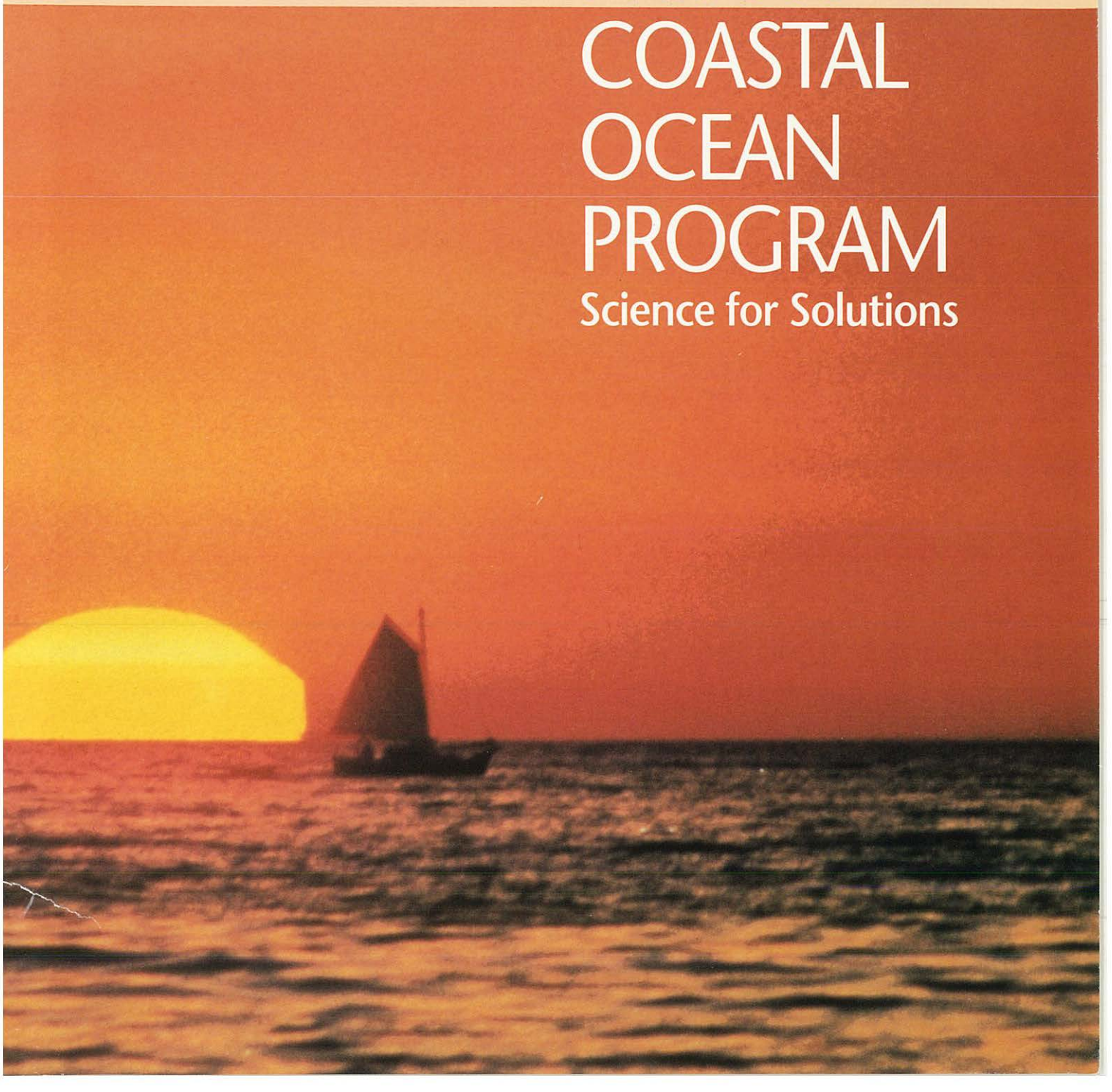
NOAA'S COASTAL OCEAN PROGRAM

Science for Solutions



For more information on the history, program goals, and accomplishments of NOAA's Coastal Ocean Program, please write:

NOAA
Coastal Ocean Office
Suite 518
1825 Connecticut Ave., N.W.
Washington, D.C. 20235

or phone 202-606-4330.

Publication editing, design, and production by Rhode Island Sea Grant and the University of Rhode Island Publications Office. This publication is sponsored in part by NOAA Office of Sea Grant, U.S. Department of Commerce, under Grant No. NA 89 AA-D-SG-02.

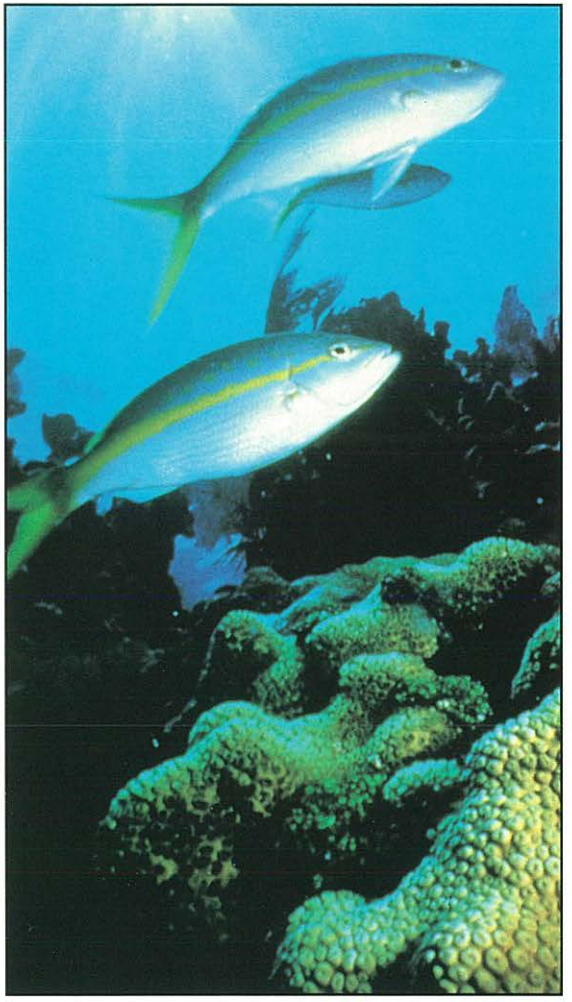
December 1992

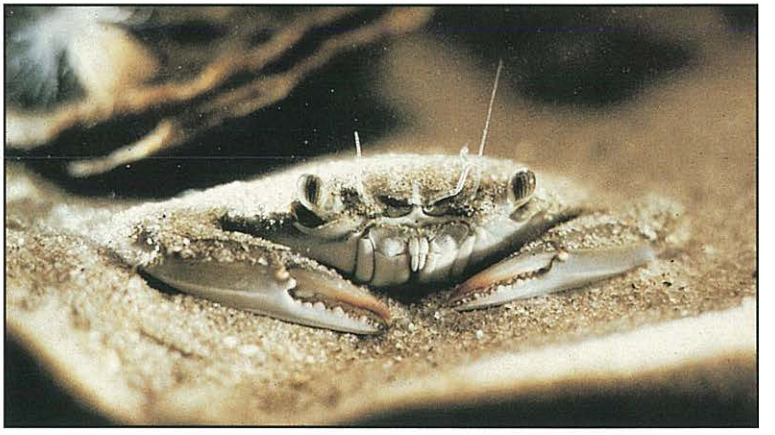
Printed on recycled paper.

The Coastal Ocean Program's Vision:

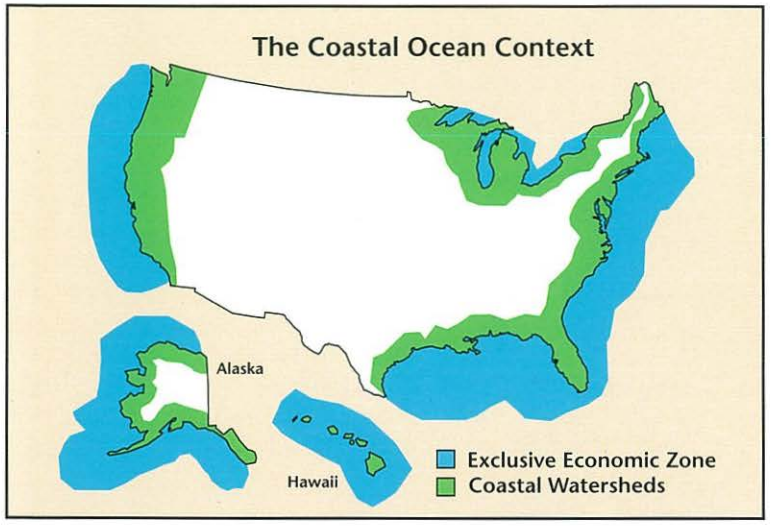
...To deliver the highest quality science in time for important coastal policy decisions

The Coastal Ocean—
science can help preserve its beauty and resources.





What Is NOAA's Coastal Ocean Program?



The COP deals with environmental problems that extend from the Nation's coastal watersheds and Great Lakes out to the 200-mile limit of our exclusive economic zone (EEZ).

The National Oceanic and Atmospheric Administration (NOAA), through science and services: describes and predicts changes in the Earth's environment; manages the Nation's ocean and coastal resources; and promotes global stewardship of the world's oceans and atmosphere. The Coastal Ocean Program (COP) provides a focal point through which the agency, together with other organizations with responsibilities for the coastal environment and its resources, can make significant strides toward finding the solutions that will protect coastal resources and ensure their availability and well-being for future generations. The COP's vision is to deliver the highest quality science in time for important coastal policy decisions.

What Critical Issues Does the Coastal Ocean Program Address?

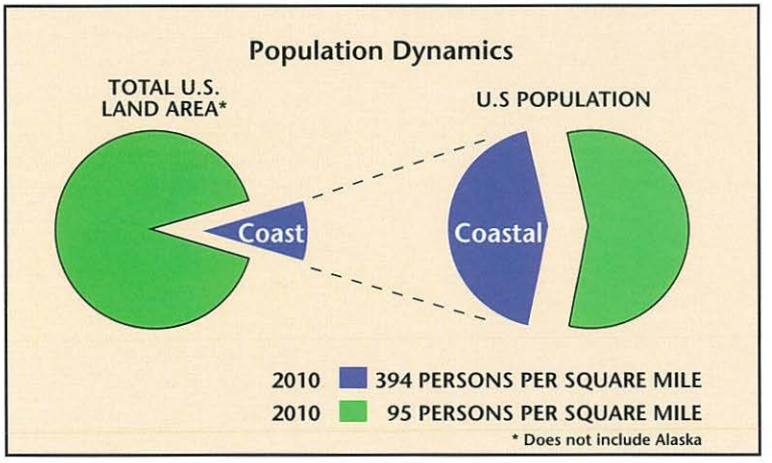
The COP addresses issues in the Nation's estuaries and coastal waters and in the Great Lakes. Three issues vitally important to the protection of coastal resources and of life and property are:

Environmental Quality. The costs of preventing environmental degradation in the coastal ocean are far less than those involved in cleaning up and restoring damaged resources. However, preventing loss and damage requires accurate and timely predictions of what might occur. To achieve this predictability, scientific research and monitoring designed to improve our understanding of ecosystem processes and human-induced impacts on them are needed.

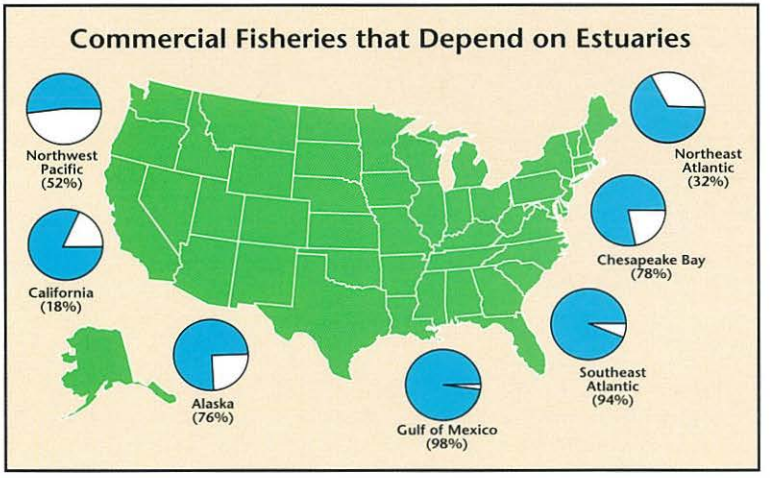
Fisheries Productivity. The recreational and commercial fishing industries contribute over $50 billion annually to the U.S. economy. But overfishing and loss of habitat threaten their long-term productivity and commercial success. Increasing long-term yields and fostering the recovery of depleted fish stocks can benefit and strengthen the Nation's economy. Understanding human impacts on estuaries—which support over 75 percent of the commercially important U.S. fisheries during some phase of their life cycles—will help improve and restore the quality of these habitats and of the living marine resources that use them.

Coastal Hazards. Episodic coastal storms and long-term physical ocean processes affect the lives and property of those who live along the Nation's shorelines. The number of people living in coastal communities will increase substantially in the next 20 years, from 112 million in 1990 to more than 127 million by the year 2010. Increased population density means that the present cost to the U.S. economy from threats to lives and property in the coastal zone will also increase. Improvements in our ability to understand the impacts of the storms and the physical ocean processes involved will help reduce these losses and provide protection for those who live in the paths of these events.

Population growth along the Nation's coastline is a driving force in environmental problems. By the year 2010, almost half of the U.S. population will live in 10 percent of our land area.



Estuaries are used by many of the most commercially important U.S. fisheries at some time in their life cycles. The COP helps improve fishery resources by increasing our understanding of estuaries for better management.



What Are the Challenges to Decision Making About the Coastal Ocean?

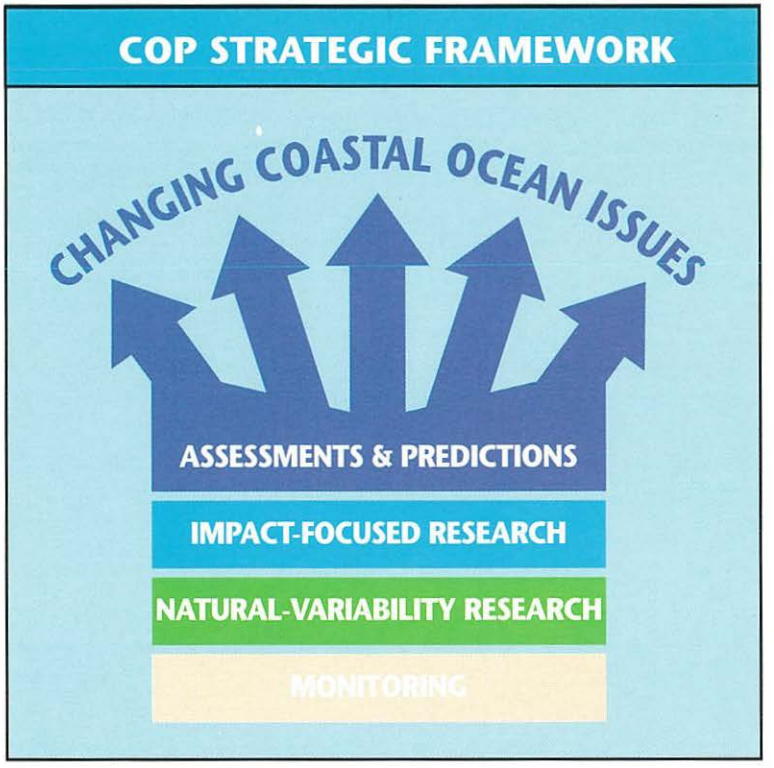
Each year the Nation invests billions of dollars and enormous human capital to protect and manage coastal resources. Yet an integrated approach to ensure that these dollars and human efforts are spent wisely has been lacking. Indeed, coastal ocean problems, driven by increasing population pressures, continue to escalate and these problems are becoming more complex and more diverse. Coastal resources are in jeopardy and the solutions to coastal problems become more costly each year.

Environmental issues along the coasts are also economic issues. Balancing environmental conservation with economic growth is difficult. As increasing demands on coastal resources are made, solutions must be found that both foster the coastal economy and preserve the natural beauty and health of the coastal ocean. In the past, information provided to decision makers was not complete enough to support this balanced view.

Coastal ocean problems are often addressed only when a crisis occurs and information given to decision makers may only relate to an individual problem. Frequently, this information is outdated, incomplete, or delivered too late. Policymakers who must rely on such information may be unable to act or may make ill-advised decisions.

Coastal development has brought economic growth but has created environmental problems. The COP supports research into ways to balance the use of coastal resources with sound environmental practices.

The COP builds upon stable monitoring and natural-variability research efforts to support focused research and assessment in response to rapidly changing coastal issues.



What Are the Goals of the Coastal Ocean Program?

COP activities are organized around four goals. Three address the major coastal ocean issues of Environmental Quality, Fisheries Productivity, and Coastal Hazards; and the fourth, Information Delivery, operates at the science-policy interface.

Environmental Quality

Improve predictive capabilities to help correct and prevent degradation of coastal ocean quality.

How Does the Coastal Ocean Program Help?

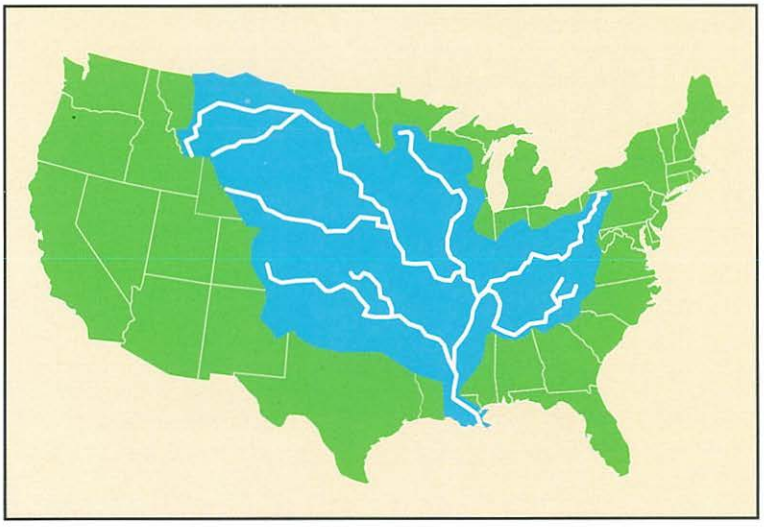
Policymakers need a comprehensive, proactive approach to managing coastal resources. This approach must be supported by the best available scientific information and must take account of the need to balance environmental concerns with economic growth. The COP, by enlisting the scientific expertise of a broad spectrum of federal and academic researchers, provides the best information available in time for coastal decision making. The aim of the COP is to provide information that is predictive. The scientific basis of this predictive information builds upon monitoring, research on impacts and natural variability, and assessment. As is illustrated in the diagram, this science-based foundation can support decisions on a broad range and changing suite of coastal ocean issues. It can also provide decision makers with the balanced perspective needed to promote economic growth consistent with a healthy and sustainable environment.

Excessive Nutrients

Nutrients such as phosphorus and nitrogen enter coastal and estuarine waters from point sources (e.g., municipal sewage treatment plants) and from nonpoint sources (e.g., runoff containing fertilizers and animal wastes). Nitrogen also enters coastal waters through atmospheric deposition from sources such as automobile exhaust and smokestacks. Excessive nutrients may create a condition in water bodies known as eutrophication that can alter the phytoplankton

community structure and food chains in the ecosystem, create low-oxygen conditions that adversely affect marine life, or encourage the growth of harmful algal blooms. These algal blooms have impacts ranging from preventing the growth of submerged aquatic vegetation to causing health problems in people who consume fish and shellfish harvested from waters where blooms occur.

Current COP activities dealing with nutrient overenrichment are focusing on assessment of the impacts of nutrient inputs to coastal waters and on the ability to predict bloom events. Specifically, COP research will help determine: 1) the effects of excessive nutrients on the water quality and productivity of marine life in coastal waters, bays, and estuaries; 2) the quantity of nitrogen the atmosphere deposits in estuarine areas and its significance in relation to other sources; and 3) the causes and impacts of harmful algal blooms.



The drainage basin of the Mississippi River (in blue) is the country's largest, covering 41 percent of the contiguous U.S. Drainage patterns and fertilizer use in the basin can degrade water quality in the Gulf of Mexico. The COP studies the distribution and impacts of contaminants entering the Gulf to reduce problems stemming from nutrient overenrichment.

Toxic Chemical Contaminants

It is estimated that huge amounts of toxic chemicals are allowed to enter the coastal waters of the United States each year. Toxics from industrial and municipal treatment plants, herbicides and pesticides from agricultural use, automobile exhaust, and emissions from power plants and homes enter coastal waters through groundwater, surface water, or atmospheric deposition. While very low concentrations of toxics can often appear harmless, higher levels of contamination can produce adverse effects in fish and other marine life ranging from the inability to reproduce to death. High levels of contaminants have been linked to fish tumors, and chlorinated organic compounds can accumulate in fish at levels that endanger the health of people who consume them.

Current COP activities in this area include intensive site-specific surveys of areas with known high concentrations of contaminants. Based on assessments of the extent and severity of toxic-related environmental degradation, selected areas are examined for biological effects of contaminants. These surveys will allow resource managers to better understand how contaminants affect marine organisms. COP is funding research efforts to establish causal links between levels of contaminants and observed biological effects such as impaired growth, cancer, genetic damage, and reproductive impairment in marine organisms. Improved bioindicators to detect and measure the biological effects that contaminants have on organisms at an early stage are also being developed and tested.

Fisheries Productivity

Improve predictive capabilities to better conserve and manage coastal ocean living resources.

Coastal Fisheries Ecosystems

Although in 1990 the U.S. ranked fifth in worldwide fishery landings, imported fishery products valued at $9 billion exceeded exports by $3.4 billion. The U.S. trade deficit in fishery products could be significantly reduced if yields were improved and depleted resources were allowed to recover. Overfishing and the incidental catch, or "bycatch," of young fish and noncommercial species stresses both the resource and ecosystem dynamics. A 1991 NOAA review of 232 fish species or species groups concluded that 65 are overexploited. Among these overexploited species are many of the Nation's most commercially valuable fishery resources. If these resources were restored through sound fisheries management, there would be strong benefits in jobs and profits in the commercial fishing industry, other fisheries-related industries, and the U.S. economy.

For many of our fisheries, the scientific information needed to optimally manage the resource is lacking. To sustain healthy harvests of crustaceans, mollusks, and fish, it is necessary to improve our understanding of their ecosystems and of the fisheries-related consequences of coastal activities. The COP is working to: 1) identify the critical bottlenecks that control replenishment of fishery resources; 2) improve our understanding of how some fish populations withstand intense fishing pressure; 3) improve our knowledge of how fish populations interact with each other; and (4) determine how these interactions can be monitored and incorporated into management strategies.

Two COP projects that address coastal fisheries are currently in progress. One involves research on the population dynamics of walleye pollock in the Bering Sea, which has been adversely affected by foreign overfishing. The U.S. catch of walleye pollock is valued at more than $1 billion annually. The second project focuses on understanding how environmental factors affect the economically important menhaden fishery off the southeast coast. Menhaden is estuarine-dependent during critical stages in its life cycle.

Estuarine Habitats

Estuaries are ecologically important coastal water bodies. They provide food, shelter, migratory pathways, and nursery areas for 75 percent of the Nation's commercial fisheries. Unfortunately, these areas, with their wetlands and seagrasses, are threatened by coastal development, pollution, erosion, freshwater diversion, and potential changes in sea level. More than half of the Nation's original coastal wetlands were destroyed by 1980.

By knowing the extent and condition of existing coastal wetlands and understanding the factors that impact them, coastal managers can make informed judgments when managing development, improving agricultural practices, building sewage treatment facilities, and addressing other issues. Analyzing the functional ability of restored habitats to support marine life, compared with that of natural habitats, will help decision makers understand when and where restoration should be used as a management tool.

COP initiatives in this area focus on: 1) determining the extent, health, and rates of change of coastal seagrasses, wetlands, and adjacent uplands; 2) determining the function, interaction, and dynamics of natural and restored coastal habitats; and 3) developing models to link information on land-cover change to habitat function.

To facilitate coordination in wetlands policy, NOAA's COP is leading an effort to help federal, state, and private organizations develop guidelines to ensure that all methods of habitat mapping and change analysis are compatible. Satellite images and aerial photography are being used to map wetlands and seagrasses, respectively. A wetlands change analysis has already been completed for the Chesapeake Bay and adjacent watershed areas and seagrass maps have been generated for a portion of the North Carolina coast. The goal of these efforts is to build a nationally consistent program to monitor land cover/habitat change (including submerged aquatic vegetation, all coastal wetlands, and adjacent uplands) at a frequency relevant to decision making. Additionally, the COP supports scientific research documenting the role of habitats in supporting living marine resources.

The COP studies fishery ecosystems in the Bering Sea and the South Atlantic to improve our understanding and prediction of fishery stocks.

Coastal Hazards

Improve predictive capabilities to better protect life and property along America's shorelines.

This house in Camp Ellis, Maine, was damaged in the Halloween Nor'easter of 1991 that inflicted serious damage along the northeast U.S. coast. The COP supports research to improve prediction of storm impacts to assist state and local planners

Coastal Hazards

Hurricanes, tsunamis, and coastal storms in some years kill over 100 people and cause losses of over $2 billion to the U.S. economy. With improved predictions, some of these human and economic losses could be reduced. For example, for each hurricane warning issued it costs an average of $63 million to prepare and evacuate the local population. Improved forecasting could decrease the number of unnecessary evacuations, thereby reducing the cost to local and state governments and safeguarding the lives of those in the storms' paths. While hurricanes are the more spectacular of the weather disturbances affecting the coasts, the COP has emphasized improving our understanding of other, more frequent types of coastal storms.

The COP is complementing technological advances in storm monitoring by supporting efforts to model the impacts of severe coastal weather events and ongoing physical ocean processes to improve planning and responses to emergencies. Ongoing COP projects in coastal hazards involve: 1) expanding deepwater measurements of tsunamis, developing real-time tsunami warning systems, and building inundation models for vulnerable west coast locations; 2) developing models of coastal storm surge and investigating meteorological phenomena affecting storm surge, wave, and wind forecasts; and 3) measuring and assessing the contribution of sea level variability to coastal water levels.

Information Delivery

Improve synthesis, assessment, and delivery of information to coastal ocean decision makers.

CoastWatch

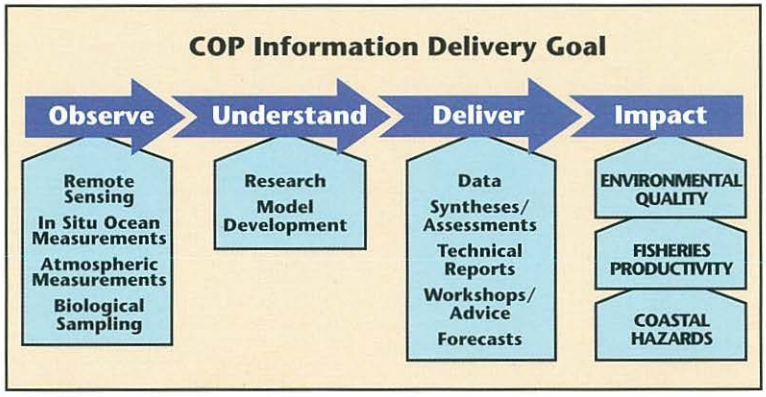
Coastal decision makers require accurate and immediate information concerning environmental processes and events that may affect the health and stability of the coastal marine environment. Informed and timely management of coastal activities during potentially hazardous environmental events will minimize the threat to lives, property, and marine resources. The CoastWatch program is designed to support the information needs of coastal managers by providing rapid dissemination of satellite observation data to regional coastal sites. Local resource managers and researchers use the satellite imagery, along with conventional marine data, to aid in detecting and monitoring such environmental events as harmful algal blooms, migrations of fisheries stocks, unusual ocean circulation patterns, ocean warming trends, and the movement of endangered species. CoastWatch is moving into the second generation of satellite observation products with the addition of ocean color imagery to its current suite of marine data. The ocean color data will provide a powerful tool for under-

standing and monitoring marine biological and physical trends that have been difficult to analyze in the past, including ocean productivity, coastal sediment transport, ocean front and current patterns, and the extent of marine oil spills.

Synthesis, Assessment, and Policy Interface

Those who manage and protect coastal resources often lack access to important information, do not know it exists, or cannot translate scientific data into forms useful for decision making. Policies made without this critical information can endanger coastal resources. Information from the natural and social sciences that translates the data to address coastal management issues is critically needed.

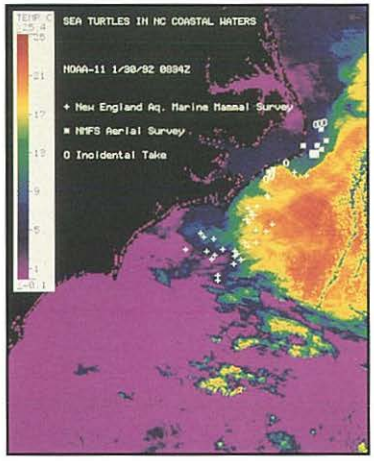
One of the major tasks of the COP is to assess and synthesize current coastal resource information produced by NOAA and other agencies and to make it accessible to federal, state, and local officials. Early efforts centered on implementation of the computer-based Coastal Management, Planning, and Assessment System (COMPAS). This system brings a variety of scientific information from different subject areas in a comprehensive and usable form to the desktops of state coastal resource managers. The COP supports COMPAS applications for Texas and the Florida Keys, as well as the development of a generic version adaptable to the needs of other coastal states.



The COP brings timely scientific information to the coastal decision-making process.

Another major thrust in information synthesis is to identify critical coastal policy and management issues for study by knowledgeable professionals, who then develop analyses and information in forms that are directly useful to coastal decision makers. Among the topics currently being developed in these synthesis documents are methodologies for assessing cumulative impacts in the coastal zone, salt-marsh restoration techniques, habitat requirements of selected commercial fish species, and a national survey of eutrophication and harmful algal blooms.

The role of social sciences in informed decision making about the coastal ocean is becoming increasingly recognized. The COP is working to develop methodologies in four research areas: cumulative impact analysis, economic valuation, growth management, and multiple-use conflicts.



Scientists were able to interpret the distribution of endangered sea turtles and possible interactions with the summer flounder fishery off North Carolina using CoastWatch-delivered, near-real-time satellite imagery. Sea turtles are usually found in warm waters associated with wintertime Gulf Stream intrusions nearshore. Airplane surveys were directed to the warm-water areas detected in the imagery to observe the turtles and map them.

What Has the Coastal Ocean Program Accomplished?

The COP has made significant advances in addressing many of the issue areas related to coastal problems. Among its accomplishments have been: the development of CoastWatch and its application to a variety of scientific problems, including helping to understand red tide events off North Carolina and in the Gulf of Maine; the development of a national protocol for wetland and seagrass mapping; the encouragement of comprehensive research on algal blooms; the development of models for tsunami inundation forecasting; the intensive study of the causes and impacts of nutrient overenrichment along the Louisiana continental shelf; the initiation of research on atmospheric deposition of nitrogen in the Chesapeake Bay and the extension of this effort into other northeast estuaries; and the leadership, under the auspices of the Committee on Earth and Environmental Sciences, of a federal effort to coordinate coastal ocean science.

NOAA's COP provides the synthesized, quality information needed to solve the Nation's critical coastal problems. With its defined mission, concrete goals, and integrated management mechanisms, the COP works to ensure that existing resources and expertise are used effectively. It provides a focused and cost-effective way to address coastal management problems and thereby helps to protect and promote the economic and environmental value of coastal ocean resources. In its short history, the COP has earned support throughout NOAA and built strong, coordinated links with other federal, state, and local agencies working to improve the quality of the coastal ocean. In addition, the COP has forged an effective partnership with the academic community and capitalizes on the expertise of the Nation's leading universities. This partnership approach to understanding the coastal ocean harnesses the Nation's best talents and resources in solving some of the Nation's most pressing environmental problems.

With this foundation to build upon, and a long-term plan that ensures stability, the COP will continue to apply the expertise needed to improve environmental quality and enhance the productivity of the Nation's coastal ocean.

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Coastal Ocean Program