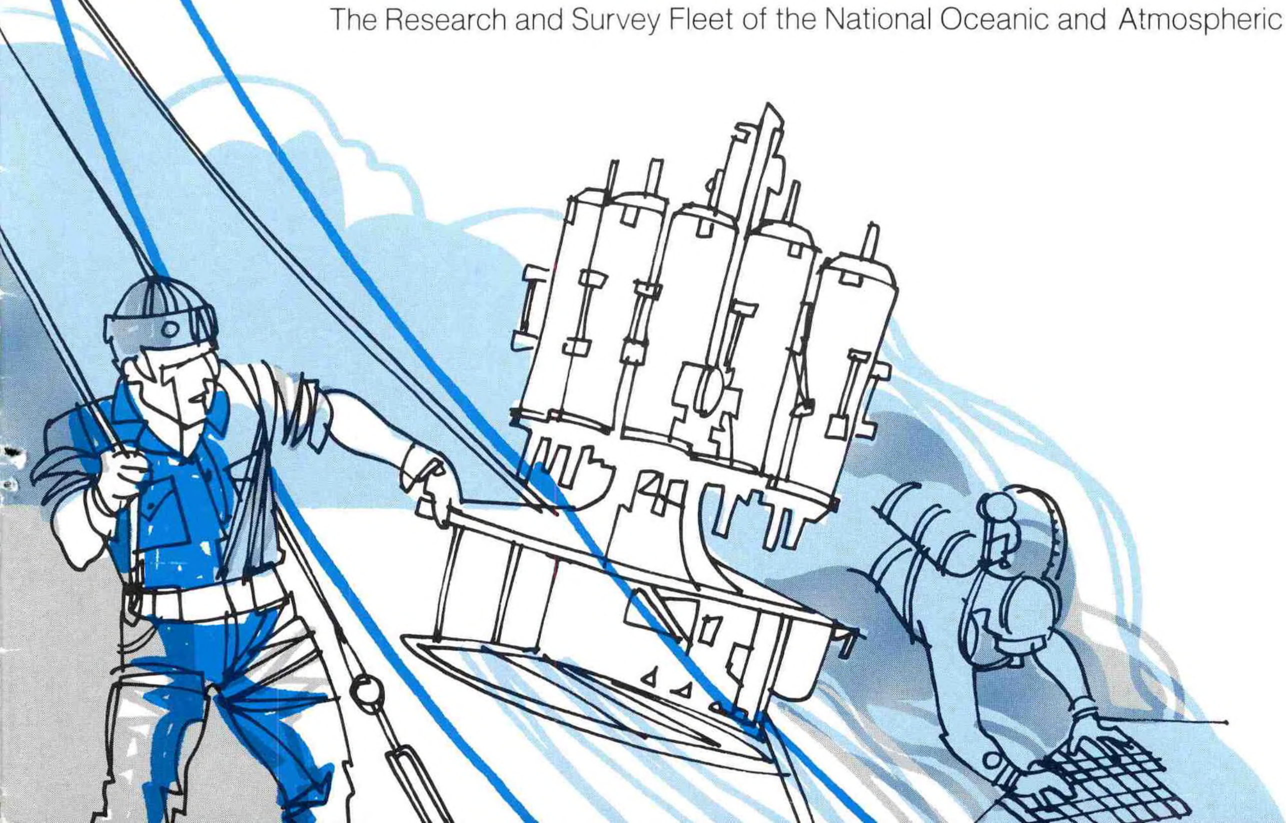
NOAA'S SHIPS

At Your Service

The Research and Survey Fleet of the National Oceanic and Atmospheric Administration • U.S. Department of Commerce



April 1986

The National Oceanic and Atmospheric Administration (NOAA) is a major Federal scientific agency. Its missions include forecasting the Nation's weather and climate, providing America's nautical and aeronautical charts, surveying the coasts and adjacent waters, monitoring and assessing the effects of marine pollution, protecting certain marine mammals and endangered species, and—together with the States—managing the Nation's coastal zone and its saltwater fisheries, both commercial and recreational. The ships of the NOAA Fleet provide vital support for the achievement of these missions.

The NOAA Fleet is thus a national resource, part of a triad of government, academic, and privately owned ships that serve America's needs. NOAA encourages visiting scientists and other prospective users to share in the opportunities its ships provide, whenever possible. Ship time is made available, in cooperation with NOAA program managers, to scientists from academic institutions, private industry, and other Federal and state agencies.

The purpose of this brochure is to describe the capabilities of the fleet. If you or your organization is interested in taking advantage of the facilities or opportunities offered by NOAA ships, please contact:

Office of Marine Operations
National Ocean Service, N/MO
National Oceanic and Atmospheric Administration
Rockville, MD 20852
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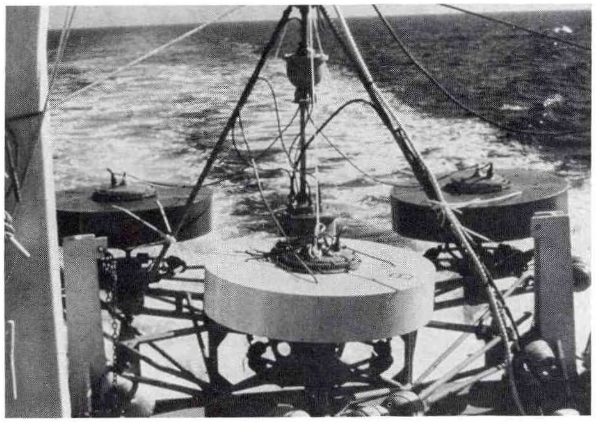
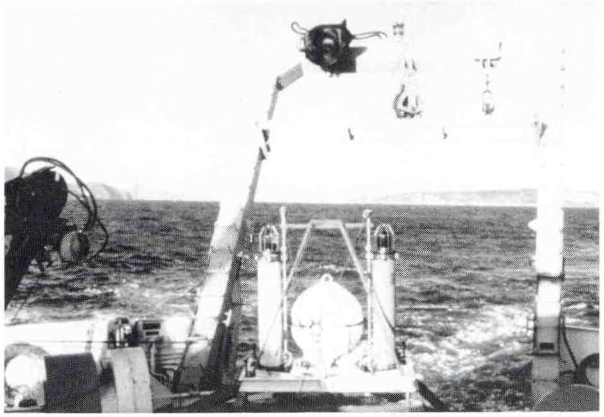
The Research and Survey Fleet of the National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service



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NOAA

The NOAA Fleet

The National Oceanic and Atmospheric Administration (NOAA) is a science-based Federal agency responsible for providing Americans with environmental information, forecasts, and services to help them plan their lives and run their businesses more effectively. To carry out its duties, NOAA has created a fleet of ships with many scientific capabilities, ranging from coastal craft that work chiefly in estuaries and near shore areas to major deepwater oceanographic ships that work throughout the world.

Among the ships of the fleet are vessels that use the most recent satellite navigation systems, computerized data handling, undersea photography and mapping equipment, and remote sensing devices. Other fleet capabilities include up-to-date methods of measuring and sampling the atmosphere, the water, the ocean floor, and the living creatures that inhabit the seas. The larger ships are equipped with both wet and dry laboratories and winches, cranes, and booms for handling many kinds of scientific equipment.

Visiting scientists are invited to bring their own equipment aboard; for the larger ships, arrangements can be made for handling specialized equipment or laboratories housed in vans that can be secured to the deck.

The ships are operated by civilian crews; with few exceptions the officers are the men and women of the NOAA Corps, America's smallest commissioned service. All NOAA Corps officers have at least a bachelor's degree in science, engineering, or mathematics; many have advanced degrees. Officers and crew are experienced in handling and working with a wide variety of scientific equipment. They are also well accustomed to coping with the special problems of conducting scientific research at sea, ranging from scheduling stations to trying to minimize the effects of bad weather.

Class 1 (the largest) ships have a sick bay, and there is usually a medical technician or doctor aboard. All ships of the fleet, wherever they may be, can obtain advice from medical experts by radio link to a medical advisory service.

Scientists and technicians aboard are often from NOAA, but may also come from academic institutions, other Federal or state agencies, and private research and industrial firms.

Program requirements determine the at-sea schedules of the ships, which normally run from February until November. Cruises also take place through the winter months to accommodate special projects such as weather-related or fishery research when key events occur during the season.

A semiannual NOAA Fleet Information Exchange publication and detailed sailing schedules list opportunities for non-NOAA scientists to participate in cruises, work on cooperative research experiments, or "piggyback" projects on scheduled missions.

NOAA works closely with the Federal Oceanographic Fleet Coordination Committee (composed of representatives of the National Science Foundation, the Navy, the U.S. Geological Survey, and other agencies with oceanic responsibilities) in setting priorities for ship time.

Ships of the NOAA Fleet that operate in the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico are based at NOAA's Atlantic Marine Center, Norfolk, VA, and Southeast Marine Support Facility, Miami, FL. Additional facilities at Woods Hole, MA, and Pascagoula, MS, support fisheries work in those areas.

Ships that operate in the Pacific Ocean and the Bering Sea are based at the Pacific Marine Center, Seattle, WA, with additional ship support facilities in Honolulu, HI, Juneau, AK, and San Diego, CA.

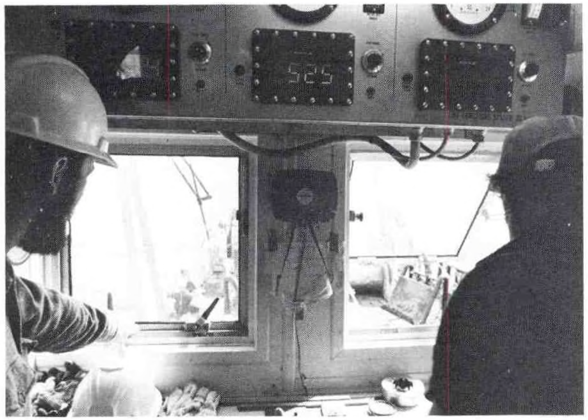
Several kinds of shipboard data processing systems are installed on NOAA ships, keyed to ship missions. They include large computers capable of collecting, verifying, and storing oceanographic and meterological data. In some cases the computers can be used to advise on-board scientists of the status of experiments and to provide information for experiment control. With the onrush of computer development, it has become necessary to upgrade some of these systems, a program that has begun and will continue as funds become available.

Replacement of existing systems with multiuse computers is planned at least for the larger ships. Individual work stations will permit scientists using the computer to process some of their data while still on board, enabling them to look at preliminary results and, where necessary, modify the experiment in midcourse.

Shipboard Environmental Acquisition Systems (SEAS) are installed on all NOAA ships, and additional units are available for ships of opportunity. They obtain and transmit marine weather observations and ocean temperature profiles, and have increased the data sampling coverage of systems previously in use. The SEAS package on larger vessels consists of a digitizer/controller, microprocessor, data collection platform, and expendable bathythermographs (XBT's), as well as a transmitter for real-time transmission of the information via the GOES weather satellite network where desired. Smaller, manual versions integrate a personal computer and data collection platform plus XBT's and a GOES transmitter.

Several navigation and positioning systems are currently in use in the NOAA Fleet. A program is underway to upgrade them with a new satellite navigation and time distribution array called Global Positioning System (GPS). It provides precise, continuous, all-weather common-grid navigation and time information, and enables ships to know exactly where they are at all times.

International Maritime Satellite (INMARSAT) terminals are being installed to provide a highly reliable voice communication system for ships in remote areas. They provide a direct communications link for operational purposes, and can be used in real-time monitoring of scientific data.



The ships are grouped by classes. Classes are determined by a combination of each ship's gross tonnage and rated horsepower, and not necessarily by primary mission.

Class 1 ships, the largest, range in length from 278 to 303 feet. They normally carry from 14 to 30 scientists. They conduct worldwide oceanographic research, primarily in physical and chemical oceanography, air-sea interactions, and marine geology, and have participated in major international oceanographic and atmospheric research programs. Two are also capable of conducting multibeam acoustic swath surveys for bathymetric mapping, charting, and research. There are plans for additional swath systems.

There is adequate "bringalong" space in the labs for visiting scientists to install their equipment and personal computers. One ship has a gravity meter installed, and the others have gravity rooms available in their stablest areas for installation of gravity meters.

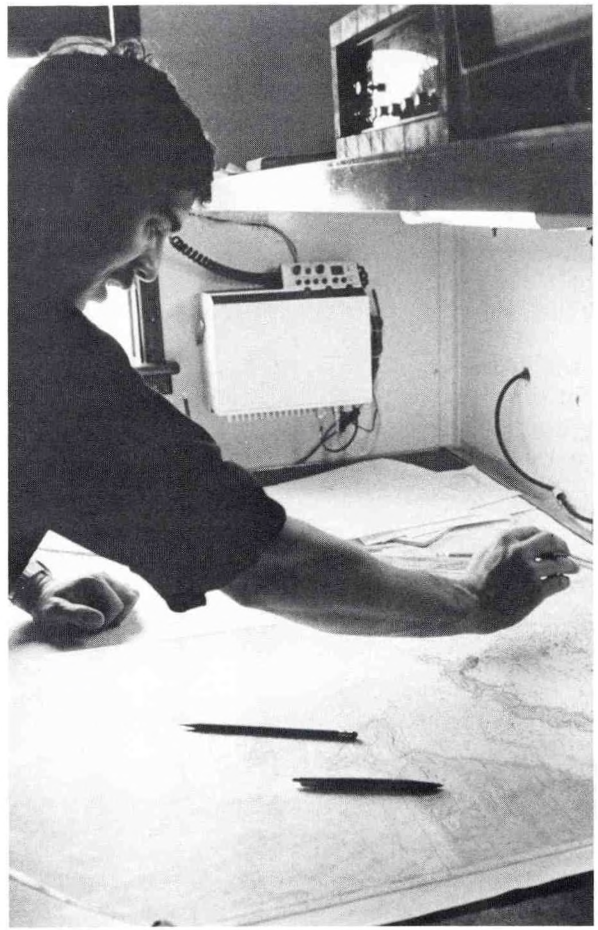
Class 2 ships are 215 to 231 feet in length. Most are outfitted primarily for hydrographic surveys involving nautical charting; they carry four scientists. One conducts fishery and living resources research and takes up to 11 scientific staff members aboard.

Three class 3 ships primarily conduct hydrographic surveys of the Exclusive Economic Zone for bathymetric maps and nautical charts; one is outfitted for studies of estuarine health and two for fishery research and resource assessment. They range from 163 to 187 feet in length. Ships that do hydrographic surveys have only a few scientific billets; those that support fisheries research can accommodate up to 15.

Five of the class 4 ships primarily support fisheries and marine resources research, and are from 127 to 171 feet long. They carry up to 13 scientists. The sixth in the class, 133 feet long, has recently been refitted for studies of estuarine health and water quality, and carries up to four scientists.

One class 5 ship, of 93-foot length, is dedicated to fisheries research, and has a scientific complement of four; the other two are twin vessels used to locate hazards to navigation and to conduct surveys in support of charting programs.

The single class 6 vessel is an 86-foot converted Army self-propelled barge used for fishery research and logistic support in southeast Alaskan waters. It can accommodate five scientists for short cruises studying such problems as resource assessment and habitat protection.



The Jobs and the Tools

NOAA's jobs include forecasting the weather, charting the Nation's coastal and estuarine waters, and providing the scientific information required for management of America's saltwater fisheries, both commerical and recreational. NOAA also conducts scientific studies in conjunction with other agencies, such as its work with the Environmental Protection Agency on air and water pollution and with the U.S. Geological Survey on undersea mineral deposits.

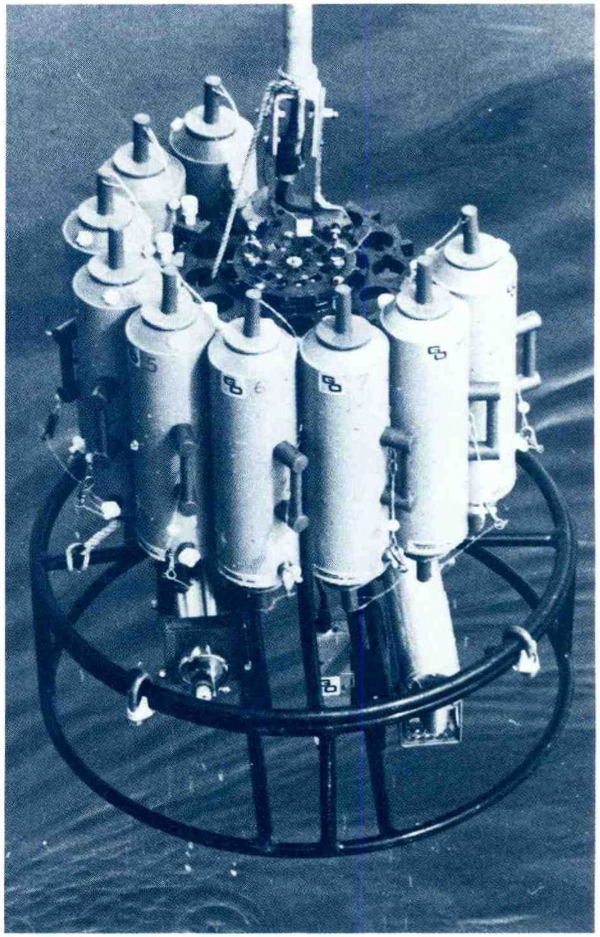
Accomplishment of these and other NOAA missions necessitates that its ships be provided with modern technological tools and competent crews to run them. It is with an eye to these requirements that the ships are outfitted. This is a look at the major jobs that the fleet undertakes in support of NOAA's missions, and at some of the tools the ships are provided with to get these jobs done.

Understanding the World's Climate and Weather

A major NOAA mission, accomplished by the National Weather Service, is to provide the Nation with its basic weather forecasts. This is accomplished through the use of ever more sophisticated computer models of the atmosphere, up-to-the-minute satellite imagery, and reports from the network of weather stations around the country. The mission also encompasses increasing our knowledge of long-term climate and of climate changes such as those associated with the El Niño-Southern Oscillation phenomenon.

Scientists of the Environmental Research Laboratories work to support this mission by seeking better understanding of how the atmosphere and oceans affect each other, and by steadily improving predictive and diagnostic models.

Other NOAA scientific responsibilities related to climate, weather, and atmospheric resources include obtaining better information on air quality and on how the oceans respond to materials injected into them by humans—everything from carbon-14 and tritium released during the atmospheric nuclear tests to freon from aerosol cans.



A major scientific question concerns the long-term consequences of the carbon dioxide buildup in the atmosphere, which is caused by burning fossil fuels. The oceans are the earth's major sink for carbon dioxide, and understanding how they affect and are affected by the carbon dioxide increase is very important. Ongoing work of this nature supported by the fleet includes assessing seasonal variations in the distribution of anthropogenic carbon dioxide in the ocean.

Still other NOAA research involves tracking the distribution of such pollutants as those that cause acid rain, by using non-polluting trace elements that can be released into the atmosphere and traced as they drift across continents and seas. NOAA scientists are also investigating the climatic role of radiatively important trace species other than carbon dioxide, using ships as well as land platforms for observations.

NOAA and academic scientists also seek better understanding of major ocean currents such as the Gulf Stream. A practical application of NOAA tracking of the stream and its eddies is the use by private shipping companies of NOAA data to plan the courses of their ships (riding the stream northbound, avoiding it southbound) to save time and fuel. And studies of the exchange of heat between earth and atmosphere are very important, both for hurricane forecasting and for eventual long-term climate prediction.

The class 1 ships provide a major part of the seagoing support for research on weather and air-sea interactions. They have taken part in major international climate research expeditions, including those of the Global Atmospheric Research Program operated under the auspices of the World Meteorological Organization and the National Academy of Sciences. Standard shipboard facilities for such research support include capabilities for handling all types of oceanographic and atmospheric sensors and sampling devices. These include CTD (conductivity-temperature-depth) samplers, rosette water sampling equipment, weather balloons, and the like.

A meteorological laboratory housed in a van is frequently installed on these ships; its equipment includes a meteorological radio receiver that is used for tracking radiosondes.

Assessing the Quality of Waters and Seabed

The composition of ocean waters is as dynamic as their physical movements. It varies markedly from place to place and time to time because of both natural and man-made causes. Natural oil seeps and oil spills affect some areas of the sea, either permanently or for a short time. Salinity is affected by amounts of rainfall and by river flow into estuaries. Toxins from industrial waste or sewage outfalls poison some waters. Buildups of certain marine organisms may absorb available oxygen, causing "fish kills" and reducing the stocks of other organisms.

NOAA's ocean missions include working with the Environmental Protection Agency and other scientific groups to find out what is happening to the Nation's estuaries and its surrounding ocean waters, and how changes affect saltwater fisheries and some marine mammals. Scientists measure the characteristics of water and sediments, analyze the processes taking place in the oceans, and try to find out what changes are occurring in the quality of the waters.

One important area of research is aimed at understanding what happens to tiny particles of matter and what chemical changes take place in them as they sink down through the water column. The gradual buildup of sediments on the bottom affords a history of what transformations have taken place and whether the changes represent deterioration of quality.

NOAA Fleet capabilities include taking water and bottom samples in shallow or deep water. Underwater sensors can be monitored during experiments. Preliminary analyses of water and sediment samples can be made on shipboard, and the samples preserved for more sophisticated treatment on shore. Ship personnel are trained in the importance of protecting the integrity of samples from contamination.

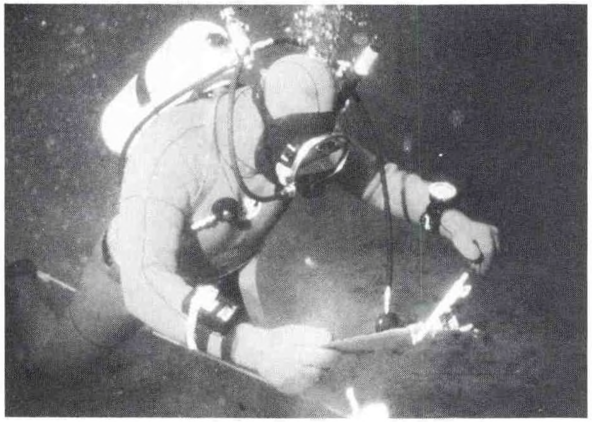
Mapping and Understanding the Seafloor

Providing the Nation's nautical charts to ensure safe navigation is a major NOAA responsibility supported by its ships that conduct hydrographic surveys. Foreign and domestic maritime trade relies heavily on high quality nautical charts, as do fishermen and recreational boaters. Offshore engineering, resource development, pollution monitoring, and estuarine conservation projects also require accurate charts and supplemental information such as tide and current data. As ships grow larger—from the 30-foot draft that has been common to huge 70-foot draft tankers—more detailed charts at greater depths are increasingly needed.

Scientists are also interested in the shape of the ocean floor, the kinds of material that make up the bottom, and key processes of plate tectonics and metallogenesis. Marine geologists investigate volcanic and sedimentation processes and how they affect the structure of the sea floor.

Cobalt crusts and polymetallic sulfide deposits are relatively recent scientific discoveries in the oceans; manganese nodules were first dredged in 1870. All are resources that may be economically recoverable in the future. They are thus important to commercial mining firms and to Federal planners as well as to research scientists. The most extensively studied hydrothermal field, where the sulfides are found, is along the marginal fault system of the Galapagos Rift valley, in 2,500 meters of water; French and American scientists have made detailed studies of its geology, fauna, and water chemistry, and NOAA has mapped it. Another massive deposit studied by government and academic scientists is in the rift valley of the Juan de Fuca Ridge off the coast of Oregon. NOAA scientists discovered the first such deposits in the Atlantic Ocean on a slow-spreading ocean ridge 1,800 miles east of Miami.

A Presidential proclamation of March 10, 1983, established a U.S. Exclusive Economic Zone (EEZ) and asserted jurisdiction over all resources in and below the oceans along our coasts and out to the 200-nautical-mile limit previously established for fisheries. NOAA ships are participating in a comprehensive effort to map the zone, using state-of-the-art multibeam swath systems, deep tow equipment, and ocean floor saturation photography.



The first area being mapped is the outermost continental shelf, the continental slope, and the upper rise of the coast of California, Oregon, and Washington. In later years the Alaskan area and the Hawaiian archipelago will be added to the project.

The NOAA Fleet has two excellent seagoing systems for high resolution multibeam swath surveys, and NOAA works closely with the U.S. Geological Survey and other interested parties in planning joint use of them. One of them, Seabeam, is a deep water system used in water depths greater than 100 meters; it has a swath width of 75 percent of water depth. Seabeam is used in EEZ areas of 400 to more than 3,500 meters depth, with total, overlapping coverage.

The other system, called Bathymetric Swath Survey System, is used in shallower water. Its swath width is two and a half times water depth, and it is used in waters from less than 150 to 600 meters deep.

A variety of deep and shallow water echo sounders and conventional hydrographic survey sounders are available. Sidescan sonar is used for detecting submerged objects.

To obtain sediment samples, corers of all types can be accommodated, including deep sea as well as shallow water equipment. Towed vehicles can also be used.

Understanding Oceanic Life

The principal job of NOAA fishery scientists is to gather the information needed for management of the Nation's saltwater fisheries, and the chief way of accomplishing this is to make stock assessments—that is, to estimate the populations of selected species and determine the physical and biological characteristics that affect populations.

To do this, the scientists use NOAA research ships to conduct systematic sampling programs designed to show variations in populations from year to year. These studies are primarily "fishery-independent"—that is, the ships do not follow the schools of fish from place to place, as do the commercial fishermen, but sample according to a pattern that will show areas of scarcity as well as areas of abundance.

In addition to nets for catching fish, the ships are equipped with a variety of instruments for making relevant physical and chemical oceanographic measurements such as water temperature, salinity, and the like.

Laboratories provide space for the scientists to dissect specimens and characterize them by age, sex, length, weight, and general condition—for example, whether they are afflicted by fin rot or other diseases. There is also provision for retaining samples for later analysis at shoreside laboratories.

These vessels are also equipped for plankton sampling, and can tow neuston and bongo nets as well as fishing gear. Some have plankton laboratories aboard for use in analysis of the specimens.

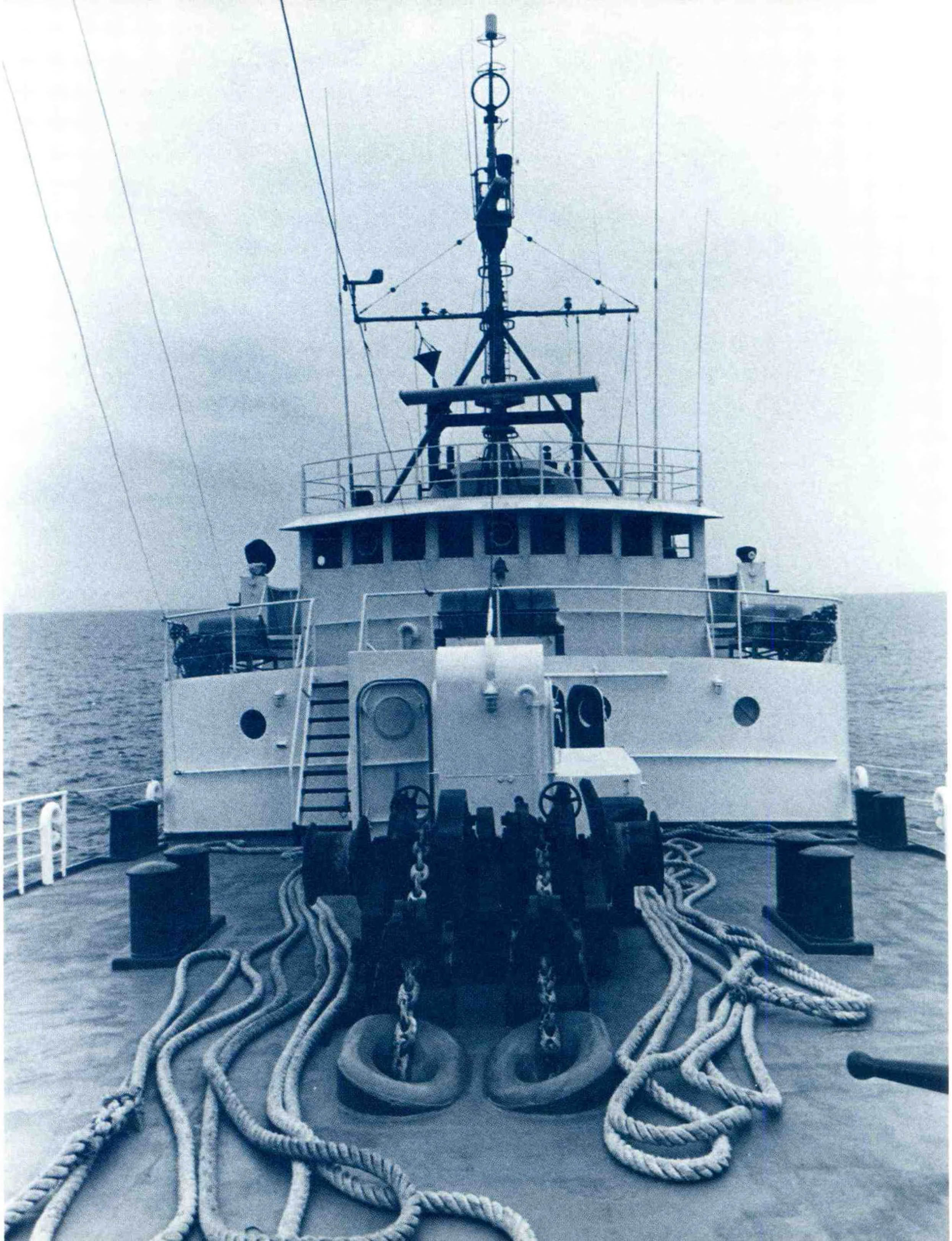
Ships assigned to fisheries research are equipped to support work related to stock assessment, including examining pollutants such as trace metals, studying the fish habitats, and making pathological studies of the animals themselves.

Certain marine mammals—whales, porpoises, and seals—are a special responsibility of NOAA's, and research is conducted on the size and health of their populations. NOAA also oversees the protection of sea turtles during their period in the oceans. Scientists from academic and conservation organizations work with NOAA staff in carrying out these responsibilities under legislation to protect endangered species and marine mammals, and stock censuses of these animals are regularly included in NOAA ship cruises.

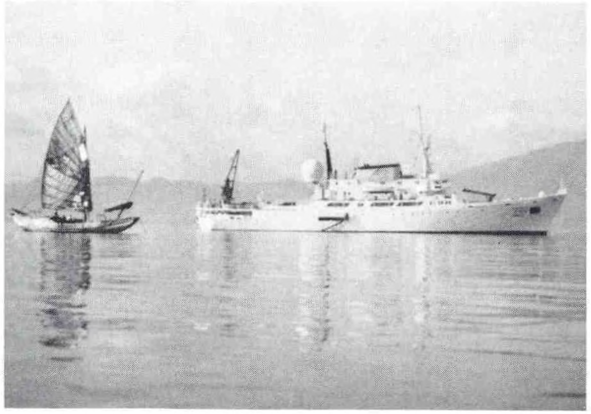
Preserving Our Nautical Heritage

Archaeology and history are not central to NOAA's mission, but certain projects of important historic interest are occasionally supported by ships of the fleet. NOAA maintains a Marine Sanctuary Program, and the earliest of such sanctuaries is the resting place of the historic Civil War ironclad U.S.S. *Monitor,* off the coast of North Carolina. A detailed seafloor map of the site is planned, and instruments will be placed near the wreck to keep tabs on the oceanographic conditions there.

In some cases, notably that of the Channel Islands Marine Sanctuary off southern California, many shipwrecks have occurred through the years. Hydrographic field surveys of the sites are carried out, and NOAA works with the National Park Service and other interested organizations to develop mechanisms for protecting the sites and assessing their significance as cultural resources.



Projects, Past and Present



No single research cruise, or set of cruises, can be called typical. NOAA's many missions, the wide-ranging interests of the scientists who use the ships, and the constant change characteristic of the scientific process itself, underscore the variety and flexibility required of the fleet. This, then, is a sampler. It affords a look at how ships of the fleet have been, and are being, used to support scientific research projects that are important to the Nation and to the progress of American science. And it shows how scientists from many organizations have been able to use NOAA ships to further their research.

Odyssey of the "Oceanographer"

On June 4, 1980, the class 1 ship *Oceanographer* became the first U.S. Government ship to visit mainland China in 30 years, calling at the ports of Shanghai and Xiamen. American and Chinese scientists aboard the *Oceanographer* and two research ships of the People's Republic of China then conducted a cooperative 3-week study of the sediment outflow of the Yangtze River, one of the largest watercourses in the world.

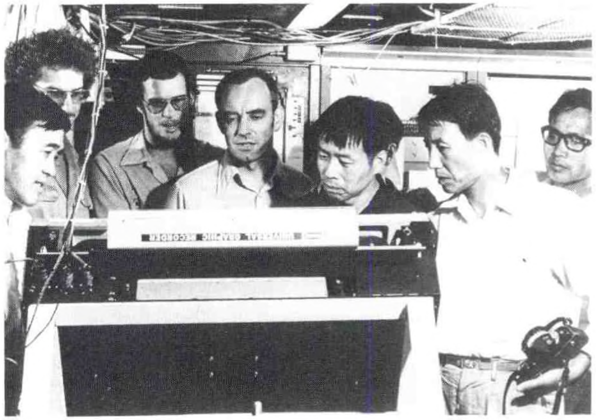
The U.S. scientific program coordinator for the Yangtze River study was from Woods Hole Oceanographic Institution. Other scientists came from the Massachusetts Institute of Technology, Virginia Institute of Marine Science, Yale University, Oregon State University, Florida State University, and the Universities of Chicago, North Carolina, and Washington, as well as NOAA.

It was the culmination of a 4-month trans-Pacific research voyage that supported four major research projects involving several fields of science and scientists from numerous research institutions throughout the United States. This is the 120-day scientific odyssey of the ship.

Fronts. The first project studied the subtropical front in the north Pacific, aiming to improve the understanding of the mixing and internal-wave processes that occur near the front. These frontal zones are common in the world's oceans, but their relationship to ocean circulation and interactions with the atmosphere have been poorly understood. They pose other uncertainties, too, such as why albacore tuna tend to run along them, and how they affect the performance and detectability of submarines.

In the course of the experiment, scientists took CTD soundings to depths of nearly a mile, along with water samples for shipboard analysis and XBT sensing to depths of several thousand feet. A device called Total Ocean Profiling System, or TOPS, was brought aboard by NOAA scientists to make vertical profiles of horizontal currents. Cast over the side, TOPS fell freely in the water to preset depths, then returned to the surface while being tracked by acoustic transponders emplaced on the seafloor.

Other measurements included temperature and salinity across the front, small-scale profiles of light transmissions, and acoustic backscattering.



Working with the *Oceanographer* on the 23-day experiment was the research ship *Thomas Washington* from Scripps Institution of Oceanography and an instrumented aircraft from the National Aeronautics and Space Administration. The Office of Naval Research contributed support to the research.

EPOCS (Equatorial Pacific Ocean Climate Studies). This was the second project supported. It is a major long-term NOAA study of the apparent relationship between anomalies in sea-surface temperatures and variations in global climate. EPOCS seeks to identify the mechanisms in the ocean that control sea-surface temperature variations, which are believed to be linked to perturbations in the mid-latitude atmospheric pressure field.

The study is important to the understanding of El Niño, the warming of parts of the south Pacific that occurs from time to time and can make significant, sometimes devastating changes in short-term climate in both the northern and southern hemispheres.

On the EPOCS portion of the cruise, the *Oceanographer* retrieved six previously deployed deep-ocean moorings carrying meteorological and oceanographic sensors, and deployed six new buoy systems. Scientists dropped XBT's along the Equator and made numerous water measurements. Meteorological balloons to measure upper-level winds were launched and tracked from the ship.

Chief scientists for the two legs of EPOCS were provided by NOAA; they were joined by scientists from Scripps Institution of Oceanography, Oregon State University, North Carolina State University, Duke University, and the University of Rhode Island.

Internal Gravity Waves. The third project was a study of internal gravity waves, the very slow, progressive oscillations of dense surfaces within the oceans. They are caused by tides, interactions among waves, atmospheric disturbances, and other forces. Internal gravity waves at the surface are quite small, but underwater they may range up to hundreds of feet. Because they modify the light-reflecting properties of the sea surface, they can be detected in satellite photographs, which show them in clusters tens of miles long.

Internal waves in the Sulu Sea, southwest of the Philippine Islands, appear to be the longest and fastest anywhere in the world, and it was there that the third experiment was conducted from *Oceanographer*. Scientists from NOAA, the University of Washington, and the Philippines deployed surface moorings and a subsurface current-measuring device, and made numerous oceanographic measurements. They took additional data with a towed thermistor chain, XBT's, and an acoustic echo-sounder. *Tiros-N*, *Nimbus 7*, and *Landsat 3* satellites all acquired special imagery of the Sulu Sea during the 2-week experiment.

Adding a fillip to this leg was the presence of a contingent of Philippine marines on board, as well as the constant companionship of a gunboat assigned by the Philippine Government, because of the high degree of danger of piracy in the area.

Yangtze River Sediment. The 3-week U.S.-China cooperative experiment focused on the massive sediment outflow from the Yangtze. Third largest river in the world, it spreads 500 million tons of sediment each year on the broad continental shelf of China. The scientists made seismic surveys of the shallow structure of the sea floor, and used sonar to map the underwater topography.

The scientists traced an underwater channel of the Yangtze, buried beneath more than 20 meters of sediment. During the last ice age, when sea level was lower than at present, what are now called continental shelves—underwater extensions of continents—were largely exposed. Rivers ran across them to the sea. The scientists mapped the channel cut through at that time, and tracked it more than 100 miles offshore.

Mapping the river's plume, they found that it sometimes forms two layers, with fresh water at the surface and saltier water below. They found a wedge of salt that intrudes into the estuary for a few miles during the summer peak river runoff period, and measured the strong tidal current at the river mouth, with an ebb flow of more than 4 knots.

Undersea Volcano Venting

Oceanographers have probed the crater of a large active volcano a mile beneath the surface of the eastern Pacific Ocean to determine the effects of the mineral-rich hot liquids venting through the sea floor. On the Juan de Fuca Ridge off the coast of Oregon and Washington, the site is the shallowest hot venting area yet found. The existence of the vents was confirmed in 1979, but their effects on ocean temperatures, chemistry, and biology are still largely unknown.

The NOAA ship *Surveyor* made photogeologic and sidescan sonar maps of the site to serve as baseline data for future studies. Seismographic instruments were placed on the surface of the volcano to give information about the system of vents, which is similar to those found in deeper water near the Galapagos Islands and elsewhere in the Pacific.

The cruise was a cooperative effort of NOAA, Oregon State University, and the U.S. Geological Survey, which is interested in identifying areas where mining of minerals at venting sites may someday be feasible.

On the east coast, the *Researcher* works on the same project, monitoring the ocean chemistry and geology in hydrothermally active areas along the mid-Atlantic Ridge between latitudes 10 and 26 degrees North. It collects water samples for analysis, and takes sediment cores and rock samples. It also measures water temperatures at various depths, and takes deep sea photographs at various stations along the ridge. Scientists from academic institutions and the U.S. Geological Survey participate in these studies.

The Health of Our Coasts and Estuaries

What are the effects of human activities on America's coastal waters and estuaries? Which areas are under stress? What are the conditions in the coastal zone today? Where is water quality deteriorating, and where is it getting better?

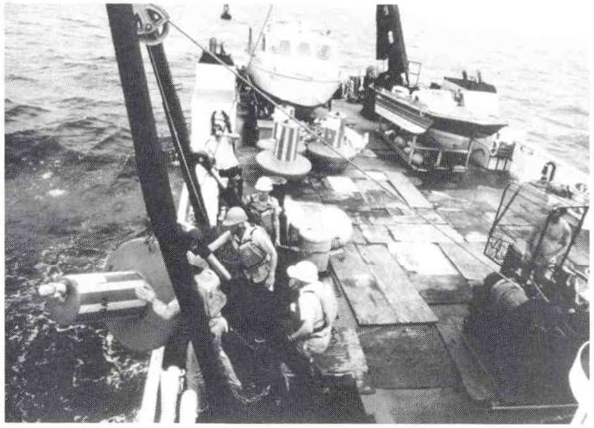
The answers to these questions will provide the data needed to assess where problems exist and what management actions might be taken to alleviate them. To be valid, the information on variations in environmental quality must be based on systematic rather than random observation, it must be taken in carefully selected locations, and consistent methods must be used in collecting and analyzing samples.

To answer the need for such a systematic data base, NOAA in 1984 initiated the National Status and Trends Program and equipped and dedicated two ships to it. The 175-foot *McArthur* is assigned to the west coast and Alaskan waters, and the 133-foot *Ferrel* to the relatively shallower waters of the east and gulf coasts. Both will be supplemented by launches for close inshore work and by occasional cruises of dedicated fishery research trawlers.

The two ships, which formerly were used primarily for circulatory studies, have now been equipped with small trawls for catching fish and winches to handle various devices for obtaining grab samples of bottom sediments. Their facilities include oceanographic and wet labs where fish can be dissected and analyzed, water quality assessed, and samples stored for transfer to shore labs. Staterooms and work space have been provided for scientists and their assistants.

Status and Trends, as the program is generally known, includes several activities.

Benthic Surveillance measures toxic chemicals in surface sediments and bottom fish taken from the same area—sediments because they are known reservoirs of contaminants, and bottom fish because they are trustworthy indicators of local pollution. Fifty coastal sites, both urbanized industrial areas and a few pristine sites for reference purposes, are monitored and measured for such contaminants as polychlorinated biphenyls (PCB's). The National Marine Fisheries Service conducts this component.



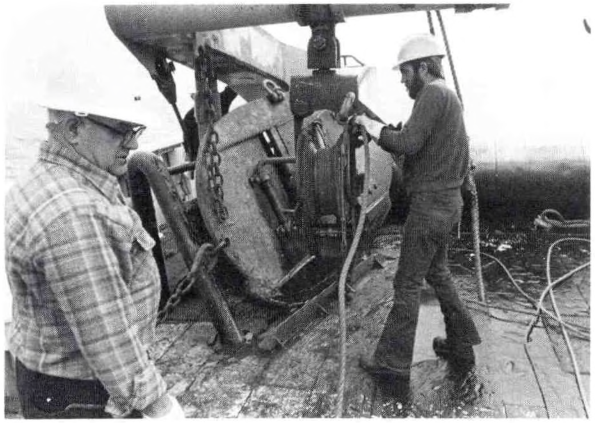
Mussel Watch is an outgrowth of the Environmental Protection Agency's program that uses mussels as an indicator species to detect environmental contamination. Mussels are collected from 150 sites nationwide and analyzed for the presence of specific materials.

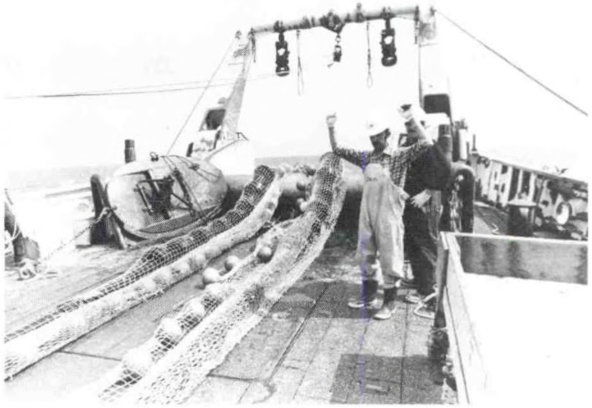
Water Quality monitors the annual cycle of reduced dissolved oxygen levels and takes physical, chemical, and biological data to aid in understanding the processes contributing to increased nutrients and reduced oxygen.

Early Alert of Climate Change

NOAA has established a rudimentary monitoring system in the Pacific Ocean to alert scientists to atmospheric and oceanic changes that may herald major climate aberrations. A cruise of the research ship *Discoverer* moored seven buoys equipped with environmental sensors to take the ocean's temperature at intervals from the surface down to about 1,600 feet. Two are the new Atlas buoys that transmit year-round daily updates of their temperature readings by satellite. Two others collect the same kinds of information, but require ship monitoring to obtain it. The other three, stationed at intervals along the Earth's Equator, gather wind and ocean current readings.

Scientists also deployed ocean instruments showing the structure of the thermocline—the sharp boundary between the warm surface layer of the ocean and the cold deeper layers. Moored current meters were also deployed as part of the alert system.





The system is located in a part of the equatorial Pacific thought to be a birthplace for changes in the oceans and atmosphere that lead to drastic climate change. Such an event took place in 1982, a periodic but unpredictable warming called El Niño that is believed to be associated with disasters that took many lives and wrought billions of dollars in damage in Ecuador, Peru, the Philippines, Australia, Indonesia, and as far away as India. Its effects were felt as far north as California, where unusually heavy storms hit the coast, and fisheries stocks plummeted with the onset of much warmer than normal ocean water.

El Niño arrives near Christmastime, about every 2 to 7 years. Its first sign is the warming of coastal waters along Peru and northern Chile, where it causes the local commerical fish, the anchoveta, to die or migrate. Local fishermen suffer the first, often serious, consequences.

In 1982 El Niño came early—so early that some signs that might have indicated its onset were not at first given credence by some scientific observers. Nor was there a system in place that would have given them any indication that that year's El Niño would be much more virulent than most. The new early-warning network is a start at making possible timely forecasts of this mysterious phenomenon, and NOAA ships and satellites will continue to contribute to this important climatological research.

Where Have All the Pollock Gone?

A routine bottomfish survey in the Shelikof Strait off Alaska, in 1980, began to turn up indications of an unusually large population of pollock—so immense, in fact, that fishery scientists on the *Miller Freeman* called back to their Seattle laboratory to discuss it. The Northwest and Alaska Fisheries Center then sent up a hydroacoustic team to record the striking echosoundings, and changed the cruise plan to investigate the phenomenon. What they recorded was a dense spawning school 20 miles wide and 70 miles long, an estimated volume of 3 million metric tons of the fish.

The word quickly spread to the U.S. commercial fishing industry, which responded by developing a fishery there from what had been zero to approximately 225,000 metric tons a year. The fishery is now dominantly U.S., in accordance with national policy—but regular resurveys of the area by the *Miller Freeman* have shown a rapid decline in the population, now down to an estimated 1 million metric tons.

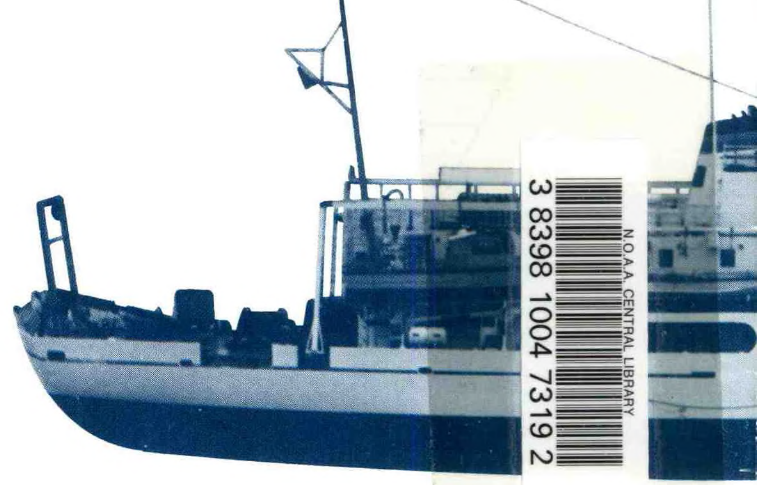
The great drop could not be attributed to the fishery, which takes only a minor quantity of the total amount, so NOAA fishery scientists and oceanographers—plus scientists from institutions such as the Universities of Alaska and Washington—have teamed up to try to find the causes. In addition to the *Miller Freeman's* trawls and hydroacoustic "fish finders," charter vessels and the *Discoverer* have been used in FOX—the Fisheries Oceanography Experiment—to look at the meteorological and oceanic factors that may have influenced the population. Early indications are that while the 1981, 1982, and 1983 year classes were poor, the 1984 year class may have been very large and the 1985 year class, again, a downer.

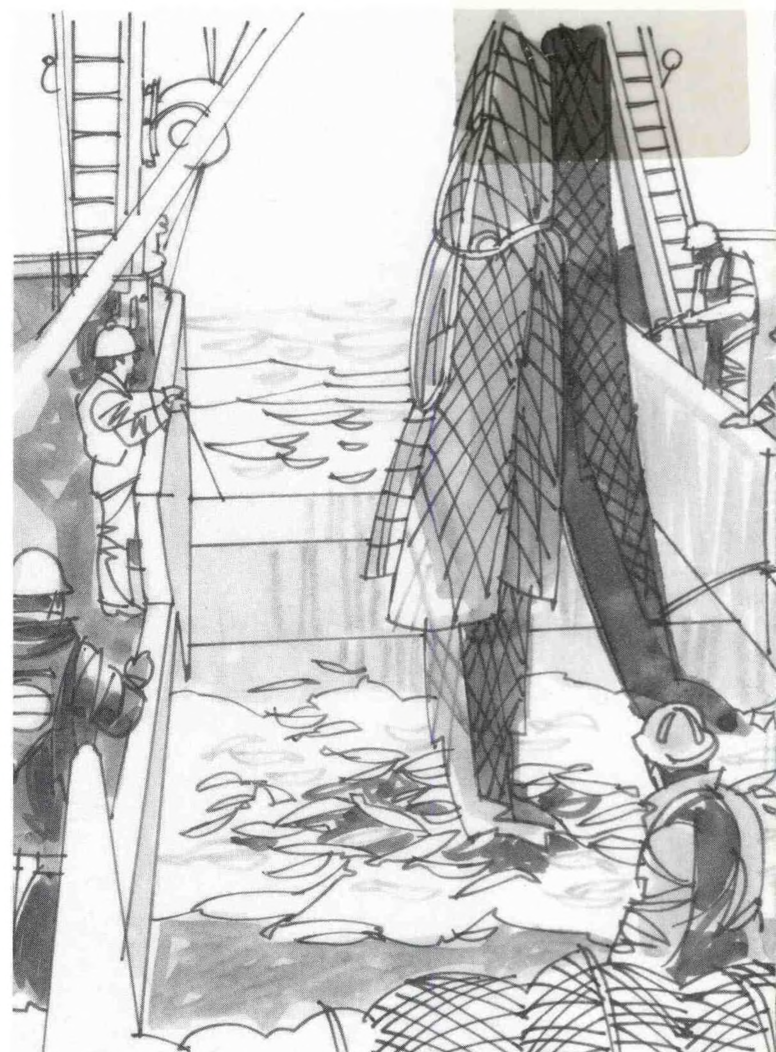
The experiment continues.

The NOAA Fleet

CLASS	NOAA SHIP	HOME PORT	GENERAL DESCRIPTION									MISSION			
			Length (feet)	Displacement (tons)	Cruising Speed (knots)	Endurance (days)	Survey Launches	Scientific Accommodation	Bow Thruster	Helicopter Platform	Laboratory	Charting & Mapping	Environmental Assessment	Fisheries Research	Oceanographic & Atmospheric Research
I 	Oceanographer	Seattle, WA	303	4,033	11	31		24	●		●				●
	Discoverer	Seattle, WA	303	4,033	11	31		24	●		●	●			●
	Researcher	Miami, FL	278	2,963	13	31		16	●	●	●				●
	Surveyor	Seattle, WA	292	3,440	12	28		16	●	●	●	●			●
II 	Fairweather	Seattle, WA	231	1,800	11	22	4	4	●		●	●			
	Rainier	Seattle, WA	231	1,800	11	22	4	4	●		●	●			
	Mt. Mitchell	Norfolk, VA	231	1,800	11	22	4	4	●		●	●			
	Miller Freeman	Seattle, WA	215	1,920	12	31		11	●		●		●	●	
III 	Peirce	Norfolk, VA	163	907	12	20	2	2				●			
	Whiting	Norfolk, VA	163	907	12	20	2	2				●			
	McArthur	Seattle, WA	175	995	10	28		6			●		●	●	●
	Davidson	Seattle, WA	175	995	10	23	2	2			●	●			
	Oregon II	Pascagoula, MS	170	952	12	31		15			●			●	
	Albatross IV	Woods Hole, MA	187	1,089	10	16		15	●		●			●	
IV 	Townsend Cromwell	Honolulu, HI	163	652	10	30		9			●			●	
	David Starr Jordan	San Diego, CA	171	993	10	31		13	●		●			●	
	Delaware II	Woods Hole, MA	155	758	11	24		9			●			●	
	Chapman	Pascagoula, MS	127	520	9	14		6	●		●			●	
	Ferrel	Norfolk, VA	133	360	8	9		6	●		●		●		
V 	John N. Cobb	Seattle, WA	93	250	9	13		4			●			●	
	Rude	Norfolk, VA	90	220	9	3		0				●			
	Heck	Norfolk, VA	90	220	9	3		0				●			
VI 	Murre II	Juneau, AK	86	295	9	8		5			●			●	

NOAA SHIP	SURVEYING: Hydrography	SURVEYING: Tide Observations	SURVEYING: Obstruction Location	SURVEYING: Precision Navigation	SURVEYING: Bathymetric Mapping	OCEANOGRAPHY: Water Column Sampling	OCEANOGRAPHY: Underway Current Measurements	OCEANOGRAPHY: Weather Observations	OCEANOGRAPHY: Atmospheric Observations	OCEANOGRAPHY: Bottom Sediment Sampling	OCEANOGRAPHY: Subbottom Profiling	OCEANOGRAPHY: Gravity/Magnetic Measurements	OCEANOGRAPHY: Plankton Sampling	FISHING: Trawling	FISHING: Dredging	FISHING: Seining	FISHING: Long Line	FISHING: Gill Net	FISHING: Pots/Traps
Oceanographer						●	●	●	●	●	●		●						
Discoverer				●	●	●	●	●	●	●	●		●						
Researcher						●	●	●	●	●	●	●	●						
Surveyor				●	●	●		●	●	●	●		●						
Fairweather	●	●	●	●		●		●		●			●						
Rainier	●	●	●	●		●		●		●			●						
Mt. Mitchell	●	●	●	●		●		●		●			●						
Miller Freeman						●		●		●			●	●					
Peirce	●	●	●	●		●		●		●			●						
Whiting	●	●	●	●		●		●		●			●						
McArthur						●		●		●			●						
Davidson	●	●	●	●	●	●		●		●			●						
Oregon II						●		●		●			●	●			●		●
Albatross IV						●		●		●			●	●	●				
Townsend Cromwell						●		●		●			●	●			●		●
David Starr Jordan						●		●		●			●	●			●		
Delaware II						●		●		●			●	●	●		●	●	
Chapman						●		●		●			●	●	●		●	●	●
Ferrel						●		●		●			●						
John N. Cobb						●		●		●			●	●	●	●	●	●	●
Rude	●	●	●	●				●		●			●						
Heck	●	●	●	●				●		●			●						
Murre II						●		●		●			●	●					





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