Report to the Congress on Ocean Pollution, Monitoring, and Research

October 1984 through September 1985

May 1986

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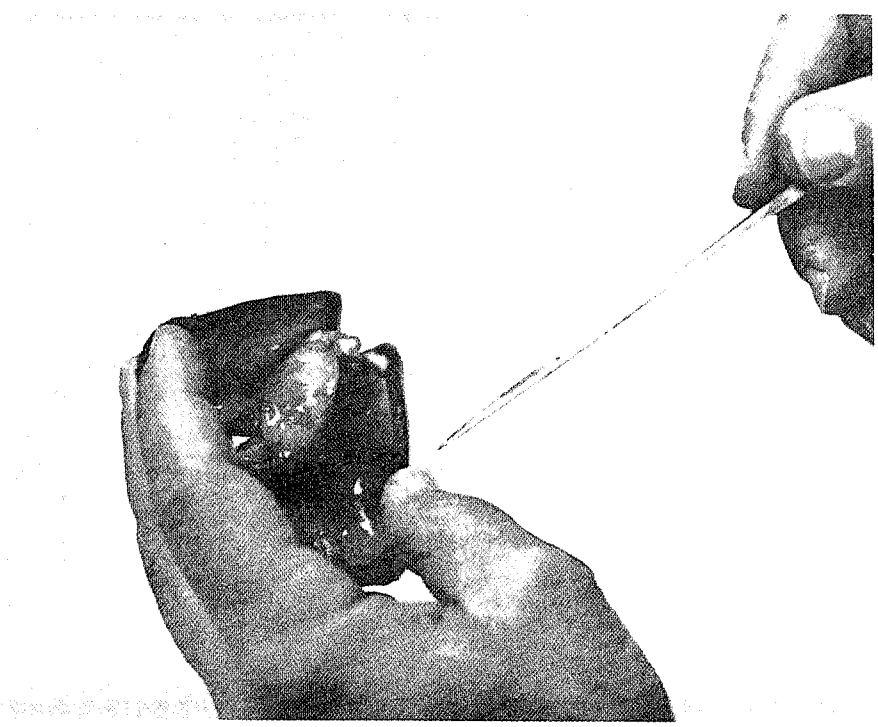

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Report to the Congress on Ocean Pollution, Monitoring, and Research

October 1984 through September 1985

Submitted in compliance with Sections 201 and 202,
Title II of the Marine Protection, Research,
and Sanctuaries Act of 1972
(Public Law 92-532)

May 1986

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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration
Anthony J. Calio, Administrator

National Ocean Service
Paul M. Wolff, NOAA Assistant Administrator for Ocean Services
and Coastal Zone Management

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

AUG 2 5 1986

President of the Senate
Speaker of the House of Representatives

Sirs:

I am pleased to submit the annual Report to the Congress on Ocean Pollution, Monitoring, and Research for FY 1985.

Under Section 201 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, the Congress assigned to the Department of Commerce the responsibility to monitor and research the effects of dumping wastes into the ocean. Section 202 gives the Department the responsibility for initiating a continuing program of research regarding the possible long-range effects of pollution and human-induced changes of ocean ecosystems. The Act requires that the Secretary report at least once a year to the Congress on the findings of this monitoring and research.

This report describes the ocean pollution activities carried out by the National Oceanic and Atmospheric Administration during fiscal year 1985. It describes results from a comprehensive, continuing program of assessment, including research, development, and monitoring, on the short- and long-term effects of human activities on the marine environment. These activities result in information products and services useful for planning and decisionmaking related to the resolution of multiple resource-use conflicts, including environmental quality problems, in the estuarine, coastal, and oceanic areas of the United States. Current activities range from long-term, comprehensive, "strategic" assessments of national marine environmental quality issues to on-scene, real-time "tactical" advice during emergency responses to spills of hazardous materials.

Sincerely,

Malcolm Baldrige

Secretary of Commerce

Enclosure

CONTENTS

	Page
EXECUTIVE SUMMARY	vii
Chapter I: THE NOAA PROGRAM	1
Legislative Authority	1
The NOAA Organization	2
Scope of this Report	2
Chapter II: INTERAGENCY COORDINATION AND DISSEMINATION OF INFORMATION	7
INTERAGENCY PLANNING AND COORDINATION	7
INFORMATION DISSEMINATION	8
Chapter III: STRATEGIC ASSESSMENTS	11
NATIONAL DATA BASE DEVELOPMENT AND ASSESSMENT	11
Living Marine Resources	12
Coastal and Estuarine and Habitats	12
Pollution Sources and Discharges	19
Economics of Coastal and Oceanic Resources	20
Geography of Coastal and Oceanic Resources	21
Chapter IV: COASTAL AND ESTUARINE ASSESSMENTS	25
NATIONAL STATUS AND TRENDS PROGRAM	25
Selecting Contaminants and Sites for Monitoring	26
Collecting and Analyzing Samples	26
Historical Data Analysis	31
Water Quality Monitoring	34
QUALITY ASSURANCE	35
Analytical Intercalibration	35
Specimen Banking	36
CONSEQUENCES OF CONTAMINANTS	38
Indicators of Human Health Risk from Shellfish and Fish Contamination	38
Effects of Contaminants in Fish Populations	39
Chapter V: HAZARDOUS MATERIALS RESPONSE	43
SCIENTIFIC SUPPORT COORDINATION AND TRAINING	43
Spill Planning and Training	43
T/V Puerto Rican Spill	44
ENVIRONMENTAL CHARACTERIZATION AND ASSESSMENT	46
TRAJECTORY MODELING and CHEMICAL HAZARD ASSESSMENT	47
HAZARDOUS WASTE DUMP SITES IN COASTAL AREAS	48

Page

Chapter VI: SELECTED PUBLICATIONS AND INFORMATION EXCHANGE 49

INTERNATIONAL OCEAN DISPOSAL SYMPOSIA 49
BOOKS AND SPECIAL REPORTS 49

Chapter VII: PROGRAM MANAGEMENT 51
Resource Allocations by Program 51
Expenditures 53
Research Platforms 53

Appendix A: PROJECTS FUNDED BY THE NOAA PROGRAM
IN FISCAL YEAR 1985 55

Appendix B: REPORTS AND PUBLICATIONS OF THE NOAA PROGRAM
IN FISCAL YEAR 1985 61

EXECUTIVE SUMMARY

Under the authority of the National Ocean Pollution Planning Act of 1978 (P.L. 95-723), Title II of the Marine Protection, Research, and Sanctuaries Act of 1972 (P.L. 92-532), and other Federal statutes, NOAA coordinates marine pollution research and monitoring activities throughout the Federal government, and conducts a continuing, comprehensive program of assessment activities, including research, development, and monitoring of the short- and long-term effects of human activities on the marine environment. Federal interagency coordination responsibilities are carried out by NOAA's National Marine Pollution Program Office (NMPPO), while NOAA's research, monitoring, and assessment programs are managed primarily by the Ocean Assessments Division (OAD) of the Office of Oceanography and Marine Assessment, National Ocean Service (NOS). Various projects of the overall program are carried out by scientists and analysts of the NOS, by other major line organizations of NOAA, and by contractors and grantees (Appendix A). This report summarizes activities performed during fiscal year 1985. These activities result in information products and services useful for planning and decisionmaking to resolve of multiple resource-use conflicts, including environmental quality problems, in the estuarine, coastal, and oceanic areas of the USA. Current OAD activities range from long-term, comprehensive, "strategic assessments" of national marine environmental quality problems to on-scene, real-time "tactical" advice during emergency responses to spills of hazardous materials.

The National Marine Pollution Program Office (NMPPO), a staff office of the Assistant Administrator of the National Ocean Service, is responsible for the interagency coordination of Federal marine pollution research and monitoring and for the timely dissemination of information from these activities. During fiscal year 1985, NMPPO prepared a third edition of a comprehensive 5-year plan for the overall Federal effort in marine pollution research and monitoring. This plan, the National Marine Pollution Program--Federal Plan for Ocean Pollution Research, Development, and Monitoring, Fiscal Years 1985-1989, analyzes national marine pollution needs and problems to determine whether Federal research and monitoring is addressing them in a manner consistent with their priority. The plan recommends ways to improve the overall Federal program.

The Federal effort is described and analyzed in two documents produced annually by NMPPO. The fiscal year 1984 update of the Agency Program Summaries provides an overview of marine pollution-related programs of the Federal government, and the Catalog of Federal Projects presents more detailed descriptions of the projects within these programs. Together, these documents provide program and project descriptions, goals and objectives, milestones, mandates, and funding for fiscal years 1983-1986, and an analysis of the overall 1984 program funding based on pollution activities and pollutants of concern. NMPPO is also analyzing high priority marine pollution issues in greater detail to develop research and monitoring strategies for acquiring scientific information needed by resource managers. During fiscal year 1985, such action plans were drafted for at-sea disposal of radioactive wastes, ocean dumping of municipal and industrial wastes, and regional pollution problems in the Great Lakes.

The OAD conducts comprehensive, interdisciplinary assessments to determine strategies for marine resource development that will result in maximum benefit to the Nation with minimal environmental damage or conflict among resource uses. To accomplish this goal, OAD evaluates existing and projected coastal and oceanic resource demands in terms of level of use, pollution discharge and transport, resources-at-risk, environmental quality effects, and resource-use conflicts. The OAD maintains an operational capability with which to evaluate the environmental and economic effects of national policies and management strategies affecting coastal and oceanic resources of the USA.

Strategic assessment activities are organized around five major inter-related categories of information: 1) living marine resources; 2) coastal marine and estuarine habitats; 3) pollution sources and discharges; 4) economics of coastal and oceanic resources; and 5) geography of coastal and oceanic resources. Within each category, data for the entire USA are being compiled in computer-accessible files on consistent scales of time and space to facilitate the systematic and comprehensive analysis of multiple resource-use conflicts within major regions of the USA and the comparison of resource distributions and uses among regions. Each category of information represents an essential part of a national data base and assessment capability, and supports the production of data atlases intended to aid decisionmaking on a national and regional basis. Data base development activities are currently underway for major coastal and oceanic regions of the USA including: 1) the East Coast; 2) the Gulf of Mexico; 3) the Bering, Chukchi, and Beaufort seas of Alaska; and 4) the West Coast and Gulf of Alaska.

In cooperation with the National Marine Fisheries Service, OAD is collecting and synthesizing information on the spatial and temporal distribution of the life histories of valuable fishes, invertebrates, reptiles, birds, and mammals. Species are selected for their commercial, recreational, subsistence, or ecological (e.g., important prey species) value or special status (i.e., endangered or threatened). During fiscal year 1985, OAD completed the compilation of information on the geographic distribution of the life history stages of 90 species of Arctic fishes, invertebrates, mammals and birds, and produced life history distributional maps for major groundfishes in the Gulf of Alaska and south along the West Coast to Baja California. The combined information on species life history and species abundance will help to identify those areas of the EEZ that are relatively important from a biological standpoint.

The National Estuarine Inventory (NEI) is being developed by OAD to provide the data base necessary to develop a national estuarine assessment capability. The first product of this activity is a data atlas that presents information, through maps and tables, on the most important physical and hydrologic characteristics of major estuaries of the USA. The 92 estuaries included in the NEI and the data atlas represent about 90 percent of the estuarine surface area and over 90 percent of the freshwater inflow entering the coastal regions of the USA. Volume 1 of the National Estuarine Inventory Data Atlas series was completed during fiscal year 1985.

Since 1966, the status of shellfish-growing waters (as classified by state shellfish sanitation control agencies) has been inventoried periodically in a National Shellfish Register of Classified Estuarine Waters. The 1985 edition of the Register was developed by a Federal task force including the U.S. Food and Drug Administration, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and NOAA. Since the 1980 report, the total area approved for shellfish harvesting has declined throughout most regions of the country. The OAD has computerized these shellfish classification data for analysis and will examine relationships among classified shellfish waters and various factors such as pollutant loadings, and the physical and hydrologic characteristics that govern the movement and deposition of pollutants in estuaries. The classified shellfish waters are now being aggregated by estuary to facilitate direct comparison with information in the National Estuarine Inventory, and analysis of the possible reasons for changes in the classification of shellfish waters.

The data bases and inventories described here can be manipulated along with other information and compared by computer to permit analysis, by region, of resource use and potential. To communicate the information content of these data bases to decisionmakers and managers, the OAD is developing a series of data atlases. The series includes the National Estuarine Inventory Data Atlas, a National Atlas on the Health of Coastal Waters of the USA, and four data atlases of of major regions of the EEZ. These atlases present information on consistent base maps for selected major regions of characteristics of each region, including: 1) physical environments; 2) living environments; 3) the life histories of living marine resources; 4) coastal and offshore economic activities; 5) marine environmental quality, including pollutant discharges; and 6) jurisdictions. These atlases are assisting coastal and oceanic resource managers in their analyses of resource-use conflicts and environmental problems, and will serve to alert them to the continuing development of national data bases within OAD. Preliminary or final versions are completed for four of these atlases.

Since 1984 NOAA's Ocean Assessments Division (OAD) has conducted a national program that will in fiscal year 1986 begin to provide comprehensive, high quality, and continuing information about the status of environmental quality in the coastal and estuarine areas of the USA. The National Status and Trends (NS&T) Program was initiated to establish and maintain the information base required to quantify the current status and long-term, temporal and spatial trends of key contaminant concentrations and biological indicators of effects in the coastal and estuarine environments of the USA. A nationally uniform set of techniques is being employed to measure environmental quality in these important areas. In conducting the program, NOAA is cooperating with and acquiring data from other existing monitoring programs to enhance its assessment capabilities.

Samples are being collected at 150 carefully selected sites throughout the USA. All sites are located in coastal or estuarine areas that range from pristine to heavily populated and/or industrialized. Samples of bivalve molluscs (mussels and oysters) and sediments are collected at each site and analyzed for trace toxic organic chemicals and trace elements.

At 50 of these sites, surveillance of benthic organisms was begun in 1984. Composite sediment samples and a statistically significant number of fish are collected by the National Marine Fisheries Service from each site. In addition to the same trace metal and trace organic analyses that are performed on the mussel tissues, fish tissue samples are examined microscopically for a variety of histological lesions indicative of damaged or diseased tissue.

Marine environmental quality measurements made by NOAA laboratories, contractors and grantees must now conform to established quality assurance (QA) guidelines. During fiscal year 1985, OAD developed and published these guidelines. All projects that measure toxic organic chemicals or trace elements in sediments, tissues, or measurements of other environmental quality parameters must contain a QA plan that conforms to these guidelines. The analytical protocols established by the QA program are currently used by all laboratories participating in the NS&T program.

A goal of OAD assessments is to determine the effects of contamination on the productivity of valued fishery resources in coastal waters of the USA. Several studies are pursuing this objective from different perspectives to provide an effective understanding of the problem, including: 1) retrospective analysis of historical fishery population and catch information relative to human activities such as waste discharges and dredging; 2) modeling of fishery population dynamics to project potential population effects of contaminant-associated changes in reproductive capacity or mortality; 3) field studies to relate the reproductive physiology of fishery species to contaminant exposure; and 4) laboratory exposures of species to environmental contaminants to determine reproductive and pathological consequences. A primary objective is to identify valid correlates of reproductive success that can be applied on a national scale to identify areas where reproduction of resource species may be diminished.

Problems associated with accidental spills of oil and hazardous materials in coastal and estuarine waters are addressed by OAD's Hazardous Materials Response Program. During fiscal year 1985, OAD responded to 105 spills of oil and fuel products and an additional 95 incidents involving other hazardous materials throughout the USA. Support included on-the-scene assistance, trajectory analysis, chemical hazard analysis, and environmental sensitivity analysis. Personnel also participated in several U.S. Coast Guard-sponsored simulation exercises designed to prepare Federal, state, and local authorities to deal more effectively with the complexities of real emergency spill situations.

NOAA's assessment of natural resource damages resulting from PCB contamination of New Bedford Harbor in Massachusetts continued through 1985. Review of EPA existing hazardous waste sites in coastal areas has identified 95 sites with some potential to affect resources under NOAA's trusteeship. NOAA is now assigning Coastal Resource Coordinators to selected EPA regional offices to facilitate assessment and cleanup activities at these coastal sites.

During fiscal year 1985, OAD issued the final three volumes in the "Wastes in the Ocean" series. These volumes are the result of the NOAA-sponsored International Ocean Disposal Symposia. Volume 4, Energy Wastes in the Ocean, characterizes fuels and their wastes, the CO_2 problem, and nuclear power plant wastes. Volume 5, Deep Sea Waste Disposal, discusses the management and monitoring of wastes in the deep sea. Volume 6, Nearshore Waste Disposal, examines the effects of dumping on nearshore marine environments and organisms and highlights the legal and policy implications of nearshore waste disposal. Volumes 1-3, published previously, have been covered in previous annual reports.

Researchers and analysts in this NOAA program have generated a large number of other technical and scientific publications that document scientific advances for environmental managers and expand the information base for future ocean assessments. Appendix B lists these publications, including those published with NOS support by scientists in academic institutions and private industry.

Chapter I

THE NOAA PROGRAM

Since its establishment on October 3, 1970, the National Oceanic and Atmospheric Administration (NOAA) has played a key role in advancing scientific knowledge about the consequences of pollution and other human-induced changes in marine, coastal, and estuarine environments. As human activities increase in coastal areas and as interest grows in developing the multiple resources of the Exclusive Economic Zone (EEZ) of the USA, the importance and value of improved knowledge and information on the effects of human activities on marine and estuarine ecosystems will grow.

NOAA's marine environmental quality programs span a wide range of activities from field measurements of the current status and long-term trends of coastal and estuarine environmental quality throughout the USA to laboratory research focused on understanding the processes that determine the distribution, movement, and effects of pollutants in marine and estuarine areas and their resources. The information products and services from these activities are used for planning and decisionmaking on environmental quality problems within the estuarine, coastal, and oceanic areas of the USA. NOAA's assessment activities range from comprehensive, long-term "strategic" assessments of national marine environmental quality problems to on-scene, real-time "tactical" assessments leading to advice about corrective actions during Federal emergency responses to spills of hazardous materials.

Legislative Authority

The authority for NOAA's marine pollution research, monitoring, and assessment programs is derived principally from two Federal laws:

- the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 (P.L. 92-532); and
- the National Ocean Pollution Planning Act (NOPPA) of 1978 (P.L. 95-273).

Title II of the MPRSA authorizes the Secretary of Commerce to initiate comprehensive and continuing programs of research and monitoring with respect to the effects of ocean dumping (Section 201) and other long-range effects of pollution and human-induced changes on ocean ecosystems (Section 202).

To promote a more unified approach to marine pollution problems, the NOPPA assigned four tasks to NOAA: 1) preparation of regularly updated 5-year plans for the overall Federal marine pollution effort; 2) establishment of a comprehensive NOAA pollution research program consistent with the Federal plan; 3) support of research in areas not being adequately addressed by the Federal Government; and 4) timely dissemination of information resulting from these studies.

Additional legislation extends NOAA's authorities related to marine pollution and environmental resource assessment beyond those identified above. For example, NOAA conducts many of its oil spill and hazardous materials response activities under authorities and implementing regulations of the Clean Water Act, as amended (e.g., the National Oil and Hazardous Substances Contingency Plan), and the Comprehensive Environmental Response, Compensation, and Liability Act (the "Superfund" Act). NOAA also conducts the Outer Continental Shelf Environmental Assessment Program (OCSEAP) for the Minerals Management Service, through the authority of the Outer Continental Shelf Lands Act, as amended. However, the activities and results described in this annual report are directly related to the mandates of the MPRSA and the NOPPA. A separate annual report on activities conducted under OCSEAP is published separately and is available from the Ocean Assessments Division.

The NOAA Organization

Marine pollution assessment, monitoring, and research activities are conducted within several components of NOAA's line organization (Figure 1). Responsibilities for preparation of the government-wide Federal Plan, interagency coordination of the work under the plan, and dissemination of information from the studies are assigned to the National Marine Pollution Program Office (NMPPO), a staff office of the National Ocean Service (NOS). Primary responsibility for NOAA's marine pollution assessment, monitoring, and research programs is assigned to the Ocean Assessments Division (OAD) within the Office of Oceanography and Marine Assessment, a major line office of the NOS. A significant part of the extramural research managed by OAD is conducted by the regional fisheries centers of the National Marine Fisheries Service and the environmental research laboratories of the Office of Oceanic and Atmospheric Research. Related programs of environmental quality research funded through other, separate authorities are also carried out in these NOAA facilities.

Scope of this Report

This report emphasizes the activities and accomplishments of OAD and NMPPO, carried out under the direct authorities of MPRSA and NOPPA. The report is structured along organizational and programmatic lines. As in past annual reports, we have described only NOAA-supported monitoring, research, and assessment activities that are funded directly by either Title II of the MPRSA or Sections 4, 6, or 8 of NOPPA.

The overall goals of these NOAA programs are to provide leadership to Federal interagency planning and coordination, and to provide the best available scientific and technical information on marine and estuarine environmental quality to national policy-makers in Congress and Federal agencies, as well as to state and local governments, the private sector, and the public. This information supports management decisions that facilitate balanced use of the Nation's coastal waters and oceans. Activities currently conducted under the program include:

- A cooperative interagency analysis of marine pollution issues and priorities, and planning the necessary research and monitoring strategies;

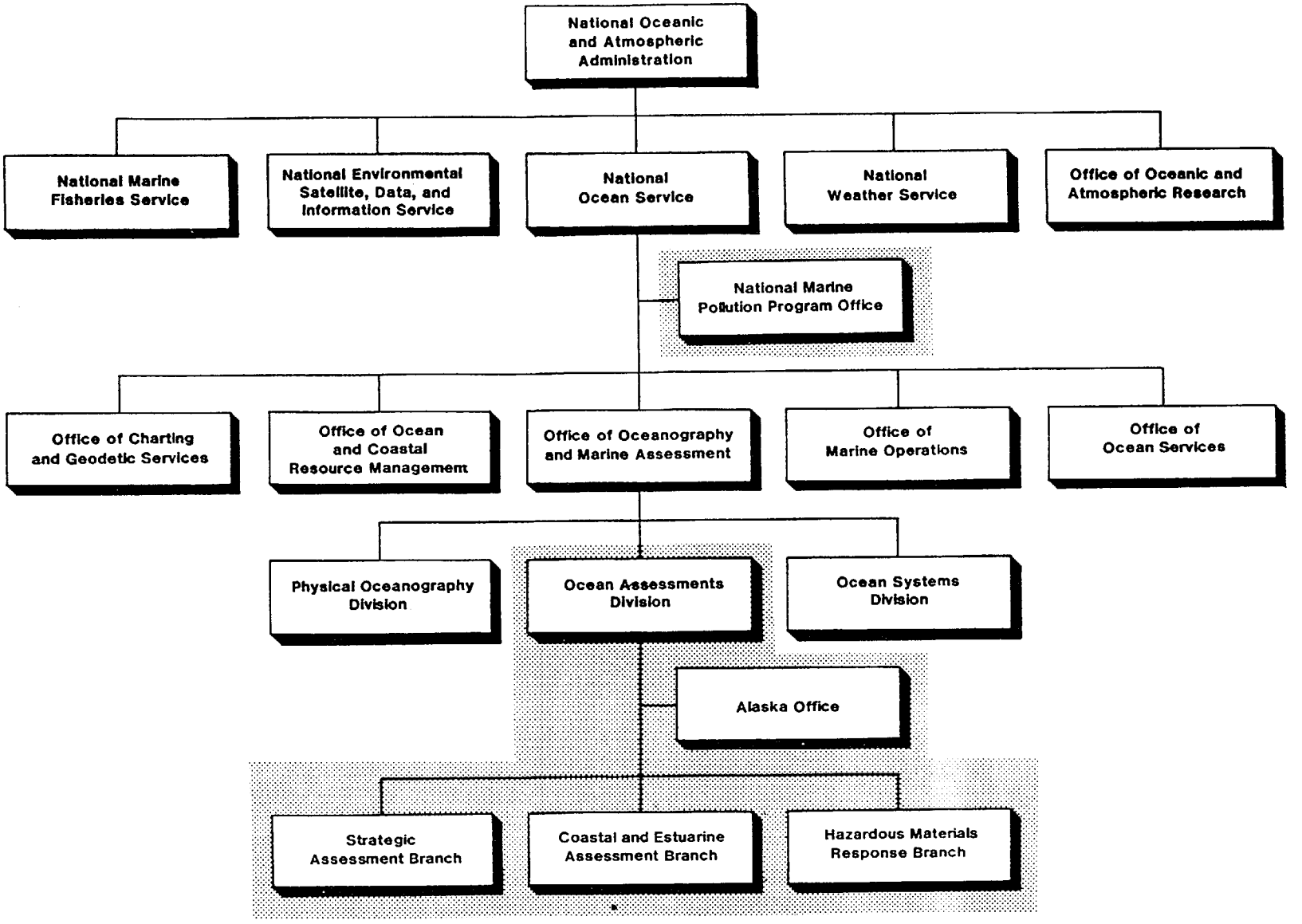


Figure 1. The NOAA Organization for Ocean Pollution Monitoring and Research Activities

- A national, strategic assessment program to assess the effects of multiple uses of resources of the Exclusive Economic Zone and adjacent coastal areas;

- A national program to assess the status and trends of marine and estuarine environmental quality;

- A NOAA-wide quality assurance program for marine environmental quality measurements;

- A program to assess the effects of selected toxic organic compounds on populations of living marine resources; and

- A national capability to provide scientific support services during Federal responses to spills of oil and hazardous materials in coastal waters.

During the past two years the program has continued to develop an operational capability for the analysis of marine and estuarine environmental quality problems in a national context. It has directed NOAA's environmental quality assessment and monitoring efforts toward coastal and estuarine areas where problems are more immediate than in the open ocean. It has focused primarily on direct measurements and analyses of the pollutants of greatest concern, the synthetic organics. New NOAA measurements of marine environmental quality are now being subjected to rigorous quality control procedures. NOAA's oil spill response experience and capability have been applied to problems related to the cleanup of hazardous waste dump sites in coastal areas. NOAA has played a substantive role in the development and review of damage assessment regulations under Section 301(c) of Superfund, and has initiated an assessment of natural resource damages resulting from PCB contamination of New Bedford Harbor, Massachusetts.

Recent accomplishments of the program include:

- Publication of the third edition of a comprehensive 5-year plan for the overall Federal effort in marine pollution research and monitoring;

- Submission of Gulf of Mexico Strategic Assessment Data Atlas to the Government Printing Office for printing and completion of a preliminary edition of the Bering, Chukchi, and Beaufort Seas Data Atlas;

- Completion of data compilation for the National Estuarine Inventory and distribution of "Volume 1: Physical and Hydrologic Characteristics" of the National Estuarine Inventory Data Atlas;

- Estimation of 17 types of pollutant discharges from almost 4,800 industrial and municipal point sources, over 86,000 sq. mi. of nonurban, nonpoint sources (e.g., agricultural lands), about 350 urban, nonpoint sources, and upstream discharges from 37 rivers for the East Coast component of the National Coastal Pollutant Discharge Inventory (NCPDI);

- Completion of 1984 and 1985 field sampling programs of the Benthic Surveillance project to determine concentrations of chemical contaminants in bottomfish and sediments at 50 locations nationwide;

- Completion of quality assurance guidelines for projects supported by NOAA that involve the measurement of toxic chemicals in environmental quality samples;

- Publication of National Status and Trends Program analytical methods manual for analysis of trace organic chemicals in marine sediments and biota; and

- Provision of NOAA scientific support in response for 95 chemical spills and 105 oil spills.

Information produced through this program is being used increasingly by other Federal agencies to make decisions that affect marine and estuarine environmental quality. For example, the Environmental Protection Agency (EPA) has used NOAA information to review applications for waivers of secondary treatment requirements for coastal sewage treatment plants under Section 301(h) of the Clean Water Act, and to propose effluent guidelines for the offshore oil and gas industry. NOAA continues to coordinate its research, assessment, and monitoring activities closely with EPA, especially with its Office of Marine and Estuarine Protection and the Office of Emergency and Remedial Response (Superfund). The Minerals Management Service has used NOAA products and services to evaluate the effects of outer continental shelf oil and gas exploration and production activities, not only in Alaska where MMS reimburses NOAA to conduct the Outer Continental Shelf Environmental Assessment Program (OCSEAP), but also for lease sales in the North Atlantic Ocean and the Gulf of Mexico. The U.S. Coast Guard is a major user of NOAA's scientific support services for spill responses. Finally, the Office of Technology Assessment is using information from the Ocean Assessments Division to complete its study of ocean waste disposal.

Appendix A lists those studies funded in fiscal year 1985, organized according to major NOAA programs. Selected results of these and earlier studies are summarized in chapters II-V under the same program topics, but not all of the projects are mentioned separately in the text. Where sample collection or data analysis is still in early stages, discussion of the results has been left for a future report. Additional, significant program products and documents are highlighted in Chapter VI, and the bibliography of publications and reports resulting from this program is updated in Appendix B.

Chapter II

INTERAGENCY COORDINATION AND DISSEMINATION OF INFORMATION

Sections 4 and 8 of the National Ocean Pollution Planning Act (NOPPA) of 1978 require NOAA to coordinate marine pollution research, development, and monitoring activities funded by the Federal government and to disseminate information resulting from these activities to interested users. These responsibilities are delegated to the National Marine Pollution Program Office (NMPPO), a staff office to NOAA's Assistant Administrator of the National Ocean Service. This chapter describes the interagency planning and coordination and information dissemination activities of NMPPO that are responsive to these two sections of NOPPA.

INTERAGENCY PLANNING AND COORDINATION

Section 4 of NOPPA requires NOAA to prepare a comprehensive five-year Federal plan for the overall National Marine Pollution Program and to update this plan every three years. The third edition of this plan, the National Marine Pollution Program--Federal Plan for Ocean Pollution Research, Development, and Monitoring, Fiscal Years 1985-1989, was completed and submitted to the President and the Congress in October 1985. This edition was prepared with assistance from, and with subsequent approval by, the interagency Committee on Ocean Pollution Research, Development, and Monitoring (COPRDM), which is composed of senior representatives from the eleven Federal departments and agencies that sponsor marine pollution research, development and monitoring activities. The Federal Plan is focused on analyzing national needs and problems and on determining whether the National Marine Pollution Program is addressing these in a manner that is consistent with their priority. The objectives of these analyses are to identify program areas that should be increased or decreased, and to recommend ways to improve the information resulting from the Federal program. Some of the major recommendations arising from the evaluation of the National Marine Pollution Program are:

- Federal research and monitoring programs related to coastal disposal of domestic sewage and industrial wastes should be strengthened;
- Federal research and monitoring directed at understanding the effects of nonpoint source pollution should be expanded;
- Greater emphasis should be placed on understanding the effects of synthetic organic chemicals in coastal waters;
- Greater emphasis should be placed on understanding the effects of nutrients and pathogens in coastal waters, while reducing the emphasis related to metals and petroleum;
- The present strong emphasis on understanding the effects of oil and gas development on the marine environment should be reduced;

- Federal programs should be strengthened in the areas of data synthesis/interpretation and information dissemination; and

- The environmental effects of the release of net fragments and marine debris from vessels is an emerging issue and should be investigated further.

Based on the programs and priorities identified in the Federal Plan, NMPPO analyzes selected priority marine pollution issue and problem areas in greater detail. These analyses, called "Federal action plans," consider existing and potential problems on specified topics, the need for additional scientific information to aid resource managers develop a research and monitoring strategy to acquire this information, and present the Federal plans for conducting research and monitoring to meet this strategy during the next five years. Three Federal action plans have been drafted and their results will be reported next year. The plans include: 1) at-sea disposal of radioactive wastes; 2) ocean dumping of municipal and industrial wastes; and 3) Great Lakes research.

INFORMATION DISSEMINATION

Section 8 of NOPPA mandates the timely dissemination of the results, findings, and information from ocean pollution research, development, and monitoring programs conducted or sponsored by the Federal Government to relevant Federal departments and agencies and to other persons having an interest in this information. All Federal agencies that sponsor marine pollution research, development, and monitoring programs use some of their resources to publish and disseminate the results and findings of these activities. However, further compilation, analysis, and synthesis of these results are particularly valuable to resource managers in cases where many agencies and programs are investigating a specific problem.

NMPPO prepares two reports that are updated annually and published as appendices to the Federal Plan for Ocean Pollution Research, Development, and Monitoring. The fiscal year 1984 update of the National Marine Pollution Program--Agency Program Summaries provides an overview of the activities of each of the eleven Federal departments and agencies that are currently engaged in marine pollution programs. This update reviews the marine pollution programs of each of these by describing program goals, objectives, recent accomplishments, future milestones, and funding for fiscal years 1983-1986. The report finds that the overall Federal program was funded at a level of $121,099,000 in fiscal year 1984. This amount represents an 8% reduction in funding from fiscal year 1983. The report concludes that the majority of these funds were allocated to study the environmental effects of marine waste disposal (44% of the total) and marine mining, primarily outer continental shelf oil and gas development (41% of the total). From a pollutant perspective, the greatest percentage of the total funding supported activities related to understanding the effects of petroleum and petroleum products (27%), while lesser amounts were expended investigating the environmental and/or human health effects of sedimentation (16%), organic chemicals (14%), and radionuclides (13%).

A companion report, the fiscal year 1984 update of the National Marine Pollution Program--Catalog of Federal Projects, presents more detailed descriptions of the approximately 650 projects supported by the Federal government. It includes the project title, name of the principal investigator, a project abstract, and funding for fiscal years 1984 and 1985. All projects in the Catalog are indexed by polluting activity, pollutant, geographic region, zone in the marine environment, and project objectives.

In addition to publishing information on Federal programs, NMPPO continues to compile descriptions of marine pollution research, development, and monitoring projects funded by sources outside the Federal Government. During fiscal year 1985, NMPPO published an inventory of non-Federal activities being conducted in the Great Lakes region. It contains project descriptions and funding analyses for an estimated total expenditure of $6,200,000. A total of 77 non-Federal pollution research, development, and monitoring projects are discussed from a geographic zone, polluting activity, and pollutant perspective. The majority of the funds (78%) were allocated to study the effects of coastal land use (i.e., construction and operation of coastal facilities, habitat alterations, and nonpoint source pollution) and waste disposal. The single largest funding category focused on the effects of power plants on the aquatic environment (cooling water, impingement, and entrainment), particularly in the states of Michigan and New York. A similar report for the South Atlantic and Gulf coastal region was published in 1984 and inventories are now being developed for the North and Middle Atlantic and Pacific coastal regions.

The Handbook of Federal Systems for Marine Pollution Data and Information was updated during fiscal year 1985. The Handbook describes 70 marine pollution data and information systems supported by 13 Federal agencies. For each information system, the Handbook provides information on the scope of service, types of information and products available, means of access, typical response time, and principal contact. The Handbook is updated annually.

Chapter III

STRATEGIC ASSESSMENTS

Continued growth of the Nation's economy places greater demands on the living marine resources and other natural resources in coastal areas and the adjacent Exclusive Economic Zone (EEZ). Increased human activities in these areas will compete inevitably for limited space and valuable natural resources, resulting in significant use conflicts, effects on marine environmental quality, and costs to society. This situation requires the timely and effective communication of scientific information to the people and institutions that make decisions affecting environmental quality. Federal laws and regulations related to coastal and oceanic resources, such as the Clean Water Act, the Outer Continental Shelf Lands Act Amendments, the Coastal Zone Management Act, and the Marine Protection, Research, and Sanctuaries Act, often require the explicit consideration of potential coastal and oceanic resource-use conflicts. These conflicts include, for example, those between the designation of sites for ocean waste disposal or the location of sale areas for oil and gas exploration and development, and areas of biological importance, such as spawning areas of commercial fishes or calving areas of whales. This type of information is generally neither well-known nor well-organized for decisionmaking.

The Strategic Assessment Branch (SAB) of the Ocean Assessments Division conducts comprehensive, interdisciplinary strategic assessments of multiple resource uses in coastal areas and the EEZ. The objective is to determine marine resource development strategies that will result in maximum benefit to the Nation with minimal environmental damage or conflict among uses. To accomplish this objective, SAB evaluates existing and projected coastal and oceanic resource uses, pollutant discharges and transport, resources-at-risk, and potential environmental effects and use conflicts. SAB maintains comprehensive national inventories of coastal and oceanic resources and their existing and proposed uses. SAB also develops strategic assessment methods and maintains an operational capability with which to evaluate the environmental and economic effects of national policies and management strategies affecting the use of coastal and oceanic resources.

These assessments are "strategic" because they develop information and analytical capabilities at time and space scales appropriate for setting or modifying national objectives for coastal and EEZ resource development and conservation, for identifying various means to achieve these objectives, and for evaluating the potential effects of their implementation. They are intended to complement, not replace, the detailed "tactical" analyses required to make site-specific decisions.

NATIONAL DATA BASE DEVELOPMENT AND ASSESSMENT

The assessment activities of SAB are organized around five major inter-related categories of information: 1) living marine resources; 2) coastal and estuarine habitats; 3) pollution sources and discharges; 4) economics of marine and estuarine resources; and 5) the geography of marine and estuarine resources. Information within each of these

categories is carefully selected and structured to facilitate intercomparison and analysis among categories. Appropriate data are being compiled in computer-accessible files on consistent scales of time and space for the entire USA to support the systematic and comprehensive analysis of potential multiple-resource-use conflicts within major regions and the comparison of resource distributions and uses among regions.

Each type of information synthesized through the Strategic Assessment Program represents an essential part of a national data base and assessment capability, and supports the production of data atlases and other information products intended to aid decisionmaking on a national and regional basis. Data base development activities are currently underway for major coastal and ocean regions (excluding the Great Lakes) of the USA including: 1) the East Coast; 2) the Gulf of Mexico; 3) the Bering, Chukchi, and Beaufort seas of Alaska; and 4) the West Coast and Gulf of Alaska (Figure 2). Collectively, these four regions represent about 50% of the surface area, about 90% of the adjacent coastline, 95% of the adjacent coastline population, and almost all of the commercial fishing, marine transportation, and oil and gas exploration, development, and production activities within the EEZ of the USA.

Living Marine Resources

In cooperation with the National Marine Fisheries Service, the Strategic Assessment Program is collecting and synthesizing information on the spatial and temporal distribution of the life history of valuable marine fishes, invertebrates, reptiles, birds, and mammals. Species are selected for their commercial, recreational, subsistence, or ecological (e.g., important prey species) value or special status (i.e., endangered or threatened). Information has been organized on the distribution of three important life history stages (reproductive, larval and juvenile, and adult) for each species, along with information on the distribution of commercial, recreational, and subsistence exploitation areas, where applicable. During fiscal year 1985, SAB completed the compilation of life history distributional information for 90 species of Arctic fishes, invertebrates, mammals, and birds, and produced life history distributional maps for major groundfishes in the Gulf of Alaska, and south along the West Coast of the USA to Baja California. Information on species life history and abundance will help to identify those areas of the EEZ that are relatively important from a biological standpoint.

This living marine resource information is organized by 10 x 10-minute offshore "grid cells" and by the four seasons of the year. An automated data system has been developed that can produce computer-generated maps and statistical summaries of data on different combinations of species, life history stages, seasons of the year, and grid cells. The system is currently operational for the East Coast (63 species), the Gulf of Mexico (74 species), and for the Arctic seas (102 species). Figure 3 illustrates the mapping capabilities of this system for the summer distribution of sockeye salmon in the Bering Sea.

Coastal and Estuarine Habitats

Coastal and estuarine habitats represent a highly valuable natural and renewable national resource. Estuaries are a source of food as well

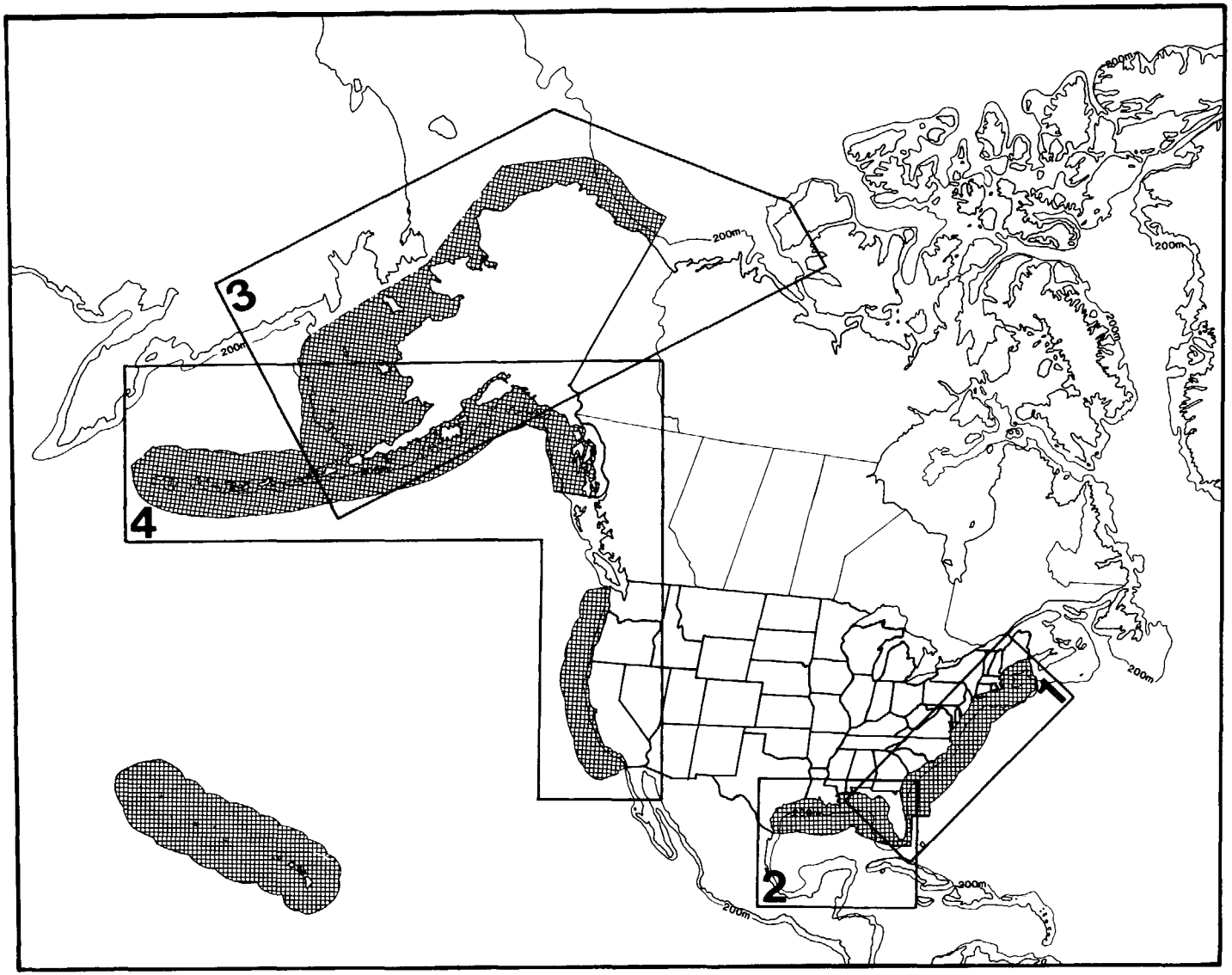


Figure 2. Analysis Regions for Strategic Assessments of the EEZ

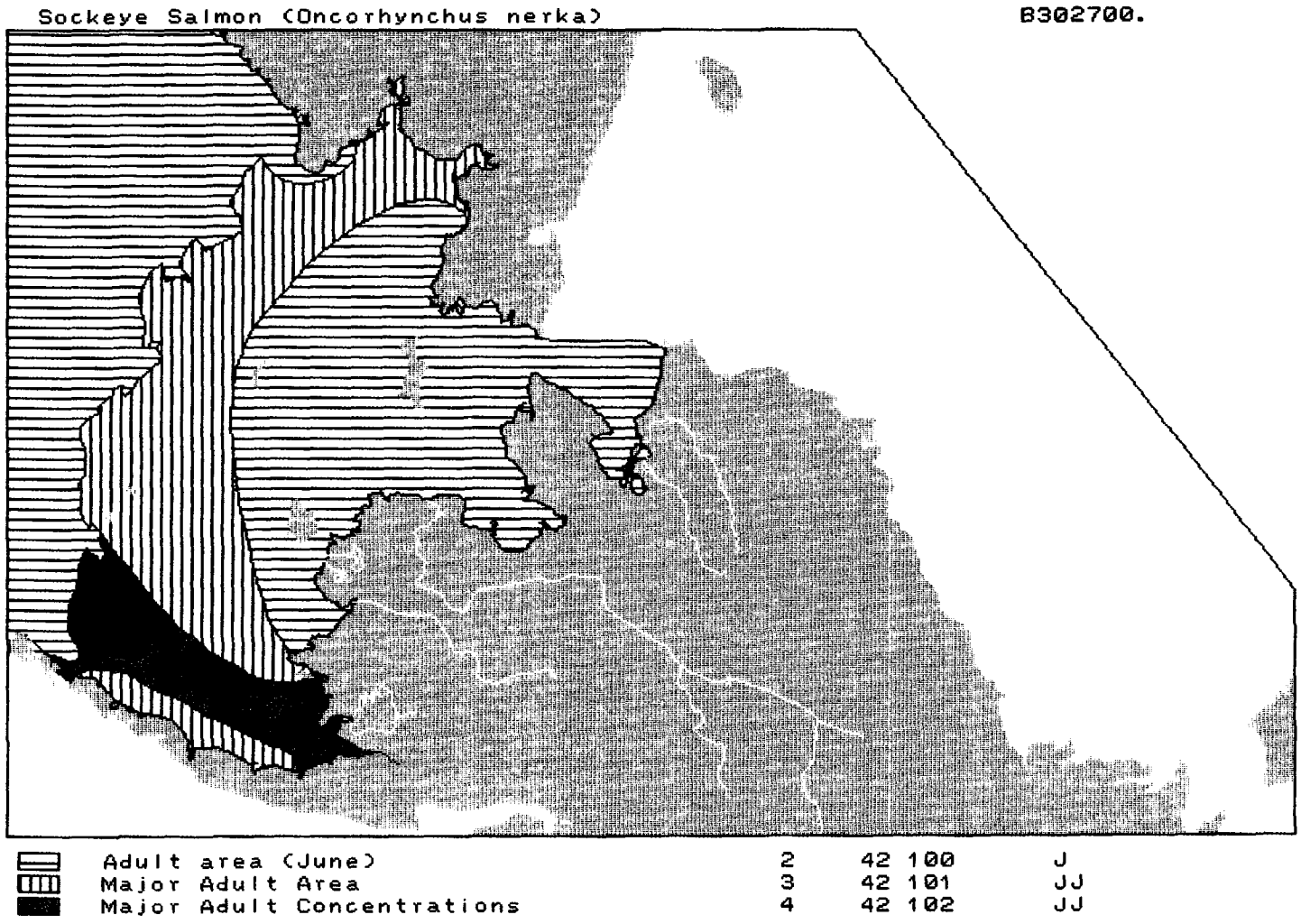


Figure 3. Sample Computer-generated Map from the Living Marine Resource Data Base

as serving as spawning and nursery grounds for many commercially or recreationally important species of finfish and shellfish. The SAB is currently involved in three assessment projects related to coastal and estuarine marine habitats: 1) the National Estuarine Inventory (NEI); 2) the National Shellfish Register; and 3) an inventory of coastal wetlands.

Estuaries are among our most productive natural systems. The freshwater and nutrients that estuaries provide to coastal areas are critically important to sustaining the health of most living marine resources in these areas, and in providing habitat particularly for early life stages. In spite of their high value and intense use, however, estuaries have not been widely recognized as a unique or depleted resource base of national significance. Several Federal laws, including the Clean Water Act, the Coastal Zone Management Act, and the Marine Protection, Research and Sanctuaries Act only partially or indirectly affect how estuaries are used. Most decisionmakers and scientists continue to address selected estuaries on an individual basis, with little or no directed, comprehensive national focus. Without a comprehensive national data base, meaningful comparisons and assessments of conditions in estuaries are not possible, and the development of effective national policies is impeded.

The National Estuarine Inventory (NEI) is being developed by OAD to provide the data base necessary for a national estuarine assessment capability. The first product of this activity is a data atlas that presents information, through maps and tables, on the most important physical and hydrologic characteristics of major estuaries of the contiguous USA. The 92 estuaries included in the NEI and the data atlas represent about 90 percent of the estuarine surface area and over 90 percent of the freshwater inflow entering coastal areas (Figure 4). The distribution of these estuarine areas by major regions of the USA is shown in Table 1.

Table 1. Estuaries included in the National Estuarine Inventory

	Number of Estuaries	Estuarine Drainage Area (sq. mi)	Estuarine Water Surface Area (sq. mi.)	Average Daily Freshwater Inflow (1,000 cu. ft./sec)
Northeast Coast	28	71,700	9,400	234.8
Southeast Coast	20	48,800	4,500	149.3
Gulf of Mexico	27	101,000	9,800	938.9
West Coast	17	54,900	8,300	613.9
TOTAL	92	276,400	32,000	1,936.9

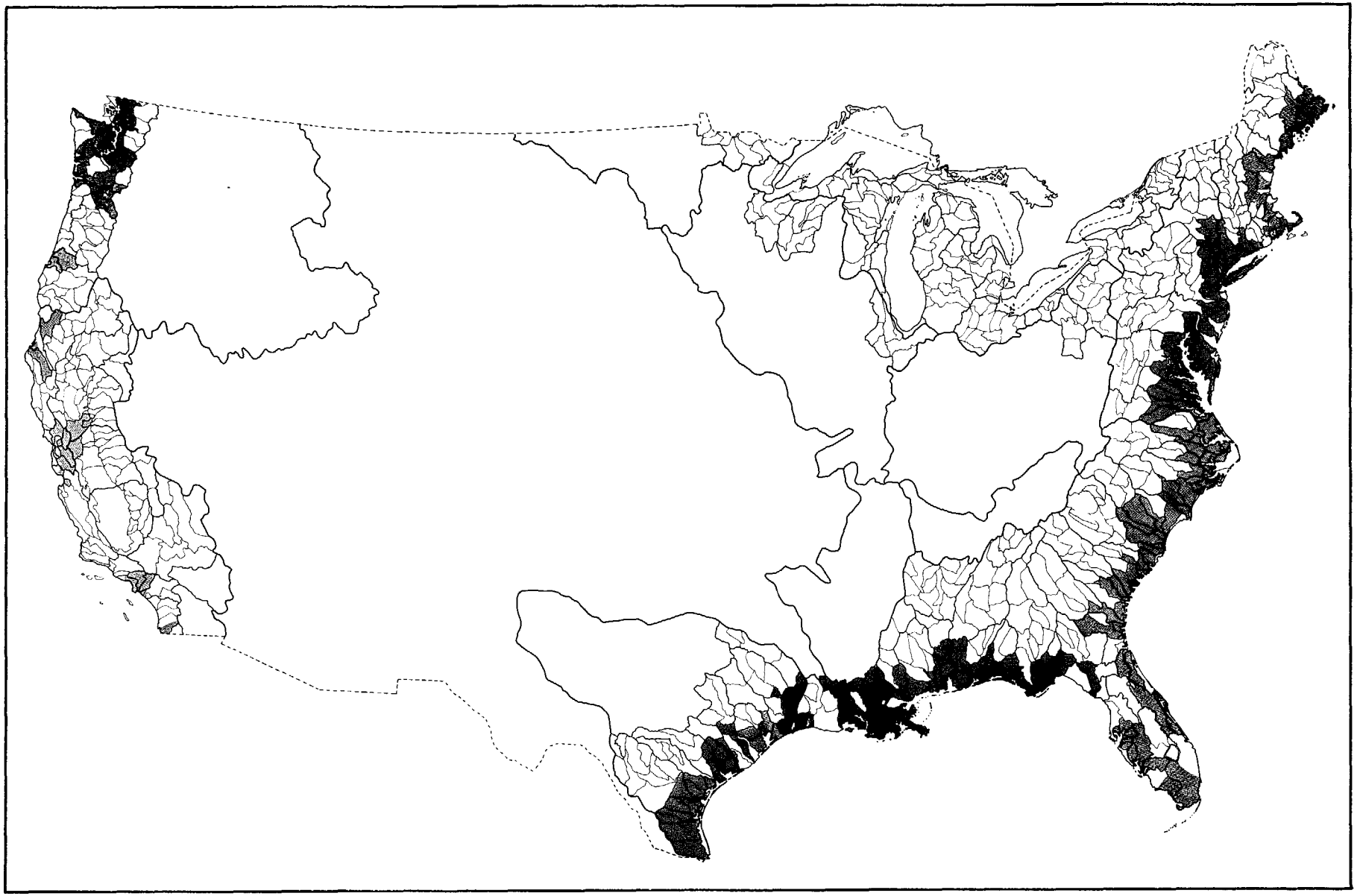


Figure 4. Estuarine Drainage Areas of the National Estuarine Inventory

The maps in the data atlas depict the boundaries of the estuarine portions of drainage basins, the approximate boundaries of the tidal-fresh, mixing-zone, and seawater portions, and important physical and hydrologic data for each estuary (Figure 5). Future efforts will focus on the nature and extent of human activities, distributions and abundance of living marine and estuarine resources, and trends in environmental quality. When completed in 1986, the National Estuarine Inventory will allow comparisons, rankings, statistical correlations, and analyses related to resource use, environmental quality, and economic values among estuaries on a nationwide basis.

Since 1966, the status of shellfish-growing waters (as classified by State shellfish sanitation control agencies) has been inventoried periodically in a National Shellfish Register of Classified Estuarine Waters. The 1985 edition of the Register was developed by a task force with representatives from the U.S. Food and Drug Administration, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and NOAA. Since the last report (1980), the total area approved for shellfish harvesting has declined throughout most regions of the country.

The SAB has computerized these classification data for analysis and will examine relationships among classified shellfish waters and various factors such as pollutant loadings, and the physical and hydrologic characteristics that affect the movement and deposition of pollutants in estuaries. The classified shellfish waters are now being aggregated by estuary to facilitate direct comparison with information in the National Estuarine Inventory, and analysis of the possible reasons for changes in the classification of shellfish waters.

In cooperation with the Beaufort Laboratory of NMFS, the SAB is also developing a nationwide data base on coastal wetlands (National Coastal Wetlands Inventory) so that potential impacts on wetlands can be considered adequately in national policy decisions and to provide a comprehensive wetlands baseline for assessment of future changes. This data base is needed because coastal wetlands represent an important and irreplaceable national resource. The thin belt of wetlands around our coastline provides important habitat for numerous fish, shellfish, and wildlife. These wetlands also buffer coastal areas against storm and wave damage, filter and process agricultural and industrial waste, and often generate large amounts of recreational fishing and hunting revenues. In some areas these wetlands are rapidly disappearing. Urbanization, agriculture, hydrocarbon exploration, and other human activities have contributed to the loss of more than 11 million acres of wetlands over the past 25 years. Although most of these losses have occurred in inland areas, coastal wetlands have reportedly been depleted at a rate of 20,000 acres (31 sq. mi.) per year during the same time period. The U.S. Census Bureau predicts that by 1990, 75 percent of the USA population will live within 50 miles of the coastline (including the Great Lakes). These trends promise even greater competition among coastal area users for the limited space and resources these areas offer.

Local, State and Federal agencies, and research organizations were consulted by NOAA to compile coastal wetlands acreage estimates for the twenty-two coastal states. Acreage estimates, maps, and descriptive

National Estuarine Atlas

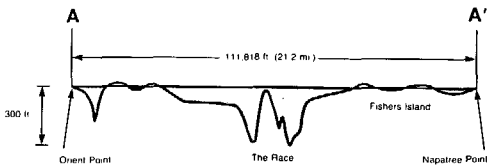
PHYSICAL AND HYDROLOGIC CHARACTERISTICS

PHYSICAL		FRESHWATER INFLOW			TIDAL DATA		
Surface Areas (mi^2)		*Flow Rates (1000 cfs)*			Prevailing Tide: Semidiurnal		
Fluvial Drainage	10,010	Period of Record		1970-1982	Tidal Prism (cf)		1.33×10^{11}
Estuarine Drainage	7,230	Long Term Average Daily		30.0	*Phase Range of Tide (ft.)*		
Estuarine Zones					Map Key	Station	Range
Tidal Fresh	29	Long Term Average Monthly	J 29.9	J 14.4	A	1191	2.4
Mixing Zone	165		F 33.4	A 11.8	B	1375	2.8
Seawater	1087		M 53.0	S 12.2	C	1215	3.3
Total	1281		A 66.4	O 19.1	D	1370	3.0
Dimensions			M 44.5	N 24.0	E	1223	4.2
Length (mi.)	199.0		J 21.7	D 31.2	F	1367	3.7
Width (mi.) Average	12.4	7-Day, 10-Year Low Flow		3.0	G	1239	4.5
Minimum	0.7				H	1249	4.2
Maximum	22.6	50-Year Flood		222.9	I	1339	3.9
Average Depth (ft.)	63.8	100-Year Flood		234.1	J	1257	4.1
Average Depth to Width Ratio	9.7×10^{-4}	*Flow Ratios*			K	1261	2.6
Stratification Classification		Average Annual		0.010	L	1267	2.0
3-Month High Flow	VH	High Flow Period		0.018			
3-Month Low Flow	VH	Low Flow Period		0.004			

Abbreviations: Vertically Homogeneous, VH; Moderately Stratified, MS; Highly Stratified, HS

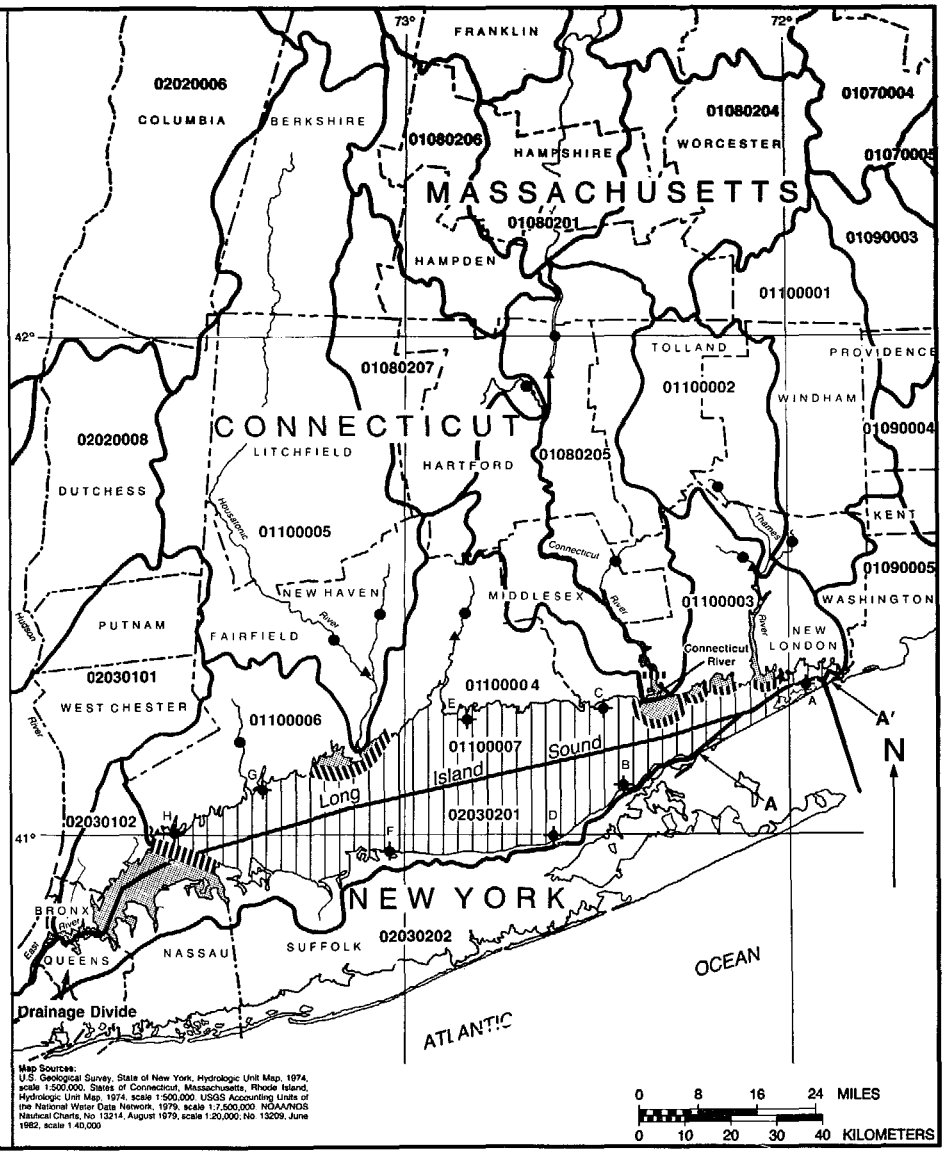
Cross Section
(at mean high water)

53 : 1 Scale Ratio



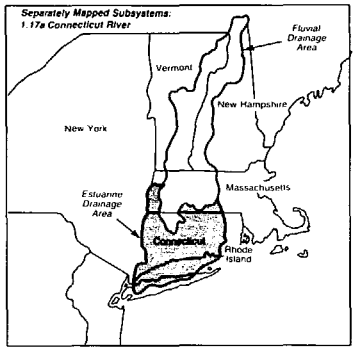
Notes:
One hundred percent of Estuarine Drainage Area is shown on map. Drainage Divide represents portion of Estuarine Drainage Area boundary not coinciding with U.S. Geological Survey cataloging unit boundary.

References:
Cerivone, et al., 1982. Garvine, 1974. Hill and Sheridan, 1970. Koppelmann, 1972. Spaulding and Beauchamp, 1983. Thomas, et al., 1983. U.S. Department of Commerce, 1983a.



Map Sources:
U.S. Geological Survey, State of New York, Hydrologic Unit Map, 1974, scale 1:500,000, States of Connecticut, Massachusetts, Rhode Island, Hydrologic Unit Map, 1974, scale 1:500,000. USGS Accounting Units of the National Water Data Network, 1979, scale 1:7,500,000. NOAA/NOS Nautical Charts, No. 13214, August 1979, scale 1:20,000; No. 13209, June 1982, scale 1:40,000

Long Island Sound
NY, CT, MA



- Tide Gage
- Flow Gage
- Head of Tide
- Estuarine Drainage Area (EDA)
- Tidal Fresh Zone
- Mixing Zone
- Seawater Zone
- Hydrologic Cataloging Unit Boundary
- County Boundary
- Salinity Zone Boundary - Low Variability
- Salinity Zone Boundary - Moderate Variability
- Salinity Zone Boundary - High Variability

Strategic Assessment Branch
Ocean Assessments Division
Office of Oceanography and Marine Assessment
National Ocean Service/NOAA

1.17

Figure 5. Long Island Sound Map from the *National Estuarine Inventory Data Atlas*

materials received at SAB and NMFS have been reviewed for appropriate information, and available acreage figures have been consolidated by wetland type and recorded by county for each state. Data were summarized under the general categories of: 1) salt marsh; 2) fresh marsh; 3) tidal flats; and 4) swamp. These categories represent a level of differentiation that is ecologically and managerially significant, while remaining technically feasible for repetitive survey and analysis. Preliminary analysis of the National Coastal Wetlands Inventory database is now underway.

Pollution Sources and Discharges

Environmental quality in coastal and marine areas of the USA is affected by pollutant discharges from land-based sources and from activities onboard ships and other offshore structures. The National Coastal Pollutant Discharge Inventory (NCPDI) is a compilation of carefully structured information on most of the land-based and ocean-based sources of pollutant discharges in coastal areas and EEZ of the USA. The NCPDI approximates pollutant discharge conditions during the period from about 1980-1985. Major categories of pollutants included are: 1) oxygen-demanding materials; 2) particulate matter; 3) nutrients; 4) heavy metals; 5) petroleum hydrocarbons; 6) chlorinated hydrocarbons; 7) pathogens; 8) sludges; and 9) wastewater. Existing information on each source is being compiled, evaluated, and incorporated into a computational framework for estimating pollutant discharges. This framework will enable for the first time nationwide assessments of the effects on pollutant discharges to estuarine, coastal, or oceanic waters under different assumptions about economic conditions, technological options, meteorological and hydrologic conditions, and public policies.

The NCPDI is being developed in phases for three geographic regions: the Gulf of Mexico; East Coast; and West Coast. The Gulf of Mexico and East Coast components of this national data base have been completed, and the West Coast component will be completed during fiscal year 1986. For the East Coast, the NCPDI includes source identification and seasonal discharge estimates for 17 major pollutants in over 4,800 individual point sources, 54 major urban areas and over 300 minor ones, streamflow from 37 rivers, and nonpoint-source runoff from 588 small drainage basins in non-urban areas, based on land-use and agricultural practices.

The NCPDI is designed to be used as a planning tool for assessing the relative contributions of various sources to pollutant discharges throughout the coastal areas and EEZ of the USA, both under existing conditions and for a range of alternative policies that affect the amount and distribution of these discharges. The NCPDI is intended to bridge the gap between the very detailed data available for some areas (typically hard to reduce and compare from area to area) and the very sparse data available for the rest of the Nation's coastal areas. It has been developed to make maximum use of pollutant-related data and information that has been compiled throughout the USA over the last decade. This capability does not exist elsewhere, and the comprehensive inferences that can be drawn from the NCPDI cannot be generated more accurately or in a more timely fashion by other means. In cooperation within the states of New York and Connecticut, the Interstate Sanitation Commission and the

U.S. EPA, the SAB is now refining a portion of the NCPDI for the sources and quantities of pollutant discharges that enter Long Island Sound. This data base, to be completed in fiscal year 1986, will provide one important component required for comprehensive management of environmental resources in the Long Island Sound area.

Economics of Coastal and Oceanic Resources

Development of detailed information on the distribution and characteristics of marine recreational activities is important for identifying and assessing many of the existing and potential resource use conflicts in the Nation's coastal and oceanic areas. Environmental legislation, such as the recent amendments to the Outer Continental Shelf Lands Act, the Clean Water Act, and the Fisheries Conservation and Management Act, stipulate that outdoor recreation is to be considered explicitly in natural resource allocation decisions formulated under these laws. There is no system, however, generally accepted for defining or valuing marine recreational activities. These resources, and the services they provide, remain unpriced and their value unquantified.

To fill partially this important gap in information, SAB has completed two national studies: 1) a compilation of public expenditures on outdoor recreation in coastal areas; and 2) an inventory of outdoor public recreation resources located in coastal areas of the contiguous USA. The principal goal of the program is to estimate the recreational value of coastal and oceanic resources to enhance the capability for including recreational values in the evaluation of policies and management strategies related to these multiple-use resources. The data base on public expenditures is derived from published and unpublished reports of the U.S. Department of Commerce, Bureau of the Census. It covers 1,339 coastal and noncoastal counties and special district cities in twenty-two coastal states and the District of Columbia. Within each county or special district city, the data are organized by level of government: local, state, and Federal for fiscal years 1972, 1977, and 1982. In 1982, for example, public expenditures on outdoor recreation amounted to over $4.5 billion, or about $57 per coastal inhabitant. Local agencies spent about 59% of this total; state and Federal agencies accounted for 25% and 16% respectively. Estimated expenditures include direct annual operating and capital outlays for outdoor recreation made by each level of government. This data base was completed in fiscal year 1985 and preliminary analyses are now underway.

Compilation of the data base on public outdoor recreation facilities was initiated in fiscal year 1985. The goal is to develop a computerized data base on all Federal, state, and locally managed outdoor recreation resources that depend on the marine environment. The inventory will be used to conduct environmental and economic analyses of coastal recreation activities in the USA. A total of over 1,500 local, 75 state, and 10 Federal agencies are being surveyed. The data will be organized by coastal county and will cover the period from 1972 through 1984. The inventory will be completed by June 1987.

The Geography of Marine and Estuarine Resources

The data bases and operational capabilities described in the previous sections are used by NOAA to provide information on estuarine and oceanic resource-use problems to a variety of users, primarily at the Federal level. The Strategic Assessment Program also develops data atlases to communicate large amounts of complex information on oceanic and estuarine areas to an even wider audience. Data atlases of thematic maps have no equal in communicating information on relationships between human activities and the natural environment and can be powerful assessment tools when used properly. The interplay between conventional map-making methods and atlas production and the simultaneous development of operational capabilities for interactively using mapped data and other information in national and large-scale, regional assessments is an innovative feature of this NOAA program.

Data atlases have already been completed for the East Coast (1980) and Gulf of Mexico (1985) coastal regions and adjacent EEZ (see the 1984 Annual Report to Congress). The final edition of the Gulf of Mexico Data Atlas, containing 163 thematic maps, will be published and distributed by the Government Printing Office in 1986. Two additional data atlases for the Bering, Chukchi, and Beaufort seas and the West Coast and Gulf of Alaska will be published in 1987 and 1988 respectively. A preliminary edition of the Bering, Chukchi, and Beaufort Seas Data Atlas, containing 27 sample maps was distributed in 1985 (Figures 6 and 7); the final atlas will contain about 115 maps. Each of these data atlases uses a base map of consistent projection and scale (1:4,000,000). The data atlases portray the best available information for each region, including: 1) physical environments; 2) living environments; 3) species life histories; 4) coastal and oceanic economic activities; 5) marine environmental quality; and 6) jurisdictions.

In addition to the National Estuarine Inventory Data Atlas described previously, the Strategic Assessment Program is producing a National Atlas of the Health of Coastal Waters of the USA. This atlas will be series of an initial 20 folio maps illustrating indicators of the use and health of estuarine and coastal waters, including new information from NOAA's National Status and Trends Program, managed by the Ocean Assessments Division and described in the next section. Map scale of the folio maps will be 1:12,000,000.

Almost 700 thematic maps have been or will be completed through these efforts when they are completed in 1988 (Table 2).

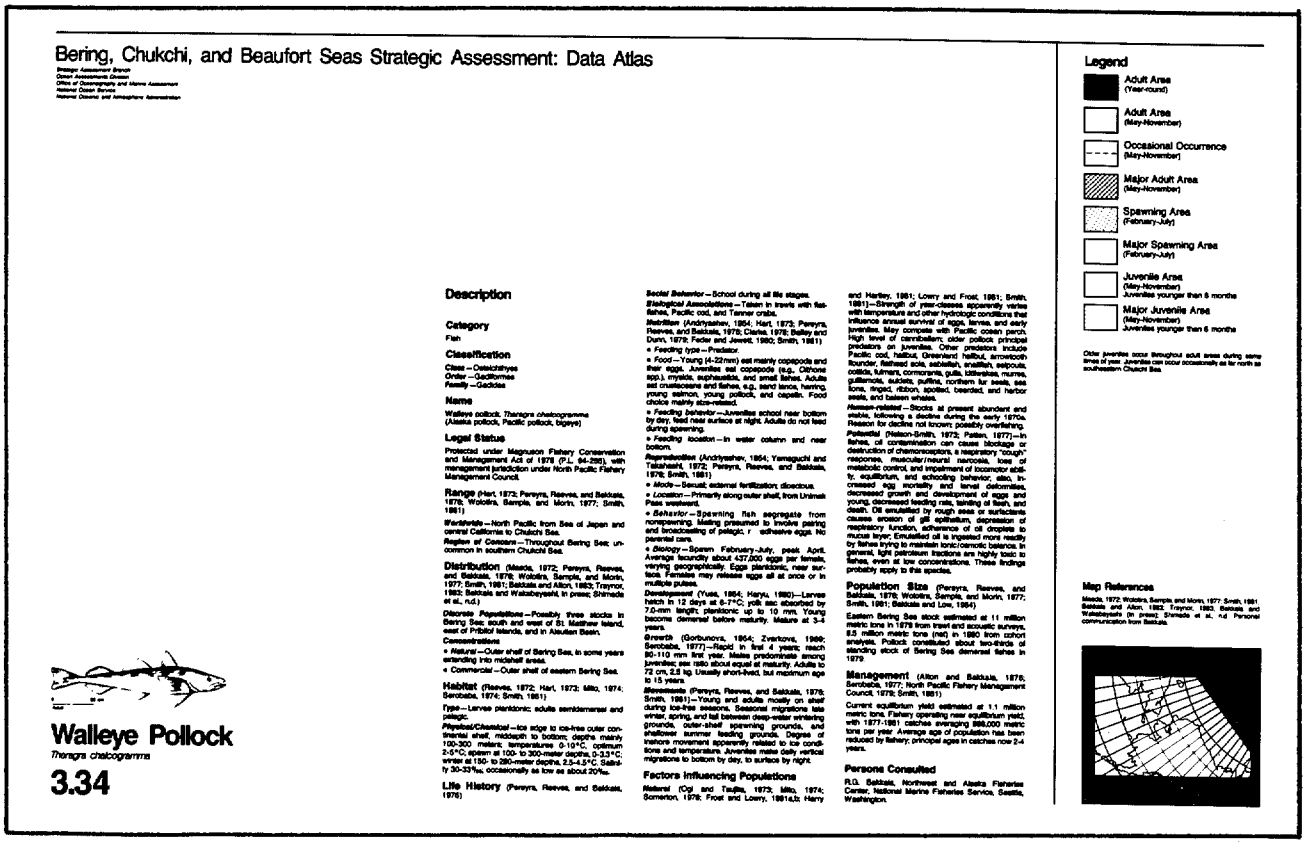


Figure 6. Sample Species Map from the *Bering, Chukchi, and Beaufort Seas Data Atlas*

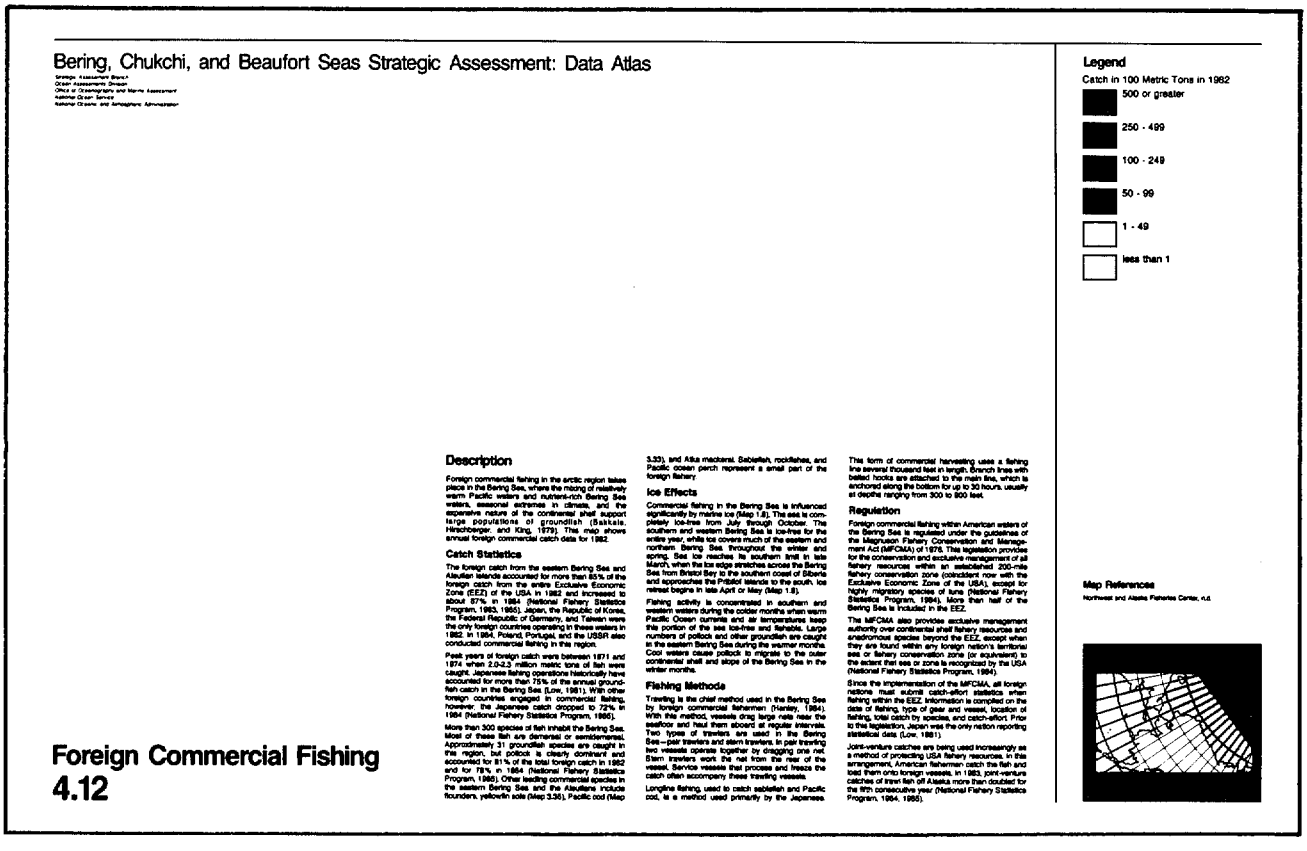
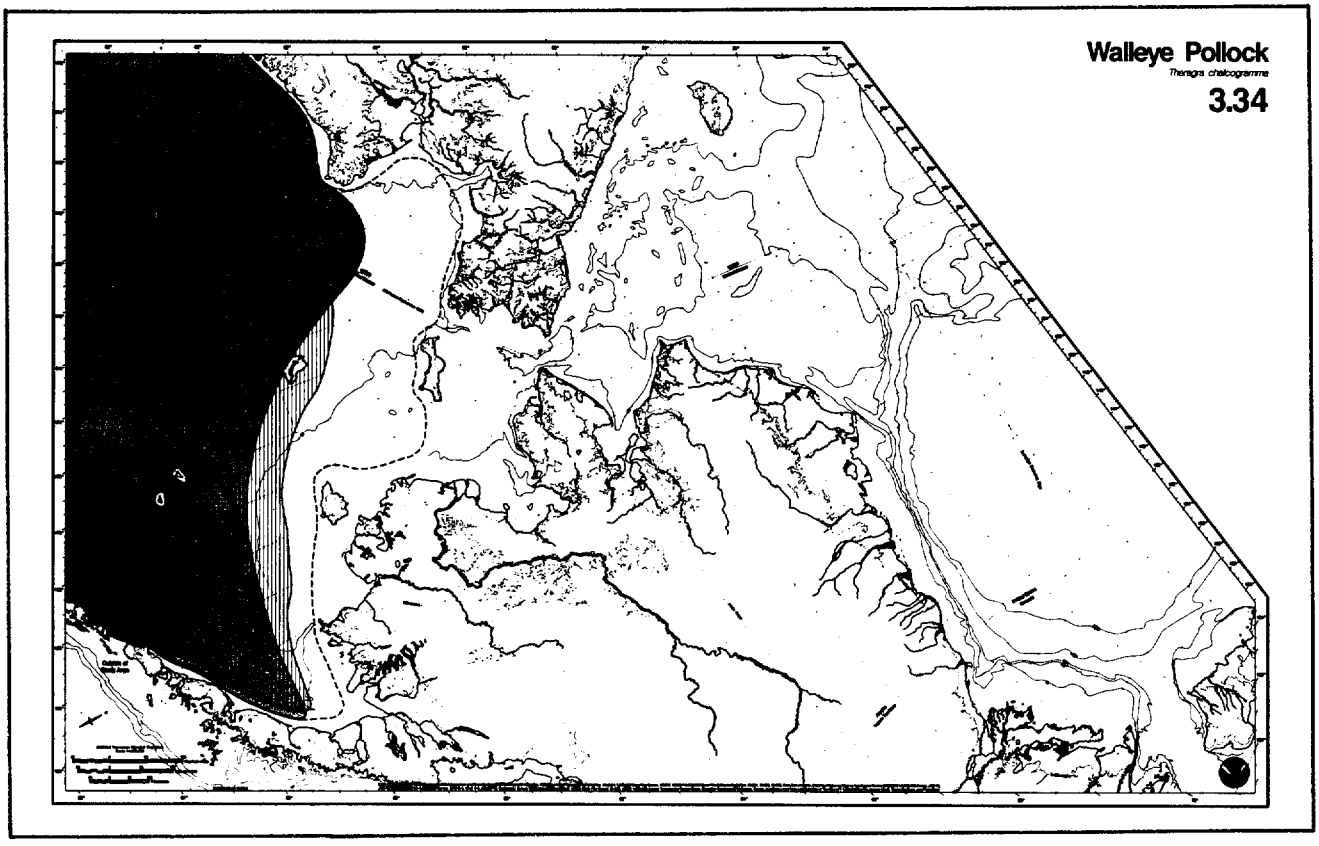


Figure 7. Sample Economic Map from the *Bering, Chukchi, and Beaufort Seas Data Atlas*


Walleye Pollock
Theragra chalcogramma
3.34

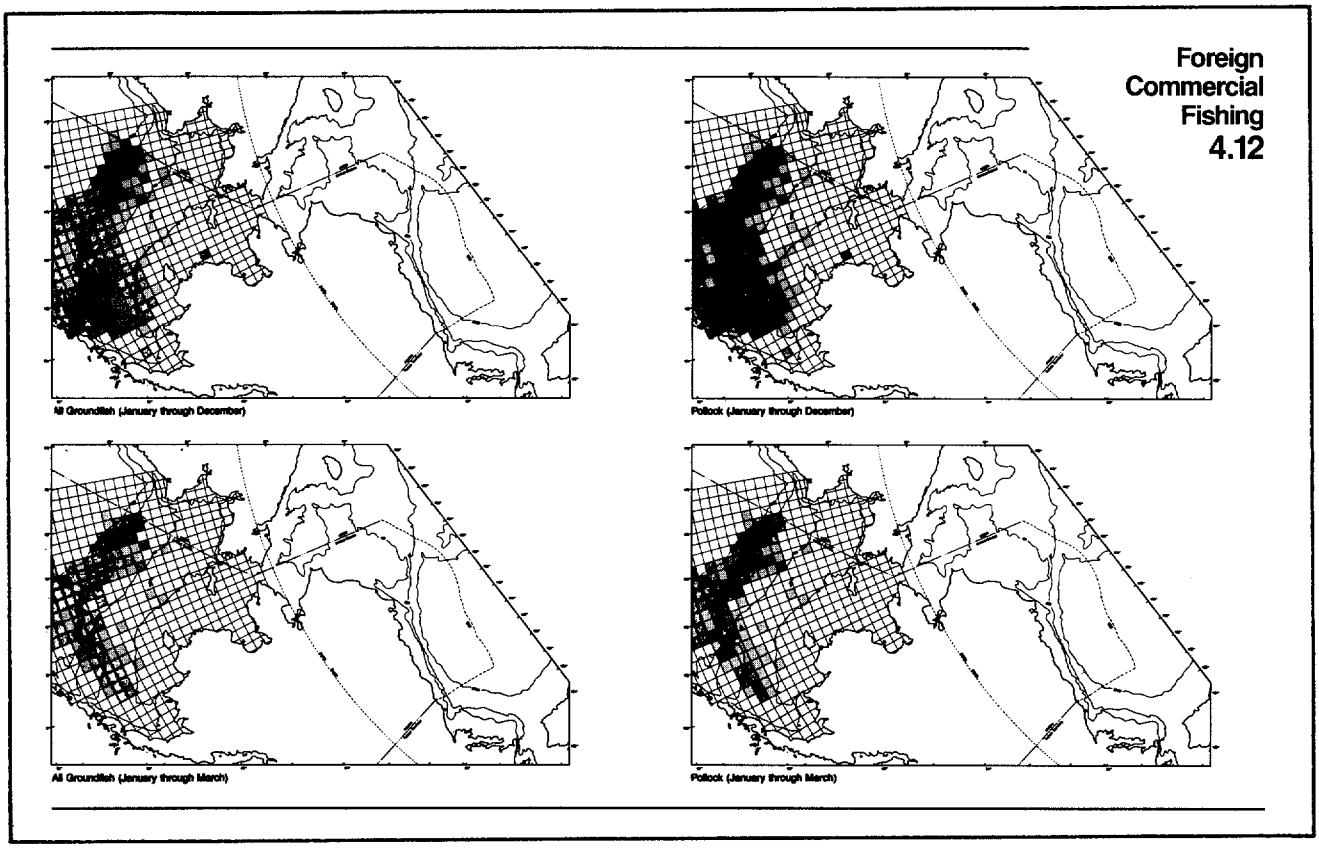

Foreign
Commercial
Fishing
4.12
All Groundfish (January through December)
Pollock (January through December)
All Groundfish (January through March)
Pollock (January through March)

Table 2. Total number of maps in each category of information in the Strategic Assessment Program data atlases.

	East Coast	Gulf of Mexico	Bering, Chukchi, Beaufort Seas	West Coast & Gulf of Alaska	National Atlas	Estuarine Atlas	TOTAL
Study Area/Place Names	2	2	2	2	0	0	8
Physical Environments	13	15	12	15	3	92	150
Biotic Environments	5	5	5	7	0	0	22
Living Marine Resources	68	71	77	79	3	0	298
Economic Activities	17	31	14	20	7	0	89
Marine Environmental Quality	12	32	0	20	6	0	70
Jurisdictions	10	7	3	7	1	0	28
TOTAL	127	163	113	150	20	92	665

Chapter IV

COASTAL AND ESTUARINE ASSESSMENTS

Under Title II of the Marine Protection, Research, and Sanctuaries Act of 1972 and other authorities, NOAA is required to conduct a continuing program of research and monitoring of the effects of human activities in the marine environment. Activities of the Coastal and Estuarine Assessment Branch (CEAB) of the Ocean Assessments Division (OAD) are designed to predict, assess, and measure the consequences to marine environmental quality from human activities in coastal and estuarine areas. The work of the CEAB falls into three programmatic areas corresponding to the following sections of this report: 1) National Status and Trends; 2) Quality Assurance; and 3) Consequences of Contaminants.

NATIONAL STATUS AND TRENDS PROGRAM

Over the past 15 years, billions of public and private dollars have been spent on pollution control and other costs of compliance with environmental regulations in coastal and estuarine areas of the USA. Much of this investment has been made without comprehensive, high quality, and continuing information about the status and trends of environmental quality in these areas. Are general conditions getting better or worse? How do existing conditions among different estuaries and coastal areas compare? Are these conditions approaching or exceeding levels that are known to be harmful to living resources?

Since 1984 NOAA has conducted a national program that will answer these questions. The National Status and Trends (NS&T) Program was initiated to establish and maintain the information base required to quantify the current status and long-term, temporal and spatial trends of key contaminant concentrations and biological indicators of effects on living resources in the Nation's coastal and estuarine environments. A nationally uniform set of measurement techniques is being employed to determine environmental quality parameters. In conducting the program, NOAA is cooperating with and acquiring data from other existing monitoring programs to enhance its assessment capabilities.

The NS&T Program has three major components: 1) "Benthic Surveillance"; 2) "Mussel Watch"; and 3) historical data analysis. The data from these efforts will be stored in a National Status and Trends data base, one of the primary products of the NS&T Program. A series of summary and interpretive reports will be derived from this data base.

The NS&T Program is managed by the Ocean Assessments Division of NOAA's National Ocean Service. Scientific work is conducted by a variety of organizations. Sampling and analysis of bottom-feeding fishes and associated sediments are conducted through the Benthic Surveillance project by NOAA's National Marine Fisheries Service laboratories in Gloucester, MA, Sandy Hook, NJ, Oxford, MD, Beaufort, NC, Charleston, SC, and Seattle, WA. The field work is conducted from NOAA oceanographic vessels, primarily the ships FERREL (east coast and Gulf of Mexico) and McARTHUR (west coast), operated by NOAA's National Ocean Service. Through

the Mussel Watch project bivalve molluscs and sediments are being collected along the east and west coasts and analyzed under contract by a consortium of Battelle New England Marine Research Laboratory, Battelle Sequim Marine Laboratory, and Science Applications International Corporation. The Texas A&M Research Foundation has been contracted to collect and analyze bivalves and sediments from the Gulf of Mexico coast. Historical data are being collected and analyzed by OAD scientists, who also maintain the NS&T data base and are responsible for evaluating the data and producing national assessment reports.

Selecting Contaminants and Sites for Monitoring

The set of contaminants being measured includes toxic trace elements, polynuclear aromatic hydrocarbons (PAHs), and synthetic chlorinated organic chemicals. The list of specific elements and organic chemicals was developed at a NOAA workshop held in October 1983. It was then reviewed by research laboratories of NOAA's National Marine Fisheries Service, the U.S. Environmental Protection Agency, the Food and Drug Administration, the National Institute of Environmental Health Sciences, and selected state and academic experts with a request for suggested additions or deletions. Geochemical and biological parameters that can help explain observed variations in the data (e.g., iron and aluminum in sediments, and age and fat content in fish) and the naturally-occurring sterol, coprostanol, a potential tracer of domestic sewage, are also measured and analyzed.

These elements, chemicals, and normalizing parameters are analyzed in surface sediment, soft tissue of bivalve molluscs, and in the liver and stomach contents of bottom-feeding fish. The elements and chemicals of concern have a high affinity for particles, especially very small ones. Therefore, the place to analyze these materials is on the particles themselves, once they settle to the bottom, or in the tissues of organisms that ingest particles, such as the filter-feeding bivalves. Bottom-feeding fish also ingest particles either deliberately or accidentally, along with their preferred prey, many of which feed on detritus and other particles on the bottom.

Samples are being collected at carefully selected sites throughout the USA (Figures 8-11). All sites are located in coastal or estuarine areas that range from pristine to heavily populated and/or industrialized. Sites were chosen that integrate contaminants from a broad area. About one-third of the one hundred original EPA mussel watch sites that were sampled between 1976-1978 were included. Some of the new sites are located in NOAA national estuarine sanctuaries. Since the measurement of contaminants from specific sources is not an objective of NOAA's national program, sites dominated by single sources of contaminants were avoided.

Collecting and Analyzing Samples

Bivalve molluscs, especially the common blue mussel, have been widely used over the past decade as "sentinel" organisms for pollution monitoring. Among the advantages of using these species are their wide distribution, their ability to concentrate contaminants within their bodies, and their

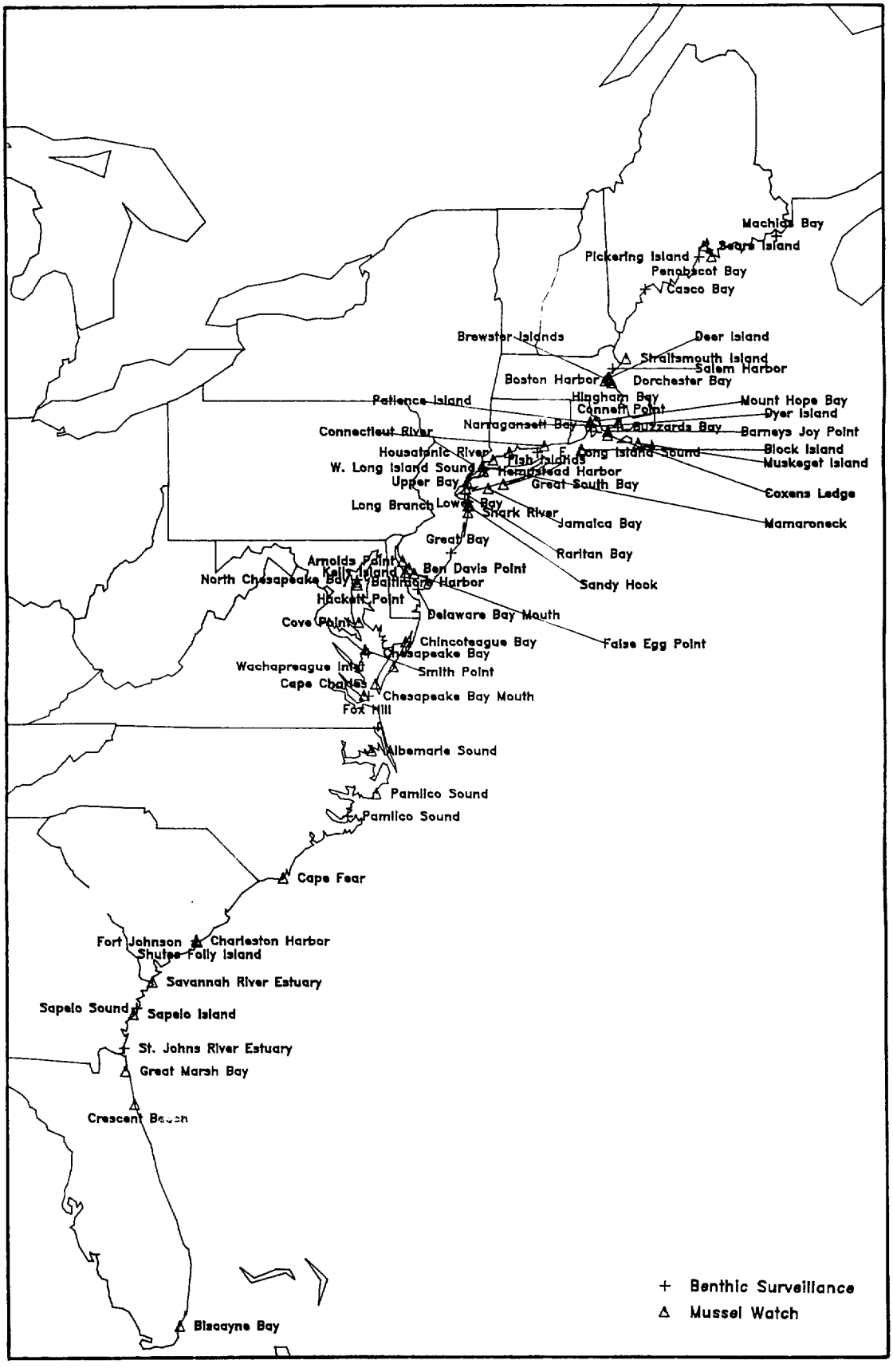


Figure 8. National Status & Trends Sampling Sites on the East Coast

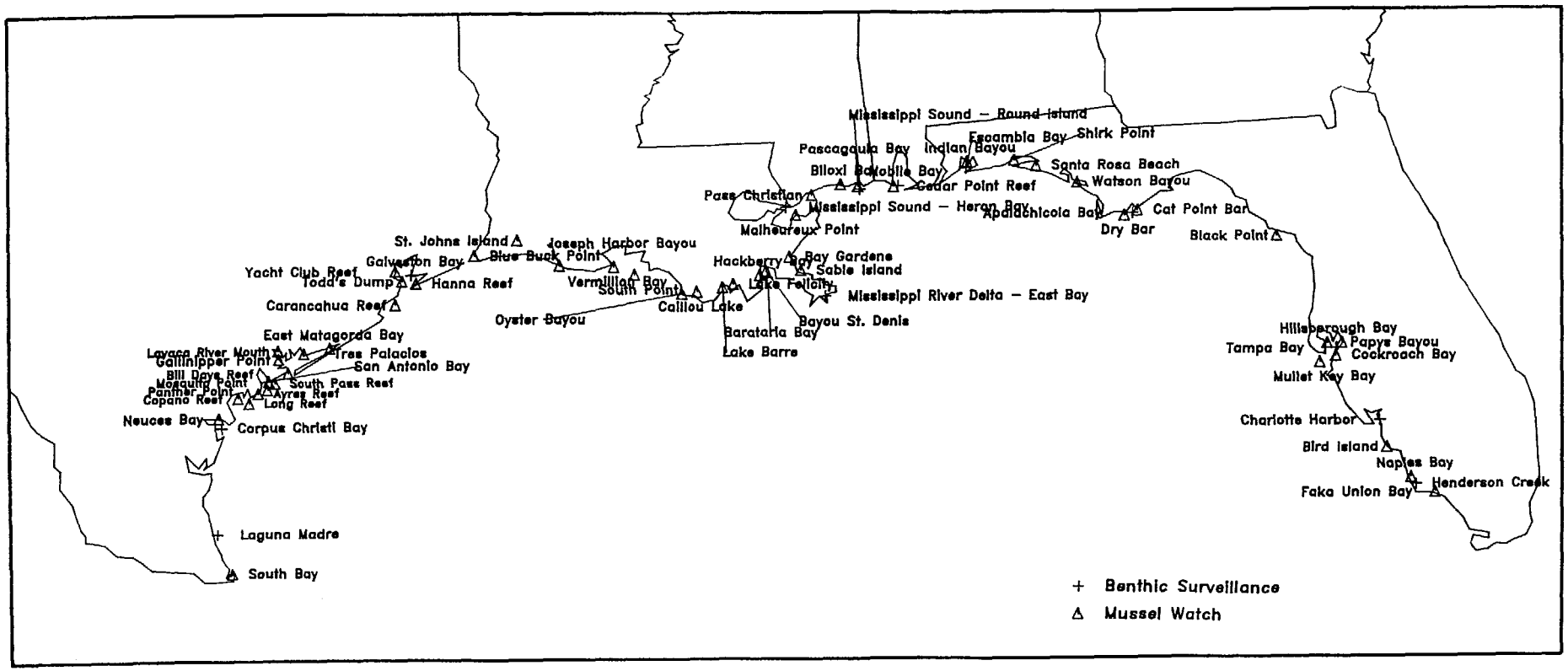


Figure 9. National Status & Trends Sampling Sites on the Gulf of Mexico Coast

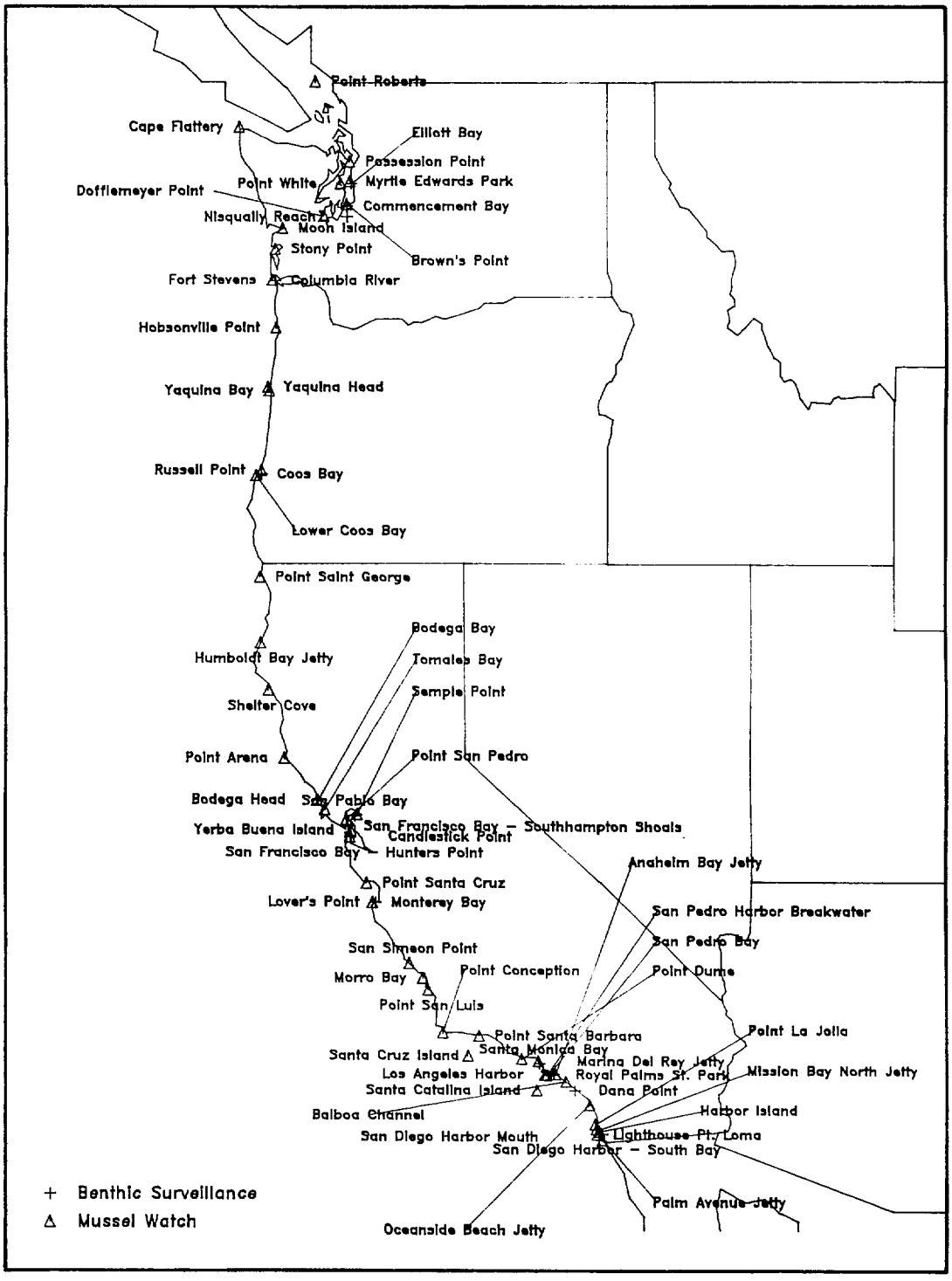


Figure 10. National Status & Trends Sampling Sites on the West Coast

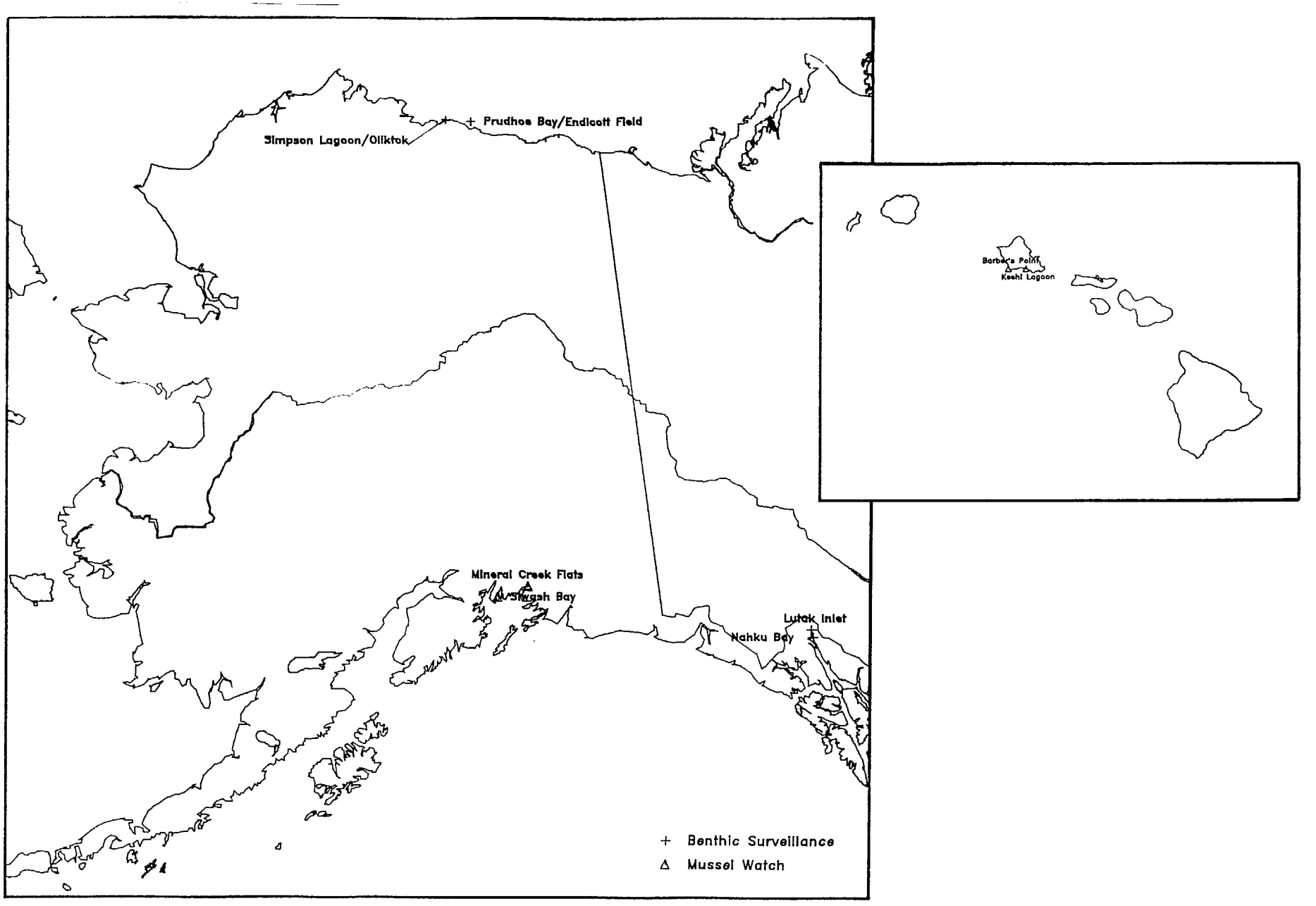


Figure 11. National Status & Trends Sampling Sites on the Alaskan and Hawaiian Coasts

high tolerance to contaminants. In January 1986, the National Status and Trends Program began to collect bivalve molluscs (primarily mussels or oysters) and surface sediments at 150 coastal and estuarine sites throughout the USA--about 50 sites on each major coast. These samples are analyzed for trace toxic organic chemicals and for trace elements.

At 50 of the National Status and Trends Program sites, Benthic Surveillance field work was begun in 1984 by the National Marine Fisheries Service. A statistically significant number of fish (about 10 individuals) and a composite sediment sample are collected from each of three stations within the site for analysis of contaminants. The fish are examined for presence or absence of external lesions, and tissue samples are examined microscopically for a variety of histological lesions indicative of damaged or diseased tissue (Figure 12).

Fiscal year 1985 represented the second year of the Benthic Surveillance project. Samples were collected at nearly all collection sites, and analyses are currently underway. In addition to the routine sample analysis, the investigators are conducting methods verification tests, analyses of reference materials, and interlaboratory comparisons.

Historical Data Analysis

Many organizations, such as local governments, municipal waste management agencies, state and Federal agencies, industrial dischargers, and some local and academic institutions are engaged in long-term, continuing programs of monitoring pollution-related changes in the estuarine and coastal marine environment. While most of these programs are local in scope, collectively they obtain a large amount of data relevant to a national assessment of the status and trends of coastal and estuarine areas of the USA. The acquisition of some of these data will supplement the interpretation of NS&T data by increasing areal coverage of the parameters measured by the NS&T Program or adding new parameters to the data base.

In order to identify extramural monitoring data useful for assessment of the status and trends of coastal and estuarine environments, OAD has developed a computerized inventory of monitoring programs conducted since 1970 that contain systematic time-series observations of at least two years' duration in coastal and estuarine areas. Of more than 350 programs identified, approximately 30 have data holdings that appear useful for NOAA's NS&T Program. Selection of these 30 programs was based on program scope, measurement parameters, data quality assurance, and overall comprehensiveness of the data base.

During fiscal year 1985 a pilot study was conducted by OAD to evaluate the nature and utility of selected historical data bases. Figure 13 presents a composite of available trend data from numerous sources on DDT in marine organisms along the West Coast. Most of these historical data sets are of short duration and several different marine species are involved. Nonetheless, taken as a whole, the data show the clear trend toward buildups of DDT in the marine environment until about 1967-1970 when it began to decline. Comparison of data for different

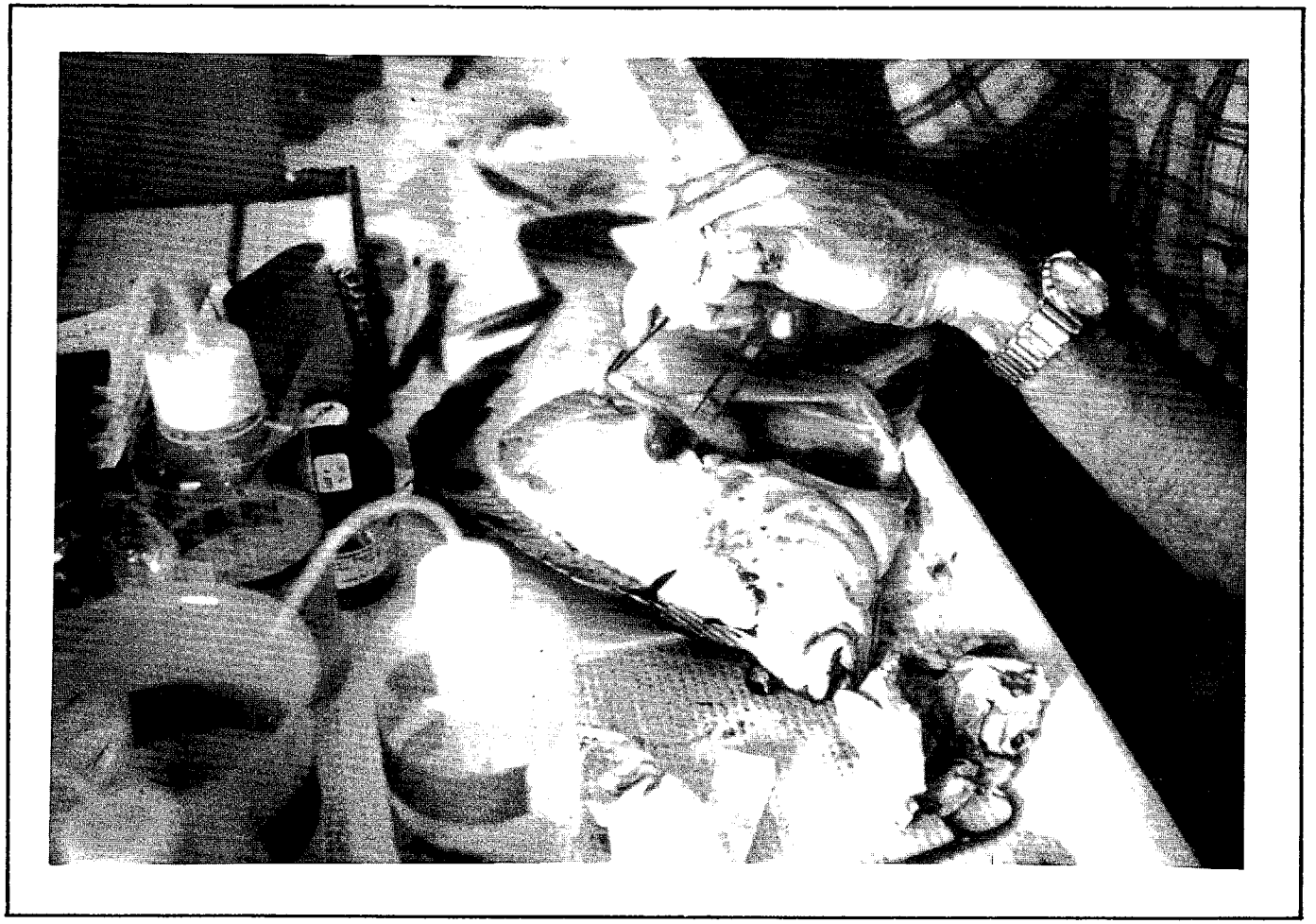


Figure 12. Dissection of Benthic Surveillance Specimen aboard the NOAA ship McARTHUR

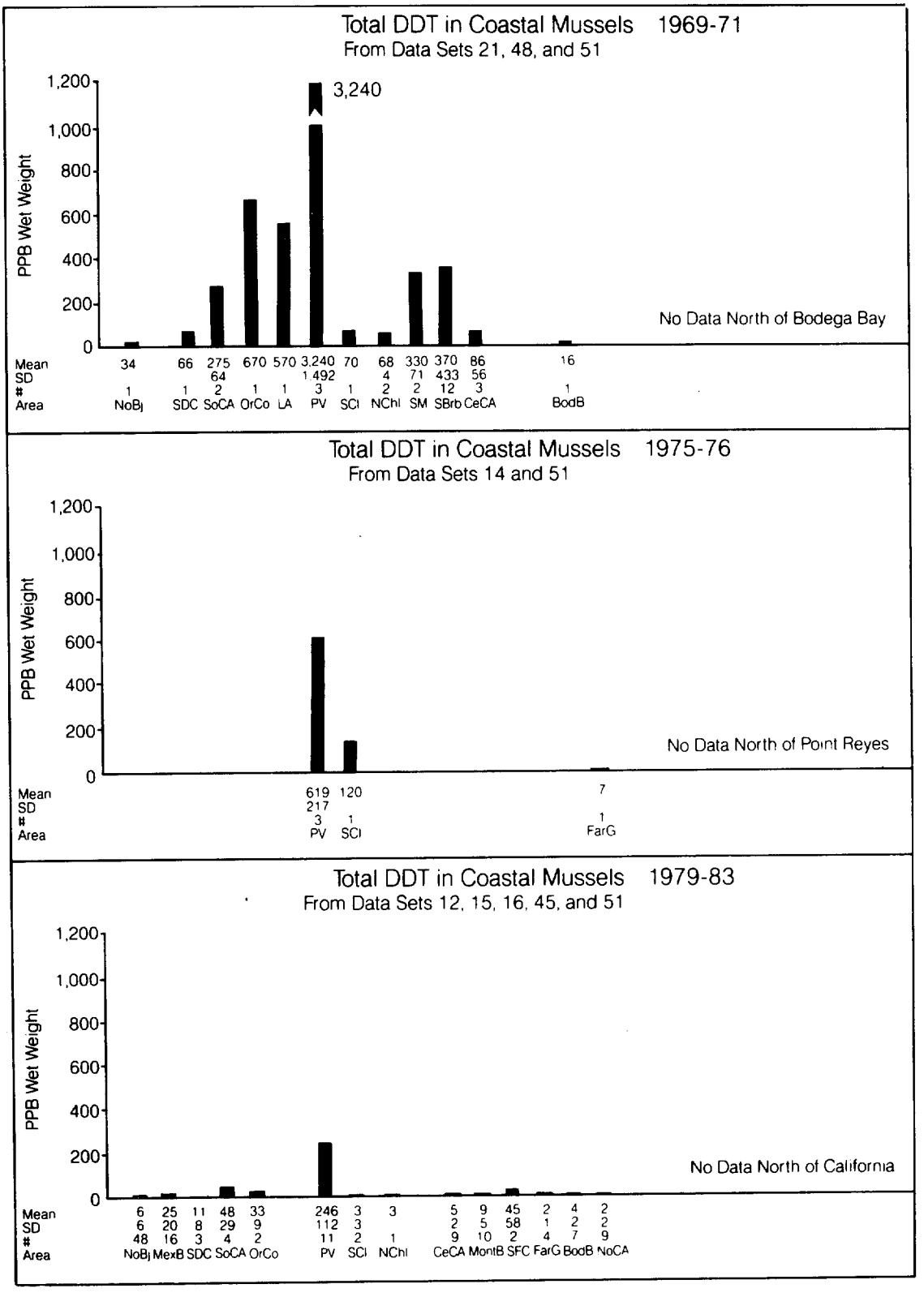


Figure 13. Total DDT in Coastal Mussels, 1969-71, 1975-76, and 1979-83

periods between 1969-1983 for DDT concentrations in tissue of mussels from various locations along the California coast clearly shows the decline of DDT since 1970. Mussels from the Palos Verdes section of the coast continue to exhibit the highest concentrations among the areas sampled. Analysis of these historical data sets emphasizes the importance of continuous, quality-controlled analysis of marine environmental samples, as a basis for detection of long-term trends and significant geographical differences.

Water Quality Monitoring

The Ocean Assessments Division also conducts a limited program of water quality monitoring in the Middle Atlantic Bight and Gulf of Mexico. Its primary objectives in the Middle Atlantic Bight are to monitor the annual cycle of pycnocline development and associated reductions of dissolved oxygen levels in bottom waters of the New York Bight/New Jersey shelf and to take ancillary physical, chemical, and biological data to aid in understanding the processes that may contribute to coastal eutrophication and hypoxia. Three water quality cruises took place in 1985. Water quality stations were also occupied in Long Island Sound during the June survey in cooperation with the National Marine Fisheries Service.

Hypoxic conditions developed in bottom waters south of Barnegat Inlet in early June and persisted through September. Lowest oxygen levels were measured during August in the area of Barnegat Inlet. Oxygen concentrations were less than 2 ml/l over an area of approximately 1,000 km^2. The areal extent and persistence of these conditions were the most extensive measured during the past six years of the monitoring program and since the 1976 hypoxia event in this area.

With support from OAD and NOAA's Sea Grant Program, the Louisiana Universities Marine Consortium and Louisiana State University initiated a program during fiscal year 1985 to assess the extent, duration, and intensity of oxygen depletion in the Northern Gulf of Mexico. Of particular interest are the effects of increasing concentrations of inorganic nutrients in the Mississippi and Atchafalaya rivers and channelization of river flow into the Gulf. Sampling began in mid-June and continued through mid-September. Although the lack of comprehensive historical data limits comparisons, it appears that during the summer of 1985 hypoxia began earlier on the Louisiana shelf, extended farther offshore, and was more spatially and temporally continuous than usual. The areal extent was roughly equal to that similarly affected during 1976 in the New York Bight and was approximately four times the area of hypoxic bottom that sometimes develops during the summer in the Chesapeake Bay. It is premature to attribute the hypoxia on the Gulf of Mexico shelf to eutrophication or to other human activities. However, the magnitude and extent of this marine hypoxia suggest potential sensitivity of the area to future eutrophication trends, and emphasize the importance of periodic surveillance.

To facilitate comparison and evaluation of water quality data, an interactive data base was established in fiscal year 1985. Temperature, salinity, and oxygen data taken from 1974 through 1985 from several

sources have been entered in a consistent format within a computerized data management system. All corresponding chemical data are being entered as a next step in unifying the data sets. These data are being used to develop assessment products concerning eutrophication and dissolved oxygen in coastal waters.

QUALITY ASSURANCE PROGRAM

The NOAA Quality Assurance (QA) Program is designed to allow an objective evaluation of the confidence level and reliability associated with marine environmental quality data. The QA Program enhances intercomparability of results from the many research and monitoring activities of NOAA. The program receives guidance from a QA Steering Committee composed of five senior NOAA scientists and coordinated through the Ocean Assessments Division.

NOAA's QA efforts are coordinated and, where appropriate, integrated with those of other Federal agencies and international organizations. Working relationships have been established with the National Bureau of Standards, the National Science Foundation, the Environmental Protection Agency, and the Minerals Management Service regarding joint conduct of QA activities. Internationally, the National Research Council of Canada, the National Swedish Environmental Protection Board, and the appropriate committees or groups within the International Council for the Exploration of the Sea (ICES) and the Intergovernmental Oceanographic Commission (IOC) are now working with NOAA on QA activities.

The NOAA Administrator has directed that marine environmental quality measurements made by all NOAA laboratories, contractors and grantees conform to established quality assurance guidelines. During fiscal year 1985, OAD developed and published this set of QA guidelines. All proposals that include measurements of toxic organic chemicals or chemical elements in sediments, water, or tissues, or measurements of other water quality parameters must contain a QA plan that conforms to these guidelines. The analytical protocols established by the QA program are in current use by all laboratories participating in the NS&T program. The requirements include the execution of a series of interlaboratory comparison exercises using appropriate reference materials and the convening of specialized technical education and training workshops. All the quality assurance/quality control information associated with the NS&T data will be part of the data archives. These practices will help to ensure that sampling and analyses for the NS&T program will be performed with well-understood methods and adherence to statistical requirements so that a known confidence level can be assigned to all data.

Analytical Intercalibration

During fiscal year 1985 the results from two major intercalibration exercises became available. The first was designed to evaluate the variability associated with existing analytical procedures for different isomeric forms of poly-chlorinated biphenyls (PCB). A sample of fish oil was prepared by the Swedish Environmental Protection Board with known quantities of several PCB isomers, and duplicate samples were distributed to several laboratories selected by NOAA. The seven participating laboratories used similar, but not identical, analytical instrumentation

and operating conditions. Their results are what should be expected from any modern well-equipped laboratory. The variability among the laboratories for results on individual PCB isomers was on the order of ±50% of the mean value. This degree of variability represents the current state-of-the-art. If sample collection, extraction, and purification steps were included in the comparison, the interlaboratory variability would be expected to increase above the observed level.

In the second intercalibration exercise, a sediment toxicity bioassay was conducted by five different laboratories to evaluate the variability that may be encountered with this type of procedure. Collection and preparation of sediments and test organisms were done by a non-participating referee, and were therefore not a major source of variability in the test. The five laboratories were able to maintain 90% (or better) survival of control amphipods in the bioassays and there was perfect interlaboratory agreement on toxicity ranking of the cadmium-dosed sediments. However, there was poor agreement among the laboratories on distinguishing "toxic" from "non-toxic" samples, where a "toxic" sample is one that is significantly (p 0.05) different from the appropriate control. Emergence of amphipods from the sediment appeared to be a more sensitive criterion of toxicity than survival. As with the PCB analytical intercalibration, greater interlaboratory variability would have been encountered if the individual laboratories had collected their own test sediments and organisms.

Intercalibration exercises of the type described above are essential for the development of reliable measures of marine environmental quality. These tests will lead to improved analytical and test methodologies for NOAA marine environmental monitoring programs.

Specimen Banking

Another important component of NOAA's NS&T and QA programs is the development of methods for preserving and archiving biological and environmental samples for retrospective analysis. This concept of "specimen banking" for the storage and retrospective analyses of biological samples is gaining wide recognition as an important component of a systematic, national environmental quality monitoring program. During the past decade, several "new" contaminants such as methylmercury, PCBs, dioxins, and kepone have become national concerns. However, few, if any environmental samples from the past have been carefully stored without change or contamination to serve as benchmarks against which contemporary levels of pollutants can be compared.

The National Bureau of Standards (NBS) has been contracted by NOAA to establish and maintain a specimen bank for the National Status and Trends Program. NBS maintains clean laboratories for sample handling and freezers for the long-term storage of biological and environmental samples in a nitrogen vapor at -110°C to -150°C (Figure 14). Sediments, bivalves, and fish livers from about 20% of the sites sampled each year under the NS&T program will be archived in the joint NOAA/NBS specimen bank. Storage techniques for environmental samples will be developed and tested to ensure that samples are available from the NS&T program for analysis by new methods in the future for previously unsuspected hazardous chemicals.

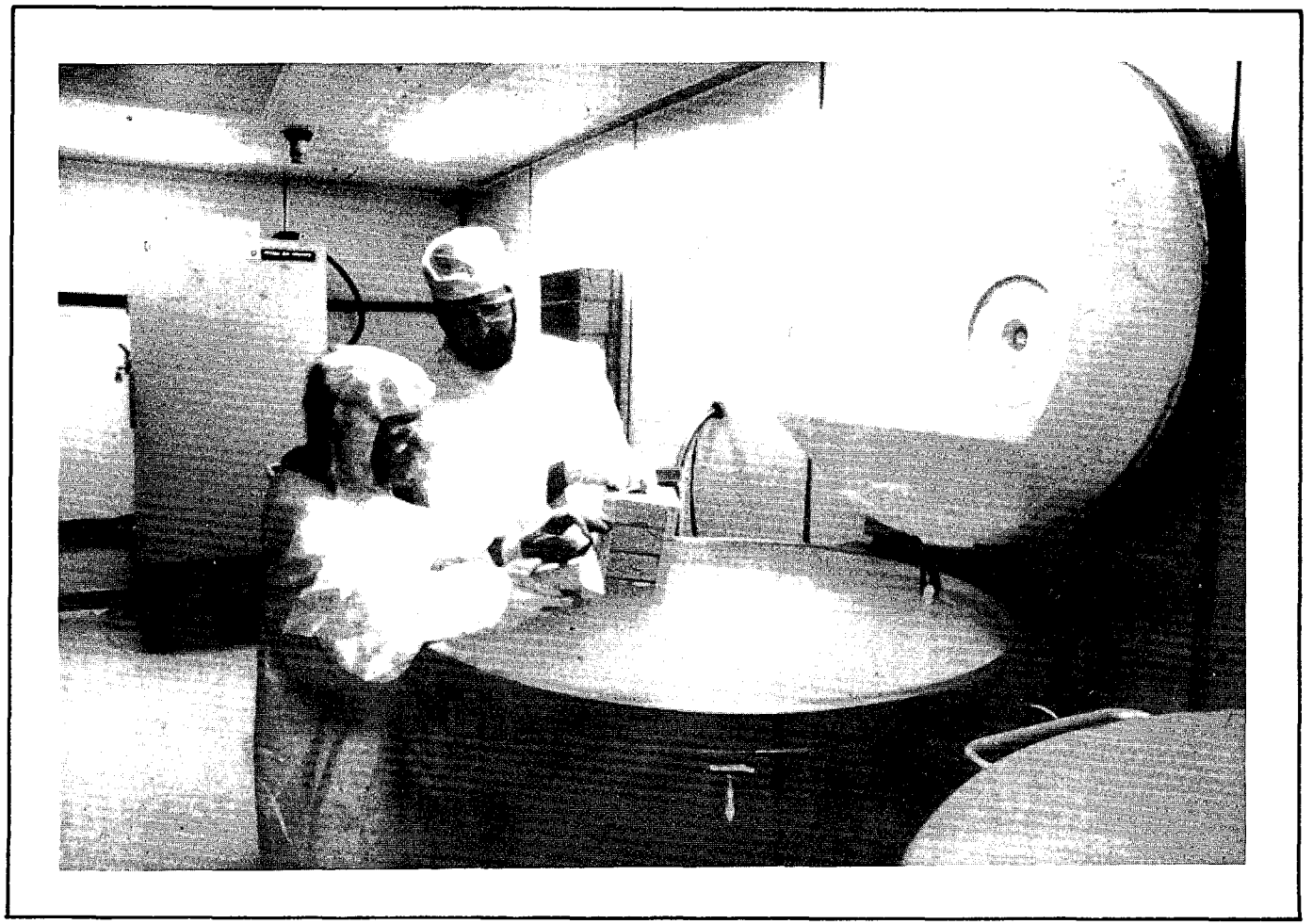


Figure 14. The NOAA NS&T Specimen Bank at the National Bureau of Standards

CONSEQUENCES OF CONTAMINANTS

Hazards to human health and decreases in populations of valued marine species are the principal threats from coastal and estuarine contamination. The major management needs are for information on the degree of contamination at which these threats become significant and for reliable methods by which to monitor the presence and extent of either threat. The Consequences of Contaminants Program emphasis during fiscal year 1985 has been on development of risk indicators for shellfish quality, documentation of chemical contaminant doses to urban subsistence fishermen, and quantification of contaminant effects on fish reproduction.

Indicators of Human Health Risk from Shellfish and Fish Contamination

In a study conducted jointly with the Environmental Protection Agency, OAD is identifying quantifiable relationships between concentrations of potential indicator microbes in shellfishing areas and the actual risks to human consumers. For over half a century, prohibitions on shellfish harvesting have been based on ambient concentrations of coliform bacteria, a measure for which there is no demonstrable relationship to the risk of shellfish-associated illness. Until recently the situation with regard to health risks from swimming in contaminated waters was similarly unquantified. Public health criteria were based on coliform bacteria concentrations with no evidence to relate the extent of the risk with bacterial concentration. After a long-term study at a number of beaches and interviews with thousands of bathers, however, it finally became possible to demonstrate a relationship between the likelihood of illness and the concentration of bacteria. The best indicator organisms were enterococci bacteria instead of coliforms. Criteria now exist with which public health officials can define the risk associated with bacterial contamination of recreational waters. The amount of risk that is deemed acceptable can be defined for a given situation and the corresponding concentration of enterococci bacteria can be used as the key for opening or closing use of recreational areas. The current NOAA/EPA study is designed to identify an analogous relationship for management of shellfishing areas, i.e., to identify those specific microbial indicators that are associated with gastroenteritis from the consumption of microbially-contaminated shellfish.

During fiscal year 1985, methods were refined for quantification of several potential microbial indicators. Selected shellfish harvesting areas will be monitored by these refined bacteriological methods, and the incidence of gastroenteritis will be monitored among volunteer consumers of the harvested shellfish. Methods are also being refined to distinguish gastroenteritis caused by microbially-contaminated shellfish from diarrhetic shellfish poisoning, a malady with similar symptoms caused by toxins from certain zooplankton species.

The presence of organic and inorganic contaminants in fish and shellfish from urban embayments has resulted in growing public concern about consumption of fish from these places. To evaluate the potential magnitude of this problem, OAD contracted with the University of Washington to perform a demographic study on the population of anglers fishing in urbanized parts of Puget Sound and to determine contaminant

levels in the edible portions of the species caught most commonly in that area. The methods used in this study will serve as a guide for public and private agencies with related concerns in other locations.

More than 4,000 anglers were interviewed at four Puget Sound embayments in the Seattle-Tacoma area: Commencement Bay, Elliot Bay, Sinclair Inlet, and Edmonds. The total catch of those anglers who permitted examination of their catch was about 7,900 organisms weighing over 4,000 kilograms. Squid, hake, tomcod, pollock, and Pacific cod were the most commonly taken species. Flatfish constituted 5.8% by numbers and 2.5% by weight of the catch. The species composition of the catch was highly seasonal, and the different species varied in their content of contaminants.

Depending on the species consumed, the daily dose of PCBs from these fish to the consumers (generally the fishermen and their families) was in the range of 0.5-6.0 ug. This dose rate would result from the consumption only of fileted muscle tissue from the subsistence species caught; other exposure pathways (e.g., from other foods) would occur simultaneously. Some subsistence fishermen consume parts of the fish other than muscle, or boil the fish in a broth. Either of these patterns could increase the daily dose of PCBs or other contaminants from the fish. A complete risk assessment for the different categories of subsistence fishermen would need to consider not only the above information, but also the potential contaminant consumption associated with alternative food sources.

Effects of Contaminants on Fish Populations

Another OAD objective is to determine the effects of contamination on the productivity of valued fishery resources in the coastal waters of the USA. Several studies are pursuing this objective in different areas, and with different approaches designed to provide an improved understanding of the problem. The OAD approach includes: 1) retrospective analysis of historical fishery population and catch information relative to human activities; 2) modeling of fishery population dynamics to project potential population effects of contaminant-associated changes in reproductive capacity or mortality; 3) field studies to relate the reproductive physiology of fishery species to contaminant exposure; and 4) laboratory exposures of species to environmental contaminants to determine reproductive and pathological consequences.

Information on fishery landings, fishing effort, hydrographic conditions, and pollution conditions were gathered and analyzed for five major northeastern estuaries: Hudson River/Raritan Bay; Potomac River; Delaware Bay; Connecticut River; and Narragansett Bay. Methods were developed to analyze historical stock-abundance time-series as a function of hydrographic conditions and "macropollution" variables. Relationships between stock abundance and macropollution variables (e.g., dissolved oxygen, biochemical oxygen demand, and dredging activity) were more evident after consideration of the time-series variability caused by time-lagged population effects and climatic conditions. Although a clear link was established between declining stock success of estuarine species and estuarine water quality (as measured by dissolved oxygen), there was

no clear connection with specific causes of the low dissolved oxygen (e.g., municipal and industrial discharges, and increased runoff). Effects of specific contaminants were not discernible in this analysis, as all the estuaries have been subjected to multiple pollutant discharges. The results established defensible associations, however, among stock histories, natural environmental variation, and macropollution trends, and identified the estuarine resident fisheries and shellfisheries most likely to be affected by contaminants.

Preliminary results on the reproductive success of flatfish from contaminated areas were reported in last year's Report to Congress. The success of fertilization of eggs spawned by flounder in San Francisco Bay was inversely related to activity of a liver enzyme system, mixed-function oxidase (MFO), which is directly related to exposure to high-molecular weight organic compounds. Among those eggs that are fertilized successfully, eggs with higher PCB concentrations are less likely to develop into healthy larval fish. Flounder from the central portion of San Francisco Bay are more contaminated than those from the less-developed San Pablo section of the bay. Related studies are now underway in San Francisco Bay, Puget Sound, Southern California, and New Bedford Harbor, Massachusetts, to determine the generality of these observations. OAD's objective is to identify valid correlates of reproductive success that can be applied on a national scale to identify areas where reproduction of resource species may be diminished.

Initial work with English sole in Puget Sound did not identify or correlate any differences in reproductive success with either enzymatic activity, tissue or sediment contamination, or the location in Puget Sound where the fish were captured. Scientists at NOAA's Northwest and Alaska Fisheries Center have injected these fish, however, with extracts of sediments from a contaminated area of Puget Sound and caused increased enzymatic activities and decreased reproductive success. Several hypotheses are being pursued in this continuing project, including the possibilities that flatfish in the more contaminated areas either do not spawn or have an altered spawning cycle and that the prevalence of serious liver lesions may be an indicator of diminished reproductive success.

In related work in Puget Sound, urban embayments were shown to exhibit higher concentrations of both organic and inorganic contaminants in the sea-surface microlayer (upper 50 micrometers) than do rural bay areas. Furthermore, the total numbers of flatfish eggs and other organisms is less in surface microlayers of urban bays than in uncontaminated reference areas. This microlayer is an important habitat for eggs and larvae of flatfish and crabs during the winter-to-spring spawning season. Approximately half of the microlayer samples taken from urban areas were acutely toxic to floating flatfish eggs in laboratory bioassays. Polynuclear aromatic hydrocarbons in the microlayer appear to be the cause of the toxicity. The overall effect of contaminants on reproductive success thus include both adult-related effects on spawning and fertilization and direct toxicity effects on the fertilized eggs and larvae.

The egg production and larval survival of an estuarine copepod were significantly diminished (relative to controls held in water from the Newport River, North Carolina) when the adults and their progeny were

maintained in waters from the Raritan Bay (New Jersey), Elizabeth River (Virginia), Cooper River (South Carolina), St. Johns River and Escambia Bay (Florida). The toxic effect of these waters (except for that of Escambia Bay) was reversed by the addition of metal-chelating agents. These studies, conducted by the NMFS Beaufort Laboratory, indicate that ambient trace metal concentrations may inhibit natural copepod reproduction and survival in some estuaries. Of the potentially toxic metals that would be chelated, copper, zinc, and nickel are present at high concentrations in the water samples causing poor larval survival. Corollary chemical studies suggest that copper and zinc ions most likely account for the observed toxicity.

Similar experiments with early larval stages of estuarine fish demonstrated the variability of trace metal toxicity in estuarine waters. Water collected from the Elizabeth River in May 1985 exhibited no significant effects on larvae of striped anchovy, whereas survival of bay anchovy and hogchoker larvae were both inhibited by Elizabeth River water collected in June, and addition of chelator increased the survival of these species by 55% and 200%, respectively. Concentrations of dissolved copper and zinc were markedly higher in the June sample, reinforcing the conclusions reached earlier with the copepod tests. Work in future years will further develop the relationship between copepod responses and those of resource species, and the copepod assay will be further exploited as a potential monitoring tool to assess the toxicity of estuarine waters over a larger scale.

Chapter V

HAZARDOUS MATERIALS RESPONSE

The transportation of oil and hazardous materials through coastal and estuarine waters poses potential threats to the resources of these important areas. When a major accidental spill of oil or a hazardous material occurs, immediate decisions are necessary about alternative courses of action that should be taken to minimize damage to the marine environment. The most important factors to be evaluated are: 1) the type, quantity, location, and movement of the material; 2) the immediate and long-term bioavailability of the material (or its degradation products) to living resources; 3) the sensitivity of affected habitats; and 4) the feasibility and cost of containment and cleanup of the material.

The Hazardous Materials Response Branch (HAZMAT) of the Ocean Assessments Division, located in Seattle, Washington, maintains a highly trained team of regional Scientific Support Coordinators (SSCs) that can be mobilized quickly to the scene of an accidental spill. The SSCs are supported by an interdisciplinary group of chemists, ecologists, and oceanographers, a carefully structured information system, and a nationwide communications network, that collectively enable each SSC to provide timely expert advice regarding the Federal response to the spill.

The legislative authorities for Federal responses to discharges of oil and releases of hazardous substances are the Clean Water Act (CWA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA--also known as the Superfund Act), both of which are implemented through the National Oil and Hazardous Substances Contingency Plan (NCP). Last year's Report to Congress described the NOAA scientific support coordination and the assessment capabilities that can be activated in the event of a spill.

SCIENTIFIC SUPPORT COORDINATION AND TRAINING

The SSCs are regionally located in nine Coast Guard Districts to facilitate their accessibility to the Federal On-Scene Coordinators. Under the NCP, the SSCs are responsible for coordinating all scientific advice on response operations in coastal and marine areas. The On-Scene Coordinator can obtain SSC assistance by contacting the regional SSCs directly or through HAZMAT's 24-hour paging system. Each regional SSC has the authority to respond immediately to pollution incidents and to commit additional HAZMAT technical resources when necessary for the response. Headquarters in Seattle provides support through centralized computer information systems and by telephone to the On-Scene Coordinator while the regional SSC is en route to a release or otherwise not available.

Spill Planning and Training

During non-response periods, the SSCs assist the OSCs and Regional Response Teams (RRTs) by obtaining scientific data to improve regional and local contingency planning. These data include: 1) forecasting pollutant trajectories with respect to specific areas or biologically important

environments; 2) identifying environmentally sensitive areas; 3) obtaining background data on the behavior of various pollutants under a range of environmental conditions; and 4) predicting the environmental effects of alternative cleanup strategies. The ability to implement an effective system of countermeasures for a given oil or hazardous substances spill depends on the facility with which the response team is able to gather and analyze data about the incident. For a variety of hypothetical incidents, HAZMAT evaluates local factors related to environmental sensitivity, climatology, and port traffic patterns. This analysis leads to development of specific response plans for likely combinations of accident sources, chemical constituents, and affected environments. During fiscal year 1985 HAZMAT published studies of oil and hazardous substances planning and response considerations for the ports of Portland, ME, Boston, MA, Jacksonville, FL, Philadelphia, PA, and Los Angeles, CA. It completed drafts for Baltimore, MD, and the upper Chesapeake Bay.

During fiscal year 1985, HAZMAT responded to 105 spills of oil and fuel products, and an additional 95 incidents involving other chemical releases throughout the USA. This represented a substantial increase from the 128 responses during the previous fiscal year. The HAZMAT response to a major incident is briefly described below to illustrate the scope of NOAA activities. Information on other responses is available through the Ocean Assessments Division.

T/V Puerto Rican Spill

At 3:35 a.m. on October 31, 1984, the 700-foot general tanker vessel Puerto Rican, carrying 101,790 barrels of lubricating oil plus additives and 8,500 barrels of Bunker C fuel oil, exploded two miles outside the pilot station, approximately 8.7 miles from the Golden Gate Bridge. The vessel, enroute from the Chevron fuel pier in Richmond, CA, to New Orleans, LA, was quickly engulfed in flames as a result of the explosion. Thirty crewmembers were evacuated either from the vessel or from the sea by the U.S. Coast Guard Captain of the Port of San Francisco, and various rescue boats and helicopters. All of the personnel aboard sustained some injury, with one fatality (Figure 15).

HAZMAT was notified of the incident at 4:30 a.m. on October 31 by the U.S. Coast Guard Captain of the Port of San Francisco, who requested that NOAA provide trajectories for the lubricating oil and additives, and evaluate the natural resources at risk. HAZMAT began coordination and notification of local scientists, and on November 1, a team from the Seattle office arrived on-scene.

The vessel continued to burn for 36 hours, fueled to some degree by the considerable quantities of lubricating oil and additives in the cargo tanks. Fire suppression measures consumed 200,000 gallons of foam before the fire was finally extinguished.

On November 3, while being towed out to sea, the stern section of the Puerto Rican parted from the bow section and sank 30 minutes later in approximately 2,400 feet of water. An estimated 27,000 to 35,000 barrels of various products were spilled. The NOAA National Weather Service, Redwood City, immediately began to provide special marine forecasts for

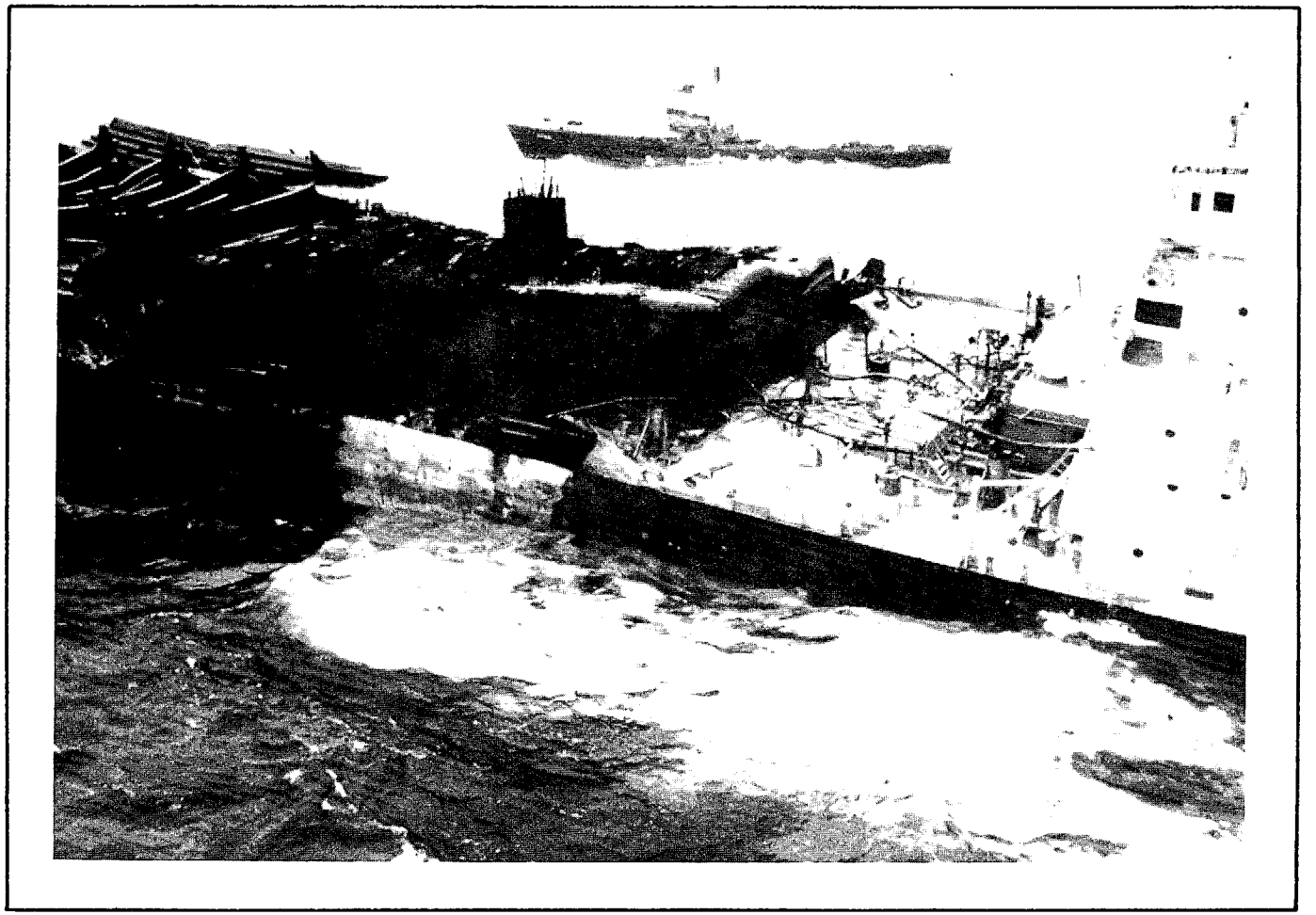


Figure 15. The *T/V Puerto Rican* Oil Spill

the general area south of the Farallon Islands. These weather forecasts were provided to HAZMAT and U.S. Coast Guard several times daily, depending on conditions.

Initial trajectory forecasts showed the lubricating oil moving in a southerly direction with no anticipated landfall. These forecasts were confirmed by regular U.S. Coast Guard overflights of the area. Overflights further indicated that a sheen extended as far as 30 to 40 miles south of the major portions of the spill. About 6 days into the spill, however, the winds shifted abruptly from northerly to strong southerly, which reversed the direction of the oil trajectory. The surge associated with this wind shift generated an unexpected narrow "jet stream" which transported the oil northward along the continental shelf break much faster than predicted, threatening the Farallon Island National Marine Sanctuary and coastal areas north of San Francisco Bay.

Major considerations with regard to protection strategies were the presence of the endangered brown pelican, migratory waterfowl, anadromous fish, and the possible early migration of gray whales in the area of the spill. The impending herring season was also a concern. Cleanup strategies and recommendations focused on protection of the Point Reyes-Farallon Islands National Marine Sanctuary, Point Reyes National Seashore, Bodega and Tomales bays, the Esteros, and northward along the Sonoma coast. The recommendations emphasized booming, skimming, collection, deflection, containment, entrainment, and absorption strategies in an effort to minimize the effects of shoreline contamination. Extensive booming and skimming operations took place during the response to the spill.

Additional trajectory and chemical analyses were provided when the use of dispersants was being considered to ameliorate the spill. Eventually, 2,000 gallons of Corexit 9527 was sprayed at a rate of five gallons an acre to mitigate the effects of the spill.

The sinking of the stern portion on November 3 resulted in an oil sheen within a few kilometers from the vessel's resting place. On November 14 the forward section of the Puerto Rican was towed into San Francisco Bay, placed in dry dock, and over 60,000 barrels of oil were offloaded.

The stern section was located on April 3, 1985, by the U.S. Coast Guard using side-scan sonar detection instrumentation. It was resting on its keel at a 30° list in about 1800 feet of water. The NOAA National Marine Sanctuary Program is preparing a damage assessment to determine the best course of action in ameliorating the effects of the spill.

ENVIRONMENTAL CHARACTERIZATION AND ASSESSMENT

Environmental Sensitivity Index (ESI) maps are a primary resource used by the SSC and Federal On-Scene Coordinator at a spill site. These documents, prepared by a contractor under HAZMAT guidance, depict the distribution of valuable coastal habitat and resources, and characterize the coast according to vulnerability from potential spills. Potential locations are also identified where booms or other mitigation actions might be deployed for the most effective protection of the coast in the event of a spill.

Environmental Sensitivity Index maps have now been prepared for approximately 80% of the shoreline of the USA. State and local agencies are intimately involved in the data compilation and review processes. These maps have been used extensively by Federal, state and local response groups for contingency planning purposes and for rapid assessment of resources at risk during spill incidents. Most of the remaining areas in the USA, including the Pacific Northwest, Great Lakes, Hawaii, and Southeast Alaska, will be mapped by the end of fiscal year 1986.

In addition to the environmental characterizations in the ESI maps, a considerable body of knowledge exists about the environmental effects of oil and hazardous chemical spills, and the measures available to minimize such effects. NOAA routinely provides, on a 24-hour basis, telephone and written consultation during such incidents to assist Federal On-Scene Coordinators and Regional Response Teams in reaching appropriate decisions on spill countermeasures that offer the best prospect of minimizing environmental damage.

TRAJECTORY MODELING AND CHEMICAL HAZARD ASSESSMENT

HAZMAT maintains a state-of-the-art modeling capability for pollutant trajectories and distribution on and in the water. Modeling of a spill is activated within a two- to four-hour response time for most incidents, with additional capability available for on-scene deployment during major incidents. This activity is essential to the SSC function in most incidents because it permits the SSC to provide forecasts of pollutant distributions and allows the Federal On-Scene Coordinator to take appropriate preventive actions. Efforts were devoted in fiscal year 1985 to development of near-field, air plume trajectory models in order to provide improved technical advice to SSCs on the movement of airborne contaminants in hazardous materials incidents. These models will help in design of sampling strategies and support the designation of evacuation and safety zones during emergencies.

In addition to trajectory analyses, the SSCs must be prepared to provide reliable advice and specific technical information on the chemical aspects of spill incidents. Through their nationwide communications network HAZMAT provides the SSC with quick access to expert chemists and state-of-the-art information in the physical, chemical, and toxicological characteristics of potentially hazardous materials. Chemical Advisory Reports (CHEMREPS) were prepared during fiscal year 1985 for more than 100 substances commonly spilled in marine transportation accidents.

Because of the limitations of portable analytical response equipment currently available to identify and analyze specific chemical compounds during spill responses, more sophisticated instrumentation for spill responses is being developed. In collaboration with EPA and the U.S. Coast Guard, HAZMAT is currently modifying analytical instrumentation for on-site analysis of potentially hazardous chemicals to assist the SSC and Federal On-Scene Coordinator quickly and precisely in making proper decisions about mitigation measures at the spill scene. Substantial progress was made in fiscal year 1985 in developing and testing portable chemical instrumentation. Microchip-based gas chromatography and associated mass spectrometric and fourier transform, infra-red spectrometric detection equipment have been field tested, and protocols

developed for the effective use of the devices in field situations. Data from the instrumentation can be transmitted over the HAZMAT communications network for evaluation and interpretation in a centralized location. The analytical equipment will undergo continuing evaluation and refinement during its initial use by the EPA and Coast Guard in fiscal year 1986. Although this second-generation analytical equipment is conceptually designed to meet the analytical requirements of emergency spill responses, the equipment will also have applicability in detecting fugitive vapor emissions from hazardous waste dump sites.

HAZARDOUS WASTE DUMP SITES IN COASTAL AREAS

In addition to supporting the U.S. Coast Guard during spills of oil or hazardous materials, NOAA assists the U.S. Environmental Protection Agency in its efforts to clean up hazardous waste dump sites under Superfund legislation.

About 40% of the 849 hazardous waste sites on EPA's National Priorities List are located in the coastal zone. NOAA is responsible for investigating the potential effects of chemical releases from waste sites on coastal and marine resources for which it acts as a trustee under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. NOAA's first review of 274 marine coastal waste sites, completed in April 1984, identified 75 sites with some potential to affect the natural resources under NOAA's trusteeship. A review of 135 additional sites was completed in June 1985. It identified 20 additional sites of concern to NOAA. These 95 sites are distributed geographically as follows: 67 in the Northeast and mid-Atlantic regions; 9 in the Southeast and Gulf regions; 15 on the West Coast; and the remainder on Hawaii and the trust territories of the USA.

To facilitate its trustee activities at coastal sites and assist EPA in addressing natural resource concerns at all stages of the cleanup, NOAA, with Superfund assistance, is assigning Coastal Resource Coordinators (CRCs) to selected EPA regional offices. The first CRC took up duties in Region III in Philadelphia in November 1985; a second will be assigned to Region I in Boston early in 1986.

During 1985 the OAD reviewed and commented on the damage assessment regulations being developed by the U.S. Department of the Interior under Section 301(c) of CERCLA and assisted EPA in its development of regulations governing natural resource damage claims against the Hazardous Substances Response Trust Fund. NOAA's assessment of natural resource damages resulting from PCB contamination of New Bedford Harbor in Massachusetts continued through fiscal year 1985. This claim for damages was the first filed by the USA under CERCLA in relation to natural resources on non-Federal lands. Additional information on the New Bedford Harbor situation was provided in last year's Report to Congress.

Chapter VI

SELECTED SPECIAL PUBLICATIONS AND INFORMATION EXCHANGE

An important objective of the NOAA programs is to disseminate information to managers, legislators, and the public, as well as marine scientists. In addition to activities mentioned previously, this is accomplished through the release of books, commercially published and widely available through external sources, through special NOAA reports and publications, and through symposia.

INTERNATIONAL OCEAN DISPOSAL SYMPOSIA

NOAA sponsors periodic symposia on selected aspects of ocean waste disposal and management. The Fifth International Ocean Disposal Symposium was held September 10-14, 1984, at Corvallis, OR, and the Sixth is scheduled for April 21-25, 1986, at Pacific Grove, CA. The proceedings from past symposia have lead to major technical books that summarize the state-of-knowledge about waste characteristics, transport and transformation processes in the ocean, and waste disposal and management alternatives. During fiscal year 1985, the 6-volume series "Wastes in the Ocean" was completed, with the publication of the final 3 volumes. Volume 4, Energy Wastes in the Ocean, characterizes fuels and their wastes, including the problems of fuel waste transportation, the CO_2 problem, and nuclear power plant wastes. Volume 5, Deep-Sea Waste Disposal, presents current information on techniques to manage and monitor deep sea waste disposal, focusing on discharges that originate near the sea surface. Volume 6, Nearshore Waste Disposal, examines the effects of disposal on nearshore marine environments and organisms. It reviews the techniques for tracking and monitoring wastes and discusses the legal and policy implications of nearshore dumping. Proceedings from the Fourth and Fifth International Ocean Disposal Symposia are scheduled to appear in 1986 in a new series entitled, "Oceanic Processes in Marine Pollution".

BOOKS AND SPECIAL REPORTS

Concepts in Marine Pollution Measurements, (Harris White, editor) was published in late 1984 by the University of Maryland Sea Grant College. This volume, supported jointly by NMPPO and OAD, examines a range of techniques for measuring marine pollution and its effects on the environment. Design considerations and applications are discussed for toxicity and bioaccumulation tests, chemical measurements and anomalies in field specimens, use of laboratory microcosms, mesocosms, and field systems, measures of community impact, and field monitoring programs. A final summary chapter provides a critical overview of pollution assessment strategies and methods.

The Shape and Form of Puget Sound, by Robert Burns, was published by the Washington Sea Grant Program under OAD sponsorship. One of a series on Puget Sound, this book describes the geological setting of the Sound, the physical and chemical nature of its waters, and the interaction of these waters with the surrounding shorelines. The overall series is designed to inform the readers about the natural resources of the Puget Sound area, the historical uses of these resources, and current management of resource-use conflicts.

Chapter VII

PROGRAM MANAGEMENT

The funds appropriated to NOAA for ocean assessment activities amounted to roughly $12.5 million in fiscal year 1985, down from the previous fiscal year level because of a $1,033,00 Congressional decrease in appropriations for ocean assessment activities. After deductions for National Ocean Service and the Office of Oceanography and Marine Assessment management support, the fiscal year 1985 NOAA allowance to the Ocean Assessments Division was about $11.7 million. A fiscal year 1984 "carry-over" of $834,000 for the NOAA National Status and Trends Program and other adjustments, brought the final fiscal year 1985 NOAA allowance to OAD to about $12.3 million.

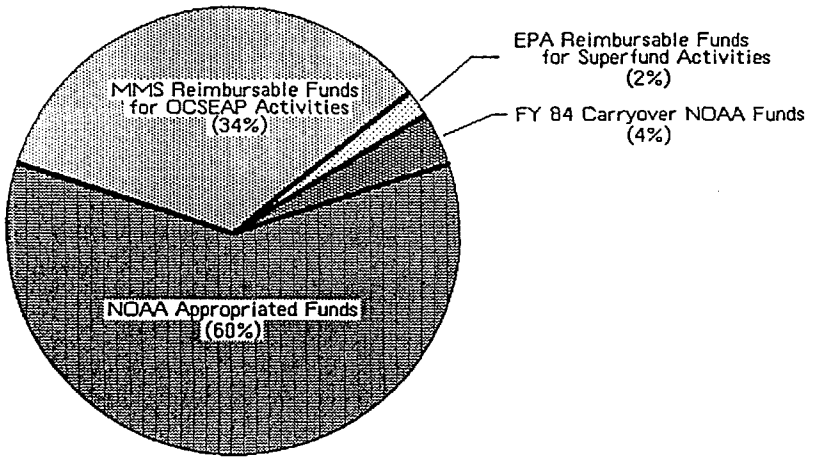
In addition to NOAA-appropriated funds, a considerable percentage of funds available to OAD is reimbursable funds from other Federal agencies, primarily the Minerals Management Service (MMS) of the U.S. Department of the Interior and the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response (Superfund) and the Office of Water. In fiscal year 1985 MMS reimbursed NOAA approximately $7.1 million for the management of the Outer Continental Shelf Environmental Assessment Program (OCSEAP). EPA reimbursed NOAA $463,000 for Superfund-related activities and $161,000 for assessment activities in Long Island Sound related to its "Bays" program. Total reimbursable funds available to OAD in fiscal year 1985 amounted to about $7.7 million.

Since the NOAA-appropriated and reimbursable funds available to programs of the Ocean Assessments Division are allocated and obligated to the extent possible as an integrated program, the summary charts below are shown as percentages of the total $20.0 million program in fiscal year 1985 (Figure 16). An additional $1,273,000 of NOAA-appropriated funds were allocated to the National Marine Pollution Program Office.

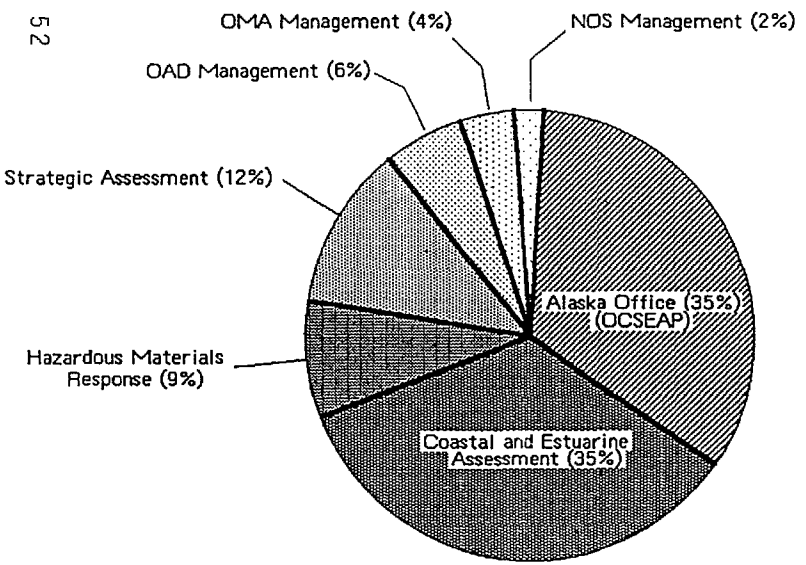
Resource Allocations by Program

About $7.2 million or over half (54%) of the NOAA-appropriated funds of the Ocean Assessments Division were allocated to the Coastal and Estuarine Assessment Branch, primarily to support activities of the National Status and Trends Program. The Strategic Assessment Branch received about $2.6 million or 19% of NOAA-appropriated funds; the Hazardous Materials Response Branch (HAZMAT) about $1.4 million or about 10%. HAZMAT also received all funds reimbursed by EPA for Superfund activities. OAD headquarters used $1.3 million or 9% of the NOAA-appropriated funds. The Office of Oceanography and Marine Assessment and the National Ocean Service took about 6% and 3% respectively of NOAA-appropriated funds for management purposes. All $7.1 million in reimbursable funds from the MMS are allocated to the Alaska Office of OAD, which manages the OCSEAP. Allocations of the total $20.0 million by OAD program are shown in Figure 17.

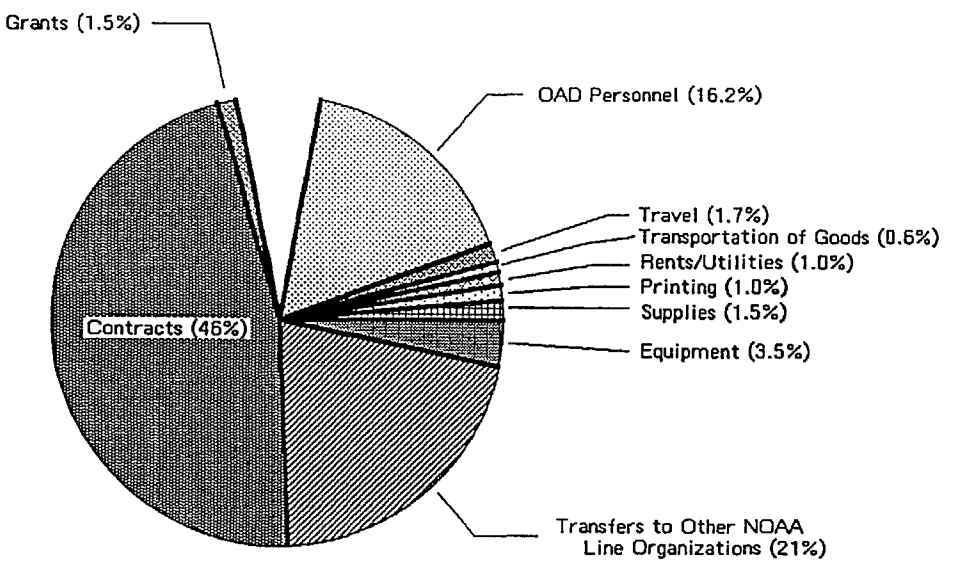
The NMPPO allocated $713,000 (56%) of its funds to Federal coordination and $560,000 (44%) to information dissemination.



Sources of Funds in FY 85



Allocation by Program in FY 85



OAD Expenditures by Budget Item in FY 85

Figure 16. Summary of FY 1985 Financial Information for the Ocean Assessments Division

Expenditures

Over $14.4 million or two-thirds (68.5%) of total funds available to the OAD in fiscal year 1985 were spent extramurally to develop information products and services. Over $9.7 million (46%) of these funds were used for contracts, only about $350,000 (1.5%) for grants, and $4.4 million (21%) were transferred to other NOAA line organizations such as the National Marine Fisheries Service to support cooperative work with OAD on the Benthic Surveillance Project, directed studies of the effects of contaminants on fish reproduction, or Strategic Assessment data base and atlas development. OAD personnel costs (salaries and benefits) totalled about $3.5 million (16.2%). Personnel costs of the 16 NOAA Corps officers assigned to OAD are paid from other NOAA funds. Miscellaneous expenditure categories, such as travel, transportation, printing, and equipment, accounted for about 9.3% of total funds available to OAD.

The National Marine Pollution Program Office spent 27.1% of its funds on personnel, 33.1% on transfers to other NOAA line organizations, and 33.2% on contracts. Miscellaneous expenditures accounted for the remaining 6.6%.

As of September 30, 1985, the Ocean Assessments Division employed 118 people in three major locations: Rockville, MD, Seattle, WA, and Anchorage, AK. In August 1985 Atlantic Office of the Coastal and Estuarine Assessment Branch was moved from Stony Brook, NY, to Rockville, MD. The Atlantic Office was established in 1973 to manage the now completed Marine Ecosystems Analysis (MESA) New York Bight project.

Research Platforms

During fiscal year 1985 the Ocean Assessments Division used over 300 days-at-sea (DAS) on ships of the NOAA fleet. The cost of operating these ships is paid from other NOAA funds. An estimate of the value of the total NOAA shiptime allocated to and used by the OAD is about $3.3 million.

The Benthic Surveillance Project of the National Status and Trends program used a total of 127 DAS. NS&T sampling activities on the West Coast used 40 DAS during July and August on the NOAA Ship McARTHUR; sampling activities on the East Coast (south of Chesapeake Bay) and in the Gulf of Mexico were conducted during 76 DAS on the NOAA Ship FERREL. NS&T sampling activities north of Chesapeake Bay were conducted over 11 DAS from the GLORIA MICHELLE, a vessel operated by NOAA's Northeast Fisheries Center. Water quality sampling activities in the Mid-Atlantic Bight were conducted during 25 DAS from the NOAA ships PIERCE and ALBATROSS IV during February, April, June, and August.

OCSEAP activities, managed by OAD's Alaska Office, used a total of 150 DAS in the Beaufort Sea and North Aleutian Shelf area aboard the NOAA ships DISCOVERER and MILLER FREEMAN in fiscal year 1985. OCSEAP activities also used about 1,200 aircraft hours of NOAA Twin Otter, NOAA helicopters, and chartered aircraft. Details of these projects can be found in the Annual Program Report of the OCSEAP, available from the OAD.

Appendix A

PROJECTS FUNDED BY THE OCEAN ASSESSMENTS DIVISION AND THE NATIONAL MARINE POLLUTION PROGRAM OFFICE IN FISCAL YEAR 1985

Performing Organization Title of Project	Funding
STRATEGIC ASSESSMENTS	
NOAA/NMFS/SEFC/Beaufort Laboratory Collection and Synthesis of Coastal Wetlands Data for National Estuarine Inventory	$ 35,100
NOAA/NMFS/Northwest and Alaska Fisheries Center Living Marine Resource Data Collection and Synthesis for West Coast/Gulf of Alaska Data Atlas	233,000
NOAA/OAR/Office of Sea Grant Support of Sea Grant Intern	30,000
Alaska Department of Fish and Game Inventory, Assessment, and Compilation of Mapped Subsistence Use Data for the Bering, Chukchi, and Beaufort Seas Data Atlas	46,882
Dalton-Dalton-Newport National Coastal Pollutant Discharge Inventory	435,602
Dalton-Dalton-Newport National Estuarine Inventory and Data Atlas	266,754
Decision Information Systems, Inc. Data Collection and Synthesis for National Assessment of Marine Recreational Values	49,754
James Dobbin Associates, Inc. Cartography for National Atlas of the Health and Use of Coastal Waters of the USA	56,000
James Dobbin Associates, Inc. Cartography for Gulf of Mexico Data Atlas	34,110
James Dobbin Associates, Inc. Editorial Support for National Estuarine Atlas	9,900
University of Alaska/Arctic Environmental Information and Data Center Cartography for Bering, Chukchi, and Beaufort Data Atlas	224,853

University of Alaska Map of Surficial Sediment Textures for the Bering, Chukchi, and Beaufort Seas Data Atlas	$ 26,290
University of Alaska Synthesis of Bird Data for West Coast/Gulf of Alaska Data Atlas	20,162
University of Virginia Intergovernmental Personnel Act Appointment	75,825

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COASTAL AND ESTUARINE ASSESSMENTS

NOAA/NMFS/SEFC/Beaufort Laboratory Effects of Trace Elements on Egg Development or Larval Survival in Estuaries	$ 124,144
NOAA/NMFS/SEFC/Beaufort Laboratory Larval Fish Food Web Dynamics	84,742
NOAA/NMFS/SEFC/Beaufort Laboratory Trace Elements in Estuarine and Coastal Waters	82,613
NOAA/NMFS/SEFC/Beaufort Laboratory Use of Life History Data to Assess the Effects of Pollution on Fish Populations	39,467
NOAA/NMFS/Northwest and Alaska Fisheries Center Effects of Contaminant Exposure on Reproduction Success of Commercially Important Marine Species	200,000
NOAA/NMFS/Northwest and Alaska Fisheries Center Quality Assurance Program for Trace Aromatic Hydrocarbons and Chlorinated Organic Analytes	106,000
NOAA/NMFS/Northwest and Alaska Fisheries Center Metabolite Measures	40,000
NOAA/NMFS/Office of Science and Technology Benthic Surveillance Project of National Status and Trends Program	1,193,100
NOAA/NMFS/Southwest Fisheries Center Response of Southern California Pelagic Fish Stocks to Trends in Contaminant Discharges	78,200

NOAA/NMFS/NEFC/Woods Hole Laboratory Development, Access, and Use of Water Quality Data Base	$ 20,000
NOAA/NOS/OMO/Atlantic Marine Center NOAA Ship FERREL Instrumentation	86,500
NOAA/NOS/OMO/Atlantic Marine Center Instrumentation Calibration and Maintenance for the Water Quality Project	35,000
NOAA/NOS/OMO/Pacific Marine Center Vessel Support for National Status and Trends Program	51,500
NOAA/OAR/Atlantic Oceanographic and Meteorological Laboratories Transformation and Assimilation of Pollutants Through Natural Chemical Processes	100,000
NOAA/OAR/Atlantic Oceanographic and Meteorological Laboratories Application Tests of Indices of Degradation	10,700
NOAA/OAR/Pacific Marine Environmental Laboratory Measurement of Sewage Sludge Settling Velocity	57,127
NOAA/OAR/Office of Sea Grant Sea Grant Intern	24,800
DOC/National Bureau of Standards NOAA/NBS Specimen Bank	90,000
DOC/National Bureau of Standards Quality Assurance Interlaboratory Comparisons and Workshop	15,000
DOE/Battelle Pacific Northwest Laboratories Sea Surface Microlayer Effects on Fish Eggs and Larvae	144,846
DOE/Lawrence Livermore National Laboratory Effects of Organic Contaminant Exposure on Reproductive Success of Starry Flounder	168,700
DOE/Brookhaven National Laboratory Mid-Atlantic Bight Water Column Chemical Analyses	88,256
DOE/Brookhaven National Laboratory Develop and Test Indices of Coastal Pollutant Degradation	9,940
DOE/Oak Ridge National Laboratory Data Base of the Effects of Pollutants on Living Marine Resources	79,000

U.S. Environmental Protection Agency/Office of Research and Development Quantitative Indicators of Risk to Humans from Pathogens through Shellfish Consumption	$ 142,600
Battelle Memorial Institute Mussel Watch Project (East and West Coasts of the National Status and Trends Program	1,501,803
E.V.S. Consultants Field Trial of the NOAA Sediment Quality Triad	99,997
Florida Institute of Technology "Wastes in the Ocean" Series	30,000
Louisiana State University Oxygen Depletion on the Inner Continental Shelf of the Northern Gulf of Mexico	101,783
National Research Council of Canada Marine Sediment and Biological Tissue Reference Samples and Interlaboratory QA Comparisons	12,236
Old Dominion University Research Foundation Analysis of Phytoplankton Samples from NOAA Water Quality Cruises	9,997
Radix Data Incorporated Review of National Status and Trends Program Data Analysis Plans	9,985
SEAMOcean Epidemiological Assessment of the Potential for Diarrhetic Shellfish Poisons in the Northeast United States	9,980
Southern California Coastal Water Research Project Reproduction Effects in Fishes Around Southern California Waste Outfalls	194,000
State University of New York at Stony Brook Phytoplankton in Mid-Atlantic Bight Sediments	19,966
Texas A&M University Mussel Watch Project (Gulf of Mexico) of the National Status and Trends Program	454,560
University of California, San Diego Development of a Passive Sampling Apparatus (Artificial Mussel)	20,699
University of Washington Potential for Exposure of Subsistence Fishermen to Toxic Chemicals in Puget Sound	163,976

University of Washington Scavenging of Reactive Elements from Marine Coastal Waters	$ 38,704
Virginia Institute of Marine Science Workshop on "Middle Atlantic Bight Physical Oceanography and Meteorology"	1,999

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HAZARDOUS MATERIALS RESPONSE

NOAA/OAR/Great Lakes Environmental Research Laboratory Support to Spill Support Coordinator	$ 10,700
Applied Environmental Services Scientific Support Coordination Support for USCG Districts 11, 13, 14	77,857
Murphy Information Services Information and Communications System Support	52,991
Research Planning Institute Environmental Assessment Support	355,138
Scientific and Environmental Associates, Inc. ESI Summary Maps fpr Chesapeake Bay	27,908

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DIVISION-LEVEL PROJECTS

NOAA/NMFS/Estuarine Program Office Support for Chesapeake Bay Information Bulletin	$ 1,500
Estuarine Research Federation Partial Support of the 1985 Estuarine Research Conference	15,000
Industrial Economics, Inc New Bedford Damage Assessment	234,410
University of Alaska Partial Support for "International Conference on Marine Living Systems of the Far North"	15,000
Various Expert Consultants New Bedford Damage Assessment	39,200

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NOAA/NESDIS/National Oceanographic Data Center FY 85 Basic Agreement for NODC/Ocean Pollution Data and Information Network (OPDIN)	$ 340,000
NOAA/NESDIS/National Oceanographic Data Center Support for the National Marine Pollution Information System	40,000
NOAA/NESDIS/National Oceanographic Data Center Support of NODC Taxonomic Code	18,500
NOAA/NOS/OMA/Physical Oceanography Division Support for Laser Raman Spectroscopy Project	12,000
NOAA/OAR/Office of Sea Grant Support for a Workshop on Methods for Analysis of Organic Compounds in the Great Lakes	4,300
DOE/Oak Ridge National Laboratory West Coast Regional Inventory of Non-Federally Funded Marine Pollution Research, Development, and Monitoring Activities	77,500
DOE/Oak Ridge National Laboratory Assessment and Uncertainty Analysis of Major Contaminants Entering the Marine Environment	70,000
U.S. Environmental Protection Agency Development an Approach for the Use of Key Indicators of Environmental Quality to Assess the State of the Marine, Estuarine, and Great Lakes Environments	65,302
EG&G Analytical Services Marine Pollution Grey Literature Data Dase	79,953
EG&G Analytical Services Selected Indicators to Describe Trends in Marine Pollution	55,698
Marine Mammal Commission Assessment of the Problems of Entanglement in and Ingestion of Marine Debris by a Variety of Marine Organisms	20,000
Virginia Institute of Marine Sciences Survey to Determine Potential Problems Related to Toxic Organic Chemical Contamination	77,627

Appendix B

REPORTS AND PUBLICATIONS FROM NOAA PROGRAM

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