Food and Agriculture Organization supports seven regional marine fisheries commissions which promote resource research and research on fisheries products

and fishery technology including standards for such products. It provides services, such as the compilation of various statistics, assessment of fish stocks around the world, and convening technical conferences, to the international fisheries community. The Food and Agriculture Organization is also involved with other organizations and groups concerned with marine-related activities. For fiscal years 1972 through 1975, State provided $1.7, $2.0, $2.0, and $1.9 million, respectively.

--All of the work of the International Hydrographic Organization is marine related. The purposes of the Organization include (1) encouraging coordination of the work of the national hydrographic offices of member states with a view to rendering navigation easier and safer throughout the world, (2) endeavoring to obtain uniformity insofar as possible in charts and hydrographic documents, (3) encouraging adoption of reliable and efficient methods of carrying out hydrographic surveys, and (4) encouraging development of theory and improvements in the practice of the science of hydrography.

--The purposes of the Intergovernmental Maritime Consultative Organization are all marine related. The purposes are to (1) provide machinery for cooperation among governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade, (2) encourage general adoption of the highest practicable standards in matters concerning maritime safety and efficiency of navigation, (3) encourage removal of discriminatory action and unnecessary restrictions by governments affecting shipping engaged in international trade to promote the availability of shipping service to the commerce of the world without discrimination, (4) provide for consideration of matters concerning unfair restrictive practices of shipping concerns, and (5) provide for consideration of matters concerning shipping that may be referred to it by any U.N. organization or specialized agency.

--The International Atomic Energy Agency has been entrusted with the responsibility for defining high-level radioactive wastes or other high-level radioactive matter not to be dumped at sea and insuring that any dumping of radioactive matter into the sea involves no unacceptable hazard to man or his environment. The Agency supports the International Laboratory of Marine Radioactivity in Monaco, which performs research on the fate and effects of radioactivity in the marine environment.

--The International Telecommunication Union establishes and regulates the use of maritime frequencies throughout the world.

--The marine-related activities of the U.N. Educational, Scientific, and Cultural Organization promote basic marine research through the Division of Marine Science. This includes research on the management of the coastal environment; encouraging the collection, exchange, and dissemination of marine science information; promoting the strengthening of national facilities and regional cooperation in the marine sciences; and promoting the development of education and training programs for specialists in the marine sciences. The Intergovernmental Oceanographic Commission is a semi-autonomous body under the U.N. Educational, Scientific, and Cultural Organization whose purpose is to promote scientific investigation with a view to learning more about the nature and resources of the oceans through action of its members. The Commission coordinates programs in basic marine research and related services; promotes the exchange of oceanographic data and publication and dissemination of the results of scientific investigations of the oceans; and coordinates and strengthens education, training, and mutual assistance programs in marine science and technology. The Commission cooperates closely with other U.N. international organizations as well as nongovernmental international organizations involved in marine-related activities.

--The U.N. Development Program funds assistance programs, to less developed countries, in marine science,

fisheries, meteorology, maritime development, and health programs relating to coastal pollution. For fiscal years 1972 through 1975, State contributed $3.1, $4.4, $4.3, and $4.3 million, respectively.

--The U.N. Environment Program is dependent upon other U.N. specialized agencies and international organizations to carry out specific action programs. The program's marine-related activities include (1) assessing problems affecting the marine environment and living resources in specific bodies of water, (2) assisting nations in identifying and controlling land-based sources of pollution, (3) stimulating international and regional agreements for the control of all forms of pollution of the marine environment, (4) developing a program for monitoring marine pollution and its effect on marine ecosystems, (5) promoting the development, on an entirely voluntary basis, of a list of clean rivers, (6) surveying the activities of international and regional organizations dealing with conservation and management of the living resources of the oceans, and (7) promoting the effective protection of threatened marine mammals.

--The World Health Organization has several programs providing for the study and development of controls for coastal pollution which affects human health. In addition, the Organization works closely with the Food and Agriculture Organization on a food standards program which includes marine fisheries.

--The marine-related activities of the World Meteorological Organization include work on marine climatology, sea ice data exchange, coordination of marine meteorological services for the meteorological and nautical communities, meteorological aspects of gradual ice build-up on ships and installations at sea, environmental influences on the movement of oil slicks, and weather routing of ships. The Organization works closely with the Intergovernmental Oceanographic Commission and other international organizations on the meteorological aspects of various marine problems. In addition, The World Meteorological Organization and the Intergovernmental Oceanographic Commission

coordinate the international plan for the use of radio frequencies in oceanic data transmission.

International fisheries commissions

State shares in the expense of the following nine international fishery commissions, established by treaties:

--International Pacific Halibut Commission.

--International Pacific Salmon Fisheries Commission.

--Inter-American Tropical Tuna Commission.

--International Commission for the Northwest Atlantic Fisheries.

--International Whaling Commission.

--International North Pacific Fisheries Commission.

--Great Lakes Fishery Commission.

--North Pacific Fur Seal Commission.

--International Commission for the Conservation of Atlantic Tunas.

The objectives of U.S. participation in the commissions are to (1) provide a means of preventing disputes between the United States and other nations fishing in common fishing grounds on the high seas and fishing for common stocks of fish, (2) insure the conservation of fishery resources of importance to the United States, and (3) increase the opportunity for U.S. fishermen to share in the catch of fish. The commissions also carry out or coordinate scientific studies on the resources for which they are responsible and recommend conservation measures to the member governments on the basis of the results of these studies. State provides funds for the travel expenses of the U.S. commissioners and their advisors.

Funds are also provided to the International Council for the Exploration of the Sea which coordinates and stimulates research in the Northeast Atlantic Ocean. The Council

proposes and organizes fishery and oceanographic investigations and disseminates the results. The research activities recommended by the Council are carried out by national organizations.

Involvement in ocean affairs

State funds in this area have been used to finance travel, salary, and other expenses of employees participating in international conferences. The increase in funding in fiscal years 1974 and 1975 is attributable, principally, to State's participation in the Law of the Sea Conference which began in New York in December 1973. State was unable to furnish a breakdown of costs incurred during its participation in the Law of the Sea Conference.

Assistance to developing nations

The Agency for International Development funded marine-related activities to developing nations. Some of the projects undertaken include (1) training in the fisheries area, (2) on-site fisheries assistance, (3) development of an experimental demonstration course for data acquisition, processing, and use which was given to students from at least 16 developing countries, and (4) purchase of oceanographic instrumentation for four Latin American marine institutions.

CHAPTER 9

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Three HEW agencies are involved in marine science activities--FDA, NIH, and OE. The following table shows HEW appropriations and the amounts allocated for marine science activities for fiscal years 1972 through 1975.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations (note b)	$26,967.6	$31,589.0	$34,672.2	$35,146.6
Allocated for marine science activities:				
FDA	$3.1	$4.5	$4.7	$5.0
NIH	4.1	3.3	2.9	2.1
OE	-	-	.1	-
Total	$7.2	$7.8	$7.7	$7.1
Percent allocated	(c)	(c)	(c)	(c)

[a]In this and following tables in this chapter, fiscal year 1975 funds represent requested appropriations.

[b]Exclusive of trust funds, principally Social Security.

[c]Less than 1 percent.

FOOD AND DRUG ADMINISTRATION

Under the Food, Drug, and Cosmetic Act (21 U.S.C. 301), FDA is responsible for insuring that food, including that obtained from the ocean, shipped in interstate commerce is

safe, pure, wholesome, and processed under sanitary conditions. FDA's marine science activities include its administration of the National Shellfish Sanitation Program and sample analyses of fish and fish products and fish plant inspections.

The following table compares funds allocated for these activities with FDA's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$101.3	$158.0	$165.6	$201.3
Allocated to marine science activities:				
National Shellfish Sanitation Program	$1.3	$1.6	$1.7	$1.9
Sample analyses and plant inspections	1.8	2.9	3.0	3.1
Total	$3.1	$4.5	$4.7	$5.0
Percent of total appropriations allocated to marine science activities	3.1	2.8	2.8	2.5

The National Shellfish Sanitation Program, established in 1925, is a voluntary cooperative program of Federal, State, and shellfish industry representatives. FDA represents the Federal Government in the program. The purpose of the program is to prevent disease in man resulting from eating unsafe shellfish--oysters, clams, and mussels.

Twenty-three States and four foreign countries participate in the program. FDA is responsible for determining each

participant's compliance with the shellfish safety standards of the program. FDA provides leadership and guidance to the States and industry through development of standards and criteria; training; and technical assistance, including any necessary field investigation and research. FDA also publishes a list of certified interstate shellfish shippers that have been inspected and approved by participating States. Essentially all regulatory activities are performed by the States under their respective laws and regulations.

FDA also regulates other edible shellfish, such as crabs and scallops and conducts plant inspections and makes sample examinations of other fish and fish products to insure safety and quality.

NATIONAL INSTITUTES OF HEALTH

NIH administers research contracts and grants and conducts in-house research to study diseases of man.

The following table compares funds allocated to marine science activities with NIH's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$2,193.1	$2,698.1	$1,859.8	$1,834.8
Allocated to marine science activities:				
Marine organism research	$4.1	$3.3	$2.9	$2.1
Percent of total appropriation allocated to marine science activities	(a)	(a)	(a)	(a)

[a]Less than 1 percent.

Each of the 10 NIH institutes sponsors research on marine organisms to obtain needed basic biological data because such organisms are simpler and easier to work with than other animal organisms.

The institutes administer and support research to study, for example, cell structure and anti-cancer agents; development of a nontoxic biologically accepted bonding agent for oral restoration and orthopedic repair; nerve functions; and anatomy and physiology of vital human organs.

OFFICE OF EDUCATION

Participation by OE in marine science activities has been minimal.

The following table compares funds allocated to marine science activities with OE's total appropriations.

	Fiscal year			
	1972	1973	1974	1975
	(millions)			
Total appropriations	$5,194.5	$6,186.9	$5,988.4	$5,962.2
Allocated to marine science activities:				
Study on need for curriculum development in marine science	-	-	$.1	-
Percent of total appropriation allocated to marine science	-	-	(a)	-

[a] Less than 1 percent.

OE's total involvement consists of a 1-year project, initiated in 1974, entitled State of the Art Study and Bases

for Curriculum Decisions in Marine Sciences. The purpose of the study is to determine whether there is a national need for curriculum development for vocations related to marine sciences. If there is a need, OE may fund such projects in the future.

CHAPTER 10

ATOMIC ENERGY COMMISSION

AEC's statutory mission is to develop, use, and control atomic energy. A portion of the radioactivity added to any environment through nuclear activities will find its way into the ocean. AEC's marine science activities and oceanic affairs are principally research oriented and designed to understand and predict the fate of radioactivity once it enters the ocean and to determine its effects on the environment and on humans who rely on marine food in their diet.

The following table shows appropriated funds allocated by four AEC divisions (formerly six) to support marine science activities and oceanic affairs.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations	$2,294.4	$2,633.4	$2,389.0	$3,057.6
Allocated to marine science activities and oceanic affairs:				
Division of Biomedical and Environmental Research	$4.0	$5.0	$5.4	$13.5
Division of Military Application	1.2	.9	.8	.7
Division of Naval Reactors	.8	.5	.6	.8
Division of Reactor Research and Development	.7	.8	.7	.7

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Division of Applied Technology	.2	.1	-	-
Division of Physical Research	(b)	(b)	-	-
Total	$6.9	$7.3	$7.5	$15.7
Percent of total appropriations allocated	(c)	(c)	(c)	(c)

[a]Fiscal year 1975 funds represent requested appropriations.

[b]Less than $50,000.

[c]Less than 1 percent.

On October 11, 1974, the Energy Reorganization Act of 1974 (Public Law 93-438) was enacted for the purpose of reorganizing and consolidating certain functions of the Federal Government into a new Energy Research and Development Administration and a new Nuclear Regulatory Commission. This became effective on January 19, 1975. Accordingly, AEC's fiscal year 1975 marine-related research became the responsibility of the Energy Research and Development Administration on the effective date of its establishment.

DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH

To provide for the safety of man and his environment, this Division supports research of biological, chemical, geological, and physical oceanography. The research is directed to learning the effects of biological activity, sedimentation, and other oceanographic processes on the

accumulation of radionuclides (a radioactive type of atom characterized by its nuclear properties) in the living and nonliving portions of the marine environment.

The research is conducted by major oceanographic educational institutions, individual oceanographers, and AEC's national laboratories.

The research undertaken includes:

--Biological uptake, concentration, distribution, and effects of radioactive elements: understanding the movement of radionuclides in the food chains of man to insure the protection of both man and the marine ecosystem on which man depends for food.

--Sedimentation and chemical interactions: studying sediments and chemical processes in the ocean because a large portion of the radioactivity in the ocean becomes attached to particles and moves with the sediment and chemical processes in the ocean can either remove radioactivity or make it more available.

--Circulation and mixing: studying (1) deep ocean currents as a distributive mechanism for radioactivity, (2) dispersal and distribution of fallout radionuclides through the ocean water masses, and (3) mechanisms for reduction or dilution of possible centers of radioactivity in the ocean.

--Other oceanographic studies: studying the effects of thermal alterations on marine ecosystems and on biocides (poisonous chemical substances that can kill living organisms) and corrosion inhibitors used in the normal operations of nuclear powerplants.

Funding for this research for fiscal year 1975 was over 250 percent greater than for any of the 3 preceding fiscal years. The increase consisted principally of funding for research-ship operations and increased support for

--conducting thermal research to better understand the impact of waste heat effluent from any electrical

generating systems on marine and estuarine ecosystems;

--understanding the behavior of plutonium in the ocean because of the role of plutonium in breeder technology,

--evaluating all types of nuclear and nonnuclear impacts on the coastal zone which may occur from the operation of offshore floating nuclear plants generating electrical power, and

--making a regional assessment of nuclear and nonnuclear impacts in several drainage basins such as the Great Lakes, Northeast Corridor, and the Pacific Northwest.

DIVISION OF MILITARY APPLICATIONS

The marine-related activity administered by this Division concerns military testing and involves large, specialized studies of fairly short duration to insure safety of a nuclear event both before and after the event occurs. For example, as a result of military testing on the island, special studies were made on the populations of sea otters and fish in the nearby ocean off the island of Amchitka, Alaska.

DIVISION OF NAVAL REACTORS

The only marine-related project being administered by this Division concerns the design and development of the nuclear propulsion plant for a deep-submergence research vehicle operated by the Navy.

DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

The Division administers and supports five projects relating to the siting of nuclear powerplants in a coastal or estuary zone including studies of problems associated with the dispersion of thermal plumes (configuration of warm water on top of ambient water) and coastal current modeling.

DIVISION OF APPLIED TECHNOLOGY

Marine-related activities undertaken by the Division before 1974 consisted of work on (1) new instruments which used radioactive isotopes for making marine measurements and (2) irradiation preservation of marine food products. The activities were transferred in 1974 to the Division of Biomedical and Environmental Research. Currently, only two projects, formerly administered by the Division of Applied Technology, remain active. The projects include irradiation preservation of cod and ocean perch and testing the use of californium-252 (a neutron source) to determine whether heavy metals exist on the ocean bottom and, if so, the abundance of such metals.

DIVISION OF PHYSICAL RESEARCH

The only marine-related activity administered by the Division was a contract for $10,000 in each of fiscal years 1972 and 1973. The contracts were for research on neutron activation of ocean sediments to determine their composition.

CHAPTER 11

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

All of NASA's oceanographic-related activities are designed to be responsive to the needs of other Federal agencies and the scientific community for improved or new oceanographic-data acquisition systems to facilitate their efforts in acquiring information about the resources and environment of the coastal zone and open ocean.

The following table shows total NASA appropriations and the portion allocated to oceanographic-related activities.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations	$3,310	$3,408	$3,040	$3,247
Allocated to oceanographic-related activities:				
Supporting research and technology	$ .8	$1.3	$2.4	$4.7
Space flight programs	2.0	3.0	2.6	10.2
Advanced applications flight experiments	.4	.5	.3	.6
Total	$3.2	$4.8	$5.3	$15.5

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Percent of total appropriations allocated to oceanographic-related activities	(b)	(b)	(b)	(b)

[a]Fiscal year 1975 funds represent requested appropriations.

[b]Less than 1 percent.

SUPPORTING RESEARCH AND TECHNOLOGY

This program encompasses research which investigates the feasibility of using remote-sensor instrumentation and techniques for obtaining useful information about oceanographic parameters, processes, and phenomena.

NASA conducts research concerning the development of computerized methods and procedures for facilitating the acquisition, processing, formatting, and interpretation of remote-sensor-derived oceanographic data. It also develops and tests predictive and descriptive models with sensor-derived data. NASA aircraft serve as platforms for remote-sensing instruments during field experiments involving flights over sites or regions where other Federal and non-Federal agency scientists are occupying ship stations and acquiring conventional oceanographic measurements. These measurements are required for assessing the ability of remote sensors to provide information on actual oceanographic conditions or physical, chemical, and biological parameters.

In addition, NASA has embarked upon a cooperative program with NOAA and the Coast Guard to demonstrate the operational utility of using an airborne radar system to acquire imagery of ice coverage on the Great Lakes and a satellite to relay the radar data from the aircraft to the satellite ground receiving station. Ultimately the data will be used to produce navigational charts.

SPACE FLIGHT PROGRAMS

Oceanographic-related activities associated with NASA's space flight programs have two purposes: (1) testing and assessing the capabilities of remote sensors from the standpoint of design and performance and (2) conducting experiments to determine whether remote-sensor-derived data provides useful information about the marine environment.

Remote-sensor-derived data obtained during the recently completed series of manned Skylab missions and during the present Earth Resources Technology Satellite unmanned earth orbiting spacecraft mission are currently being evaluated to determine their utility in providing information on oceanic conditions.

Other space flight activities being pursued under the program include the following.

--GEOS-C spacecraft: this spacecraft will be launched into near-polar orbit in the spring of 1975 and will carry a radar altimeter for use in mapping the geoid of the ocean surface with a precision of about 1 meter and measuring the average wave height under the satellite. Since the radar altimeter will be used for oceanographic measurements, its development is considered by NASA as an oceanographic-related activity; the spacecraft is not identified as solely oceanographic related.

--SEASAT-A: this satellite, to be launched in 1978, will demonstrate remote-sensor and data system capabilities and provide to the oceanographic user community knowledge about the global ocean. Specifically, the data acquired by the satellite will make possible the improvements in ocean and weather forecasting necessary for defining and developing a prototype operational system for 7- to 14-day worldwide sea-condition forecasting. It will permit the monitoring of the world's oceans every 36 hours.

ADVANCED APPLICATIONS FLIGHT EXPERIMENTS

Efforts currently include development of remote-sensing instrumentation which will be used on orbiting spacecraft to acquire information on sea ice, sea surface wave geometry, and sea roughness. This information is essential for monitoring highly dynamic oceanographic conditions.

CHAPTER 12

SMITHSONIAN INSTITUTION

The marine-related activities of the Smithsonian focus on the classification and ecology of marine organisms and investigations of biological and geological phenomena of marine environments. The following table shows appropriated funds allocated for marine-related activities.

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Total appropriations	$56.8	$76.2	$84.2	$98.3
Allocated to Smithsonian organizations for marine-related activities:				
National Museum of Natural History	1.0	1.1	1.2	1.3
Oceanography and Limnology Program (note b)	.1	.1	.1	.2
Smithsonian Oceanographic Sorting Center	.3	.3	.3	.3
Mediterranean Marine Sorting Center (note b)	.3	.3	.2	.3
Chesapeake Bay Center for Environmental Studies	.2	.2	.2	.4

	Fiscal year			
	1972	1973	1974	1975 (note a)
	(millions)			
Smithsonian Tropical Research Institute	.4	.5	.5	.6
Environmental Science Program	.2	.1	.1	.1
Woodrow Wilson International Center for Scholars	.1	.1	.1	.1
Total	$2.6	$2.7	$2.7	$3.3
Percent of total appropriations allocated	4.6	3.5	3.2	3.4

[a]Fiscal year 1975 funds represent requested appropriations.
[b]Will terminate at the end of fiscal year 1975.

NATIONAL MUSEUM OF NATURAL HISTORY

The museum supports basic taxonomic, anatomical, and environmental research projects concerning marine organisms. These projects vary in scope and emphasis but almost always include a systematic analysis of the organisms being studied. In addition, the geographical distribution of marine animals is analyzed and this information is correlated with relevant physical data, ecological research to determine the relationship between marine organisms and their environment is performed, and short- to long-term monitoring of marine areas and populations is conducted. A small amount of work is also done in the area of marine geology.

OCEANOGRAPHY AND LIMNOLOGY PROGRAM

The Smithsonian Oceanography and Limnology Program is an administrative unit providing management and support services. The two basic kinds of support services provided are (1) direct logistical support, chiefly through the

administration of two sorting centers and (2) technical support on both national and international levels, primarily by focusing Smithsonian expertise on problems of the water environment and its animal and plant life. The program also performs a research function primarily in biological oceanography and largely in support of internal marine projects involving the research staff of the Smithsonian's science bureaus.

SMITHSONIAN OCEANOGRAPHIC SORTING CENTER

Marine biological specimens are collected around the world under programs sponsored principally by the Smithsonian and other Federal and private organizations. The Smithsonian Oceanographic Sorting Center sorts the specimens into classified groups, archives the data, and distributes the specimens to interested qualified specialists for study. A worldwide list of specialists and their areas of interest is maintained by the Center. Several million specimens a year have been sorted. The Center maintains a computerized inventory of collections received and sorted which includes available environmental data and information resulting from later analysis by scientists. A collection of Antarctic-bottom photographs is also maintained and distributed to interested scientists. The services of the Center are provided to other Federal agencies and nongovernmental organizations on a contract basis.

MEDITERRANEAN MARINE SORTING CENTER

The Mediterranean Marine Sorting Center was established in Tunisia in 1966 to provide services similar to the Smithsonian Oceanographic Sorting Center, but its use is limited to scientists and institutions involved in Mediterranean marine science programs. The Center provides facility and logistical support to a number of projects in Tunisia funded from the Smithsonian Foreign Currency Program and also provides administrative support to a study of eutrophication elements in Lake Tunis which is being undertaken with EPA.

CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES

The primary functions of the Center are public education and research facilitation through administrative support and facilities maintenance. Most of the Center's research projects receive external funding through grants and contracts. Research focuses on the environmental relationship between the Rhode River estuary and its watershed and the tidal interface between the two.

SMITHSONIAN TROPICAL RESEARCH INSTITUTE

The Institute--the only basic research-oriented station in the tropics under the sponsorship of the United States--conducts research on the evolutionary and ecological adaptions of tropical organisms. The Institute conducts research on basic biological processes, supports advanced training, supports research in the tropics by others, and works on behalf of conservation in the tropics. Research in line with these objectives includes studies of

--the relationship between species diversity and evolutionary success,

--mathematical theories of community ecology, and

--predator-prey coadaptations.

Also under study are the history and composition of coral reefs and their biological communities and such organisms as sea snakes, sea urchins, squid, and coral reef fish.

ENVIRONMENTAL SCIENCE PROGRAM

This is a long-range, multibureau study of natural fluctuations in several different ecosystems. The purpose is to understand the effects that natural changes have on biological communities to gain insight about the potential effects of changes caused by man's activities. Since different ecosystems respond in different ways to environmental changes, several contrasting sites have been picked for study. These include two reserves managed by the Smithsonian Tropical Research Institute (a tropical forest and an

intertidal coral reef) and a temperate estuary managed by the Chesapeake Bay Center for Environmental Studies. Research activities include measuring the number of physical, chemical, and biological factors which vary with time--including plant production and animal consumption. These give a picture of the stability, predictability, and variability of each environment. Another research project conducted under the program is investigating the marine shallow-water ecosystem at a reef site off the coast of British Honduras.

RESEARCH CONDUCTED UNDER THE NOAA SEA GRANT PROGRAM

MARINE RESOURCES DEVELOPMENT

Aquaculture

Aquaculture is an overall NOAA goal, with the Sea Grant Program as a major participant. Under NOAA aquaculture plans certain fish species are assigned priority for development. The species are those with relatively short-range promise for commercial aquaculture. In addition, sea grant is involved with the long-range growth of American aquaculture through its research on new species. Aquaculture research includes:

a. Study of individual plant and animal species or groups of species for the specific purpose of rearing them under controlled circumstances for social or economic benefit.

b. Studies of maturation, breeding, hatching, rearing, diet, nutrition, selective breeding, genetics, disease, parasites, environmental requirements, polyculture, sequential culture, and energy flow through culture systems including use of wastes and recycled nutrients.

c. Engineering development and evaluation of aquaculture systems of all kinds.

d. Applications of aquaculture to social as well as economic benefits, including recreation.

e. Economic analysis of aquaculture systems, social and cultural impacts and barriers, environmental impacts, institutional problems, and legal considerations.

Living resources other than aquaculture

a. Studies related to the population dynamics, distribution, life history, diseases, and sustainable yield of plant and animal stocks.

b. R&D directed to resource management.

c. Effects of human intervention.

d. All of the above, plus any related research directed specifically to target species now underutilized.

Mineral resources

a. Evaluation and prediction of potential environmental impact of recovery of particular minerals in specific areas.

b. Inventories of mineral resources.

c. Techniques for locating, evaluating, and recovering mineral resources.

d. Cooperation and communications with cognizant agencies and with minerals industries in a continuing definition of the most useful and productive sea grant role that contributes to national and regional needs while avoiding competition and duplication.

e. Definition of minerals as hydrocarbons, sulphur, sand, gravel, heavy minerals, manganese, and phosphorite nodules and crusts; minerals found in beach sands and marine placer deposits and minerals extracted from seawater; and freshwater aquifers and ground water.

Marine biomedicinals and extracts

a. Investigation of potentially useful industrial products from living marine resources.

b. Investigation of chemical and bioactive substances for which clues and some background exist and which may have either industrial or medicinal use.

SOCIOECONOMIC AND LEGAL STUDIES

Marine economics

a. Continuing evaluation, beginning with the conceptual stage, of new technology development through scientific and engineering research.

b. Assessment of the economic impact of any marine resource development.

c. Economic studies of alternate decisions in marine resource and coastal zone management.

d. Development of techniques and models for economic assessment of marine activities of all kinds, including economic considerations of ecosystem maintenance or alteration.

Ocean law

a. Inventorying and classifying domestic marine and coastal laws and regulations--particularly as they apply to State and local jurisdictions.

b. Identifying potential marine resource legal deficiencies and problems and recommending solutions.

c. Developing new legal concepts and finding conflicts within legal regimes which may be solved by specific actions or new concepts.

d. Analyzing and understanding developments in international law of the sea and aiding understanding by the marine communities affected by such developments.

e. Providing background on legal considerations to the private legal community and to the legal officers of political jurisdictions and to public groups.

Marine recreation

a. Recreational fishing of all kinds--from big game fishing to pan fishing.

b. Application of marine technologies to recreational fishing opportunities, e.g. use of aquaculture technology for improvement or expansion of recreational fishing.

c. Requirements and opportunities of the boating public and those who serve the boating public with a special emphasis on assisting business and industry to improve services.

d. Examination of such questions as public access to marine recreation areas and recommendations to managers based on studies of trends and future requirements.

e. Preservation of recreational areas and environmental improvement or maintenance.

f. Innovative concepts for improvement of marine recreational activities--particularly in the major metropolitan areas where recreational opportunities have declined.

Sociopolitical studies

a. Study of institutional structures and procedures affecting marine resource development or management--including specific analyses and guidelines for the use of business, industry, and managers.

b. Assessment of the social and cultural impacts of alternative decisions for use of the marine environment or coastal zone.

c. Definition of social and cultural barriers to new and innovative uses of marine products, e.g. underutilized species or reconstituted food forms.

d. Studies of the social values, as distinct from the purely economic values, of various existing uses of the marine environment.

MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT

Ocean engineering

Ocean engineering in sea grant is directed to conception and development of specific methods and equipment. Both new engineering systems and improvement of those already in use are appropriate.

a. Life support systems--relates both to surface and subsurface support systems.

b. Seafloor engineering--offshore, seafloor emplacement of various kinds of structures, including storage structures.

c. Vehicles, vessels, and platforms.

d. Materials and structures.

e. Coastal engineering.

f. Engineering--aquaculture

g. Dredging--relates to coastal engineering, but the substantial industry involvement rates a separate heading.

h. Ocean engineering--other--a category for fields not covered elsewhere; permits an opportunity for innovation not proposed often enough to warrant separate treatment.

Resources recovery and use

a. Behavioral sciences--the focus for behavioral sciences within this category is recoverable (or culturable) marine organisms whose behavior determines the effectiveness of recovery or culture systems. A criterion is the commercial value of

the organism concerned. Priority depends on the importance of behavior to design and effectiveness of capture or culture systems.

b. Commercial fisheries--technology--directed to gear and fishing platform research and other fields designed specifically to improve the efficiency of the fisherman or to open up new fisheries.

c. Man-in-the-sea research--for both diver and submersibles, research priority is limited to fields of demonstrable cost effectiveness.

d. Seafood science and technology--a broad category of research which may include recycling or other use of wastes and byproducts from seafood handling and processing; improvements in safety and palatability of seafood products; increased efficiency for processors; better handling at all stages from catch to consumer; new products; longer life for processed products; methods of meeting criteria established by regulatory agencies; or any other field that will increase the quality, efficiency, or utilization of foods from the sea either as foods or industrial products.

Transportation systems

Marine transportation is the primary responsibility of other agencies, including Maritime, COE, and the Coast Guard. However, sea grant plays a useful role in providing economic, legal, social, and environmental information.

a. Studies directed to development, improvement, and evaluation of marine transportation systems and their components--covering both existing and new designs.

b. Design criteria for safe and effective harbors, marinas, offshore terminals, artificial channels, breakwaters, etc.

c. Systems analysis of marine transportation including interface with land and air systems.

d. Basic methodology and decision criteria.

e. Economic, social, institutional, engineering, and environmental considerations.

MARINE ENVIRONMENTAL RESEARCH

Research and studies in direct support of coastal zone management decisions

a. Acquisition, compilation, evaluation, and analysis of existing data necessary for coastal zone management--including materials of value to the design of appropriate data management systems.

b. Studies of social and institutional arrangements and constraints, demographic data and population trends, economic structures in the coastal zone, and projected land and water uses.

c. Consequences of alternate decisions and courses of action.

d. Procedures and techniques for transfer of information and data to appropriate elements of the coastal community.

e. Physical, chemical, biological, and geological data necessary to determine the effects of alternate courses of action or of past actions relevant to decisions.

f. Relative values, in social and economic terms, of various geographical and environmental elements of the coastal zone under study.

Ecosystems research

a. Developing the methodology for ecosystems research.

b. Defining and isolating key parameters through which an ecosystem can be defined.

APPENDIX II

Pollution studies

a. The source, fate, and effects of oil spills, pesticides, thermal and radioactive pollutants, and metals in the marine environment.

b. Alternate means of waste disposal.

Environmental models

a. Mathematical models of physical, biological, and other environmental processes.

Applied oceanography

a. Chemical, physical, biological, and geological oceanographic studies.

NAVAL SYSTEMS SUPPORTED BY OCEAN ENVIRONMENTAL KNOWLEDGE

SURVEILLANCE

Acoustic

Stationary sensors (fixed, moored, and free floating)
Vehicle-towed sensors
Hull-mounted sensors
Vehicle-dipped sensors

Nonacoustic

Direct detection
Surface manifestation detection
At-depth manifestation detection

TACTICAL WARFARE

Ship and submarine active sonar
Ship and submarine passive sonar
Air-deployed localization sensors
Acoustic communication systems
Nonacoustic sensors

NULLIFICATION

Underwater-launched air transit missiles
Torpedoes
Undersea mines
Mine countermeasures (excluding hunting)
Acoustic sensor countermeasures

COASTAL-INSHORE OPERATIONS

Coastal conditions and processes
Remote sensing
Tactical-strategic forecasts
Shallow water acoustics

APPENDIX III

OCEANOGRAPHIC OPERATIONS

Mapping, charting, geodesy
Acoustic-ocean condition measurement
Ocean engineering and construction
Search, rescue, and salvage

PRINCIPAL OFFICIALS OF THE DEPARTMENTS AND AGENCIES RESPONSIBLE FOR ADMINISTERING ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office			
	From		To	
AEC (note a)				
CHAIRMAN:				
Dixy Lee Ray	Feb.	1973	Jan.	1975
James R. Schlesinger	Aug.	1971	Feb.	1973
Glenn T. Seaborg	Mar.	1961	Aug.	1971
DOC				
SECRETARY OF COMMERCE:				
Frederick B. Dent	Feb.	1973	Present	
Peter G. Peterson	Feb.	1972	Feb.	1973
Maurice H. Stans	Jan.	1969	Feb.	1972
DOD				
SECRETARY OF DEFENSE:				
James R. Schlesinger	July	1973	Present	
William P. Clements, Jr. (acting)	Apr.	1973	July	1973
Elliot L. Richardson	Jan.	1973	Apr.	1973
Melvin R. Laird	Jan.	1969	Jan.	1973
HEW				
SECRETARY OF HEALTH, EDUCATION, AND WELFARE:				
Caspar W. Weinberger	Feb.	1973	Present	
Frank C. Carlucci (acting)	Jan.	1973	Feb.	1973
Elliot L. Richardson	June	1970	Jan.	1973
DOI				
SECRETARY OF THE INTERIOR:				
Rogers C. B. Morton	Jan.	1971	Present	

APPENDIX IV

	Tenure of office	
	From	To
DEPARTMENT OF STATE		
SECRETARY OF STATE:		
Henry A. Kissinger	Sept. 1973	Present
William P. Rogers	Jan. 1969	Sept. 1973
DOT		
SECRETARY OF TRANSPORTATION:		
Claude S. Brinegar	Feb. 1973	Present
John A. Volpe	Jan. 1969	Feb. 1973
EPA		
ADMINISTRATOR:		
Russell E. Train	Sept. 1973	Present
John R. Quarles, Jr. (acting)	Aug. 1973	Sept. 1973
Robert W. Fri (acting)	Apr. 1973	Aug. 1973
William D. Ruckelshaus	Dec. 1970	Apr. 1973
NASA		
ADMINISTRATOR:		
James C. Fletcher	Apr. 1971	Present
NSF		
DIRECTOR		
H. Guyford Stever	Feb. 1972	Present
Raymont L. Bisplinghoff (acting)	Jan. 1972	Feb. 1972
William D. McElroy	July 1969	Jan. 1972

	Tenure of office	
	From	To

SMITHSONIAN INSTITUTION

THE SECRETARY:

S. Dillon Ripley	Feb. 1964	Present

[a]The Energy Reorganization Act of 1974 (Public Law 93-438) discontinued the AEC and created a new Nuclear Regulatory Commission and a new Energy Research and Development Administration. This became effective January 19, 1975, and Robert C. Seamans, Jr. was appointed Administrator of the Energy Research and Development Administration which will be responsible for the marine-related activities formerly conducted by AEC.

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