Chesapeake Executive Council

Second Annual Progress Report under the Chesapeake Bay Agreement

February 1987

Chesapeake Executive Council 1986

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Osprey.
Courtesy of U.S. Fish & Wildlife Service
Photographer Ray Whittemore

On The Cover

The osprey, or fish hawk, feeds almost exclusively on fish, which it catches in spectacular dives to the water. Ospreys are found throughout much of the world, but nowhere else is the concentration of nesting ospreys so great. The Chesapeake Bay supports over 1,500 nesting pairs of osprey and has been called the "osprey garden."

Each spring ospreys return from tropical wintering grounds in South America to nest on the Chesapeake Bay. They rebuild their bulky stick nests, make hovering searches and smashing dives in pursuit of fish, and perform elegant, screaming courtship flights while holding fast to fresh-caught fish. This annual, highly visible, and somewhat noisy infusion of life to the Bay is as characteristic as the autumn return of geese and swans. Each yearly generation of the osprey is complete when adults and young soar south at the end of the summer.

In the past, ospreys served as a warning of the buildup in coastal ecosystems of the organochlorine pesticides DDT and dieldrin, which caused the death of breeders, thin eggshells and very poor hatching rates. These extreme effects are now a decade in the past. DDT residues are very low in Chesapeake Bay osprey eggs, and hatching rates are generally high.

The osprey's future as an indicator of environmental health lies in understanding the bird's relationship to available fish supply in a changing ecosystem. Especially important to osprey success is the monitoring of the feeding of their young during the eight weeks from hatch to fledge. Nestling survival in Bay tributaries is generally excellent, but certain local breeding areas along the main Bay, such as the Poplar Islands, are experiencing some large-scale nestling starvation. Suitable fish prey may be lacking in such localities.

Fortunately, problems facing ospreys today are small compared to the problems of a decade ago. Success with osprey recovery shows that man can reverse environmental damage. Recovery of the Chesapeake Bay as a whole, however, will require the committed efforts of everyone—governments, industries, private organizations, and most important, each individual.

Species notes contributed by noted osprey biologist Dr Paul Spitzer Cover Photo by William Krantz, U.S. Fish & Wildlife Service

Contents

Foreword

To the Signators of the Chesapeake Bay Agreement and the People of the Region:

It has been a privilege and a pleasure to serve as the Chairman of the Chesapeake Executive Council in 1986, a year in which I believe we have made significant progress under the Chesapeake Bay Agreement.

First, the structure which the Council established works. The Implementation Committee and its subgroups have developed an agenda we call Phase II which will enable us to refine current efforts and to design and implement the next generation of Bay restoration and protection programs. We have improved our modeling capabilities to assist in that refinement. The monitoring network established in 1984 has provided a new baseline from which we can measure the progress of cleanup efforts. We began to develop habitat and living resources objectives which, when combined with monitoring data and modeling projections, will tell us how great a reduction of nutrients and other pollutants is required to bring back the Bay. We launched new toxics initiatives to pinpoint and better control the sources of contaminants. The states have made great strides in delivering programs to reduce the loadings of nutrients and toxic substances to tributaries and the Bay from urban and agricultural nonpoint sources. We are now embarked on a major reassessment of our pollution control needs and the technology to meet them.

The Scientific and Technical Advisory Committee (STAC) challenged us with their report on the control of nutrients from point sources, and the Council members responded by taking action to demonstrate nitrogen removal technologies.

The Citizens Advisory Committee (CAC) reorganized into five task forces to provide the Council with advice on important issues. With the staff of the Citizens Program for Chesapeake Bay, Inc., the CAC worked hard in 1986 to increase public interest and participation in Bay issues.

The Council was politically visible in 1986 when it sought to influence the programs of the 1986 Farm Bill to promote maximum effect on the Bay. The Council was among the first to recognize the problems boat paints containing tributyltin may be causing. Bay Program efforts were evaluated publicly when agencies of our Implementation Committee and the CAC testified before a Congressional hearing chaired by Senator Charles McC Mathias in June. A healthy reexamination of our structure and processes followed and is now to be a continuing effort.

One result of the self-examination was the initiation of the chairmanship rotation procedure envisioned by the signators of the Agreement. Council chairmanship will rotate between the U.S. Environmental Protection Agency (EPA) (representing the federal government) and the states. EPA will hold the chairmanship on alternate years.

EPA looks forward to being an active member of the Council during 1987. I anticipate it will be a year when momentum increases and when both the program and the partnership of the Bay Agreement become even stronger.

James M. Seif
Chairman
Chesapeake Executive Council

Achievements under the Chesapeake Bay Agreement

WORKING TOGETHER— THE EXECUTIVE COUNCIL IN ACTION

When the Chesapeake Bay Commission, U.S. Environmental Protection Agency (EPA), Maryland, Virginia, Pennsylvania and the District of Columbia (D.C.) signed the Chesapeake Bay Agreement in December 1983, they agreed to establish a structure to oversee the cooperative and comprehensive measures taken to restore the Bay. The Chesapeake Executive Council and its Implementation Committee (IC) began by forming the Planning, Data Management, Monitoring, and Modeling and Research Subcommittees which report to the IC. The Council's First Annual Report outlined their activities. Representatives from the three states, the District of Columbia and the six federal agencies with which EPA signed special agreements in 1984 participate on these committees.

Through the agreements, this historic partnership has been expanded and the possibilities for cooperation greatly enhanced. The resources and knowledge of the Soil Conservation Service (Agriculture), the National Oceanic and Atmospheric Administration (Commerce), Fish & Wildlife Service and U.S. Geological Survey (Interior), Corps of Engineers, and Department of Defense now have special geographic focus on the Chesapeake Bay.

In 1985 and 1986, the Council proved that the Agreement structure works to coordinate the restoration and protection of the Bay waters and living resources. We also recognized a need for additional groups.

Late in 1985, the IC formed the *Nonpoint Source Subcommittee* (NPS). It was a logical addition to the Agreement structure since the Bay Program Study concluded that much of the pollution of the Bay comes from nonpoint sources. Further, in 1984 the Executive Council adopted a policy requiring that not less than 75 percent of the Bay Program state implementation grant monies must support nonpoint source pollution control efforts.

The NPS coordinates information exchange to ensure technology transfer of the most effective urban and agricultural BMP's. It has helped the states target their programs and utilize their funding to speed adoption of land management practices. These practices reduce the sediment, nutrient, and chemical loadings to the tributaries and the Bay from areas which contribute the highest loadings.

The nonpoint source programs of the states are in place and on track. Cost-share programs are assisting farmers throughout the region to reduce soil loss, reduce nutrient loads to the Bay, and save money through decreased fertilizer use. Best management practices (BMPs) are being installed on farms. Sediment control regulations are being enforced, construction sites are being inspected, and people are being trained in construction techniques that protect water quality.

Each state funds demonstration projects showing how reduced tillage practices can prevent soil loss from agricultural lands. Public information materials are available for the farm community, construction firms, homeowners, and the general public. The resources of the Soil Conservation Service, Cooperative Extension Service, county soil and water conservation districts and state agencies are being applied to reduce nonpoint source pollution of the Bay. The chapter "Programs to Bring Back the Bay" provides more information.

Soon after the states and D.C. began implementing Bay programs, they recognized the importance of receiving the best independent scientific and technical advice available on those programs and on directions that future efforts should take. To accommodate this concern the Executive Council established the *Scientific and Technical Advisory Committee* (STAC) in December 1984. STAC reports to the Implementation Committee. It consists of 23 members who represent major universities and research institutions in the three states and D.C. as well as several federal agencies.

After reviewing the overall nutrient reduction programs throughout the Bay basin, STAC members concluded that both nitrogen and phosphorus loadings from nonpoint sources and phosphorus from point sources were being addressed. However, nitrogen from point sources was not. This was documented in data presented by EPA showing dramatic reductions in

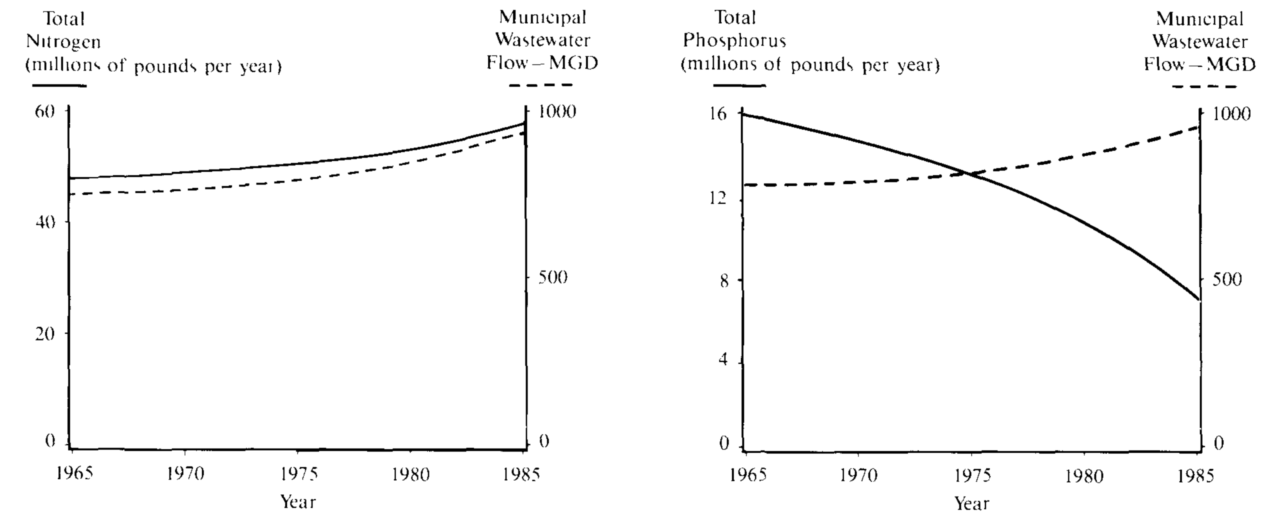


Figure 1 A and B: Annual nitrogen and phosphorus discharges and wastewater flows below the fall line and in the lower Susquehanna from municipal sewage treatment plants.

phosphorus, but essentially no reductions in nitrogen from conventional sewage treatment plants (Figure 1).

When the STAC completed its report "Nutrient Control in the Chesapeake Bay" in January 1986, it concluded that: the wastewater treatment strategy in the region should address nitrogen control; evidence exists from operating experience in nine other nations that nitrogen removal is now economically feasible; and, nitrogen removal should be considered in all plans for plant upgrading, expansion, and construction.

The report has already led to plans for expanded funding of pilot projects to remove nitrogen at sewage treatment plants and added importance to developing a Baywide dual (nitrogen and phosphorus) nutrient policy with parallel state programs. STAC has continued to examine the nutrients issue and has begun to review emerging technologies for other aspects of pollution control.

The Council also formed the *Citizens Advisory Committee* (CAC) in December 1984. Citizen participation had been an important and effective part of the Bay Program Study, and the Council wished to continue receiving the valuable perspectives of the citizens in the region.

The Citizens Advisory Committee functions as the primary public participation mechanism of the Chesapeake Bay Program. CAC is a group of 22 citizens with diverse backgrounds. They are generally well recognized in their respective fields and share a common commitment to the restoration of the Bay. Members act as ombudsmen for other Bay programs, citizens, and professional groups. During 1986, the Committee elected new officers and reorganized itself into five issue oriented task forces: land use, toxic substances, nutrient policy, alternative financing, and program tracking. The task forces are providing valued policy recommendations to the Executive Council.

The CAC's research in the area of alternative finance for pollution control programs is already useful, but will become increasingly important as new tax rules and federal water quality legislation become effective. For example, under the 1986 tax code, restrictions are placed on the use of state bonds. Cost-shared nonpoint source control programs may no longer be supported with bonds because, although the funds benefit more than one person, often the money is provided to an individual to take action on private property. Therefore, the states and local government units may have to find new ways to raise and leverage monies to finance nonpoint programs. They are already faced with identifying means to continue to build and operate sewage treatment plants.

The Committee also played an important role in public information during 1986 by contributing to the development of the Council's Communications Strategy. The strategy identifies 21 constituencies important to the Bay Program effort, the important

Citizens Advisory Committee

The purpose of the Citizens Advisory Committee is threefold:

- To provide a forum where issues confronting the Council can be discussed and commented on;
- To serve as a communication link with the affected interest groups, to keep them informed about what the Council, and the agencies it represents, are doing;
- To channel relevant information about values, views, concerns, priorities, suggestions, ideas and questions from the Public to the Council.

issues they need to understand, the methods to transmit those messages, the actions needed to develop the necessary information, and provision of that information. The Council requested that the Strategy be developed, recognizing the public's right to know how their state and federal dollars are being spent on Bay cleanup efforts and how well the programs are working. Creating the Strategy also reflects the Council's belief that the future of the Bay Program depends upon support from an informed and concerned citizenry.

In the spring of 1986, the Implementation Committee formed a *Living Resources Task Force*. This group is moving ahead with the development of living resources and habitat requirements for the state/federal Chesapeake Bay Program.

GOVERNANCE

During 1986, the Executive Council met four times: January 16 in Harrisburg, Pennsylvania; April 10-11 in Easton, Maryland; July 17 at the Blue Plains Wastewater Treatment Facility in the District of Columbia; and October 16 in Annapolis, Maryland. The April meeting was the first annual joint meeting of the Council with the CAC, STAC and members of the Implementation Committee.

The Executive Council reviewed its own role and membership in 1986. Members decided to retain the size and composition of the Council, but determined to begin rotating the chairmanship between EPA and a state every other year. A Governor, the Mayor or the Regional Administrator will hold the chairmanship with the Commonwealth of Virginia assuming the chairmanship in 1987.

In June, EPA Administrator Lee Thomas suggested strengthening the Bay Agreement with quantitative goals and a schedule for meeting those goals. His idea was presented at a hearing held in June 1986 by the Senate Subcommittee on Governmental Operations and the District of Columbia. As a result, the Council reviewed the Chesapeake Bay Agreement and compared its processes and progress with those of the Great Lakes Water Quality Agreement.

Members of the Executive Council concluded that progress toward quantifying and limiting loadings, as well as identifying and remedying problems in specific Bay harbors, parallel the progress and processes of the Great Lakes compact. Members look forward to the next two years as an important period to refine programs, develop target loadings, and reassess priorities under the Bay Agreement and state special initiatives.

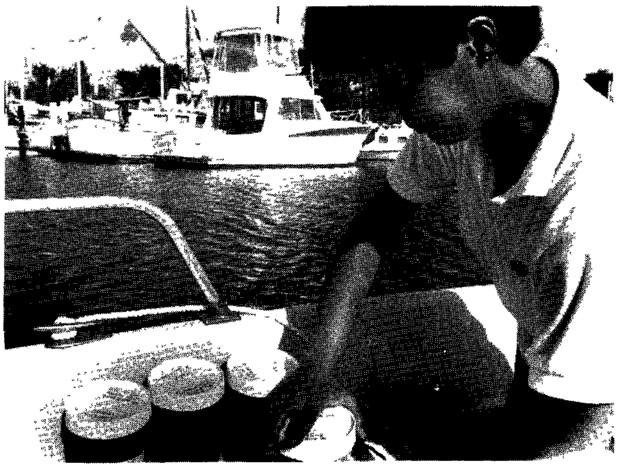
In 1986, the Council passed two formal resolutions: one on the Farm Bill and the other on tributyltin. The Council was concerned with the U.S. Department of Agriculture's development of new acreage set-aside regulations for wheat and feed grains under the provisions of the Commodity Program of the 1985 Farm Bill. The Council expressed concern that farmers who voluntarily took acreage out of production to reduce pollution in the Bay and its tributaries could be penalized by those lands not being eligible for inclusion in the acreage reduction program.

The Council, therefore, passed a resolution requesting the U.S. Department of Agriculture to consider, when developing new acreage reduction regulations, that Chesapeake Bay drainage basin farmers who have implemented best management practices such as filter strips, grassed waterways and forestry plantings be given credit for these lands within the cropland base. The Council also requested that provision be made for county Agricultural Stabilization and Conservation Service committees and local soil conservation district officials to review farmer applications ensuring that best management practices are implemented on set-aside acreage.

The widespread use of organotin anti-fouling paint in the Chesapeake Bay, and particularly its planned fleetwide use by the U.S. Navy and its continued use on the hulls of recreational boats sailed and berthed in Bay waters, concerned the Executive Council. The active ingredient in organotin anti-fouling paints, tributyltin (TBT), is toxic to aquatic animals at extremely low concentrations. Therefore, the Council believed that use of such paints could have long-term adverse consequences on marine life and the general environmental health of the Bay. The potential impacts dictated the need for adequate study of the matter by the Navy and by others such as EPA, prior to a decision by the Navy to use these paints fleetwide.

The Executive Council urged the Navy not to use organotin paint on ships in the Chesapeake Bay until it conducted a thorough Environmental Impact Statement or until EPA completed a study of comparable scope and detail on the potential environmental consequences of its use. The Council has subsequently supported a study that attempts to quantify the amount of tributyltin in certain areas of the Bay.

With EPA Office of Pesticide Programs (OPP), the Chesapeake Bay Liaison Office (CBLO) of EPA designed and coordinated a tributyltin (TBT) sampling study to gather data on TBT concentrations in harbors near marinas, boatyards, and living resources areas. Weekly water samples were taken at sixteen stations. Sediment samples were collected twice and tissue samples once at each station. Samples were sent to EPA's Gulf Breeze Laboratory in Florida. Results are still being analyzed and should be available in February 1987.



EPA Chesapeake Bay Program field intern collects samples for TBT analysis.

The OPP will consider the results during its special review of the pesticide use in antifouling boat paints. Presently, EPA is examining studies of TBT's toxicity to aquatic organisms, exposure of such organisms to TBT, and the benefits of TBT use. By comparing laboratory tests of TBT in various concentrations with actual TBT concentrations in the environment, EPA will be able to make preliminary determinations of the potential ecological hazards. In the meantime, both Virginia and Maryland are sponsoring research to test TBT's effects on some of the species found in Chesapeake Bay.

IMPROVING PROGRAMS

For the past two years, agencies participating in the Bay Program have concentrated their efforts on cleaning up and restoring the Bay by correcting problems identified during the Chesapeake Bay Study using proven methods. The "Chesapeake Bay Restoration and Protection Plan," released in September 1985, outlined the agreed upon goals and the programs being implemented in the hope of reaching those goals. The data gathered and analyzed under the coordinated monitoring program eventually will show the outcome of these efforts.

However, the Council decided in 1986 that eventually will not be soon enough. We need to know how much more must be done, where, at what cost, with what results, and for how much longer. The Council concluded that to continue their long-term support, elected officials and leaders within government, industry, and public groups will need to know these answers relatively soon. To help formulate answers, a program development process was designed during 1985 and adopted in 1986. This Phase II process has four basic steps:

1. Establish water quality, living resources and habitat objectives;
2. Determine reductions in pollution loadings needed to meet the objectives;
3. Evaluate the technical alternatives and pollution control measures which could be used, according to their costs and effectiveness;
4. Suggest what should be done, where, over what period of time, at what cost, and with what expected results.

Some of the activities necessary to the process began in 1986. For example, Maryland is reevaluating its designated uses for streams in light of living resources and habitat concerns. Virginia has begun a major undertaking with its river basin citizen advisory groups to define water usages and objectives needed to support those uses. A point source atlas is being developed to identify critical pollution sources and to help prioritize necessary remedial actions.

PLANNING FOR THE FUTURE

Modeling is an essential element of planning for the Chesapeake Bay. It is an important tool for managers who need to understand the impacts of loadings on living resources and water quality. Modeling provides a simplified representation of those cause and effect relationships. One key relationship is that between nutrient loadings and low dissolved oxygen.

Although the Modeling and Research Subcommittee (MARS) was moving forward with refinement of the watershed model used during the original Study in addition to developing a steady-state water quality (2-D eutrophication) model for the Bay, the group recognized that a more sophisticated model would be required to assist in planning future programs. MARS proposed a Bay model which has three spatial dimensions – a 3-D model (time variable).

During 1986, the workplan for the 3-D model was prepared using the expertise of the Corps of Engineers' Waterways Experiment Station in Vicksburg, Mississippi. In December 1986, the Bay Program and the Army Corps of Engineers agreed to jointly fund the model over the next three years. EPA and the states will fund the water quality aspects of the project while the Corps will fund the hydrodynamic work. The Corps will coordinate the 3-D model activities under the guidance of the MARS.

The program development process will culminate in control strategies for nutrients management and toxic substances control. The control strategies will be designed to meet living resources habitat requirements. When these requirements are met, certain key species (commercially and recreationally harvestable), and the habitat vital to both their critical life stages and the sustenance of their prey species, will have conditions which should encourage their recovery and sustain healthy future populations. The Living Resources Task Force (LRTF) has developed a list of key species. The LRTF recently sponsored a workshop designed to identify both water quality and habitat conditions that the key species need during their critical life stages as well as the geographic areas where those conditions need to be met.

Water quality data are being collected and analyzed under the guidance of the Monitoring Subcommittee to build the data base which will be used to model the effects of selected pollution control scenarios on the water quality of the Bay and its tributaries. Results from select runs of the model scenarios should be completed by spring 1987. The states and EPA will be able to use the results from modeling as one tool to assist them in improving the effectiveness of their present control and regulatory efforts and in planning future programs.

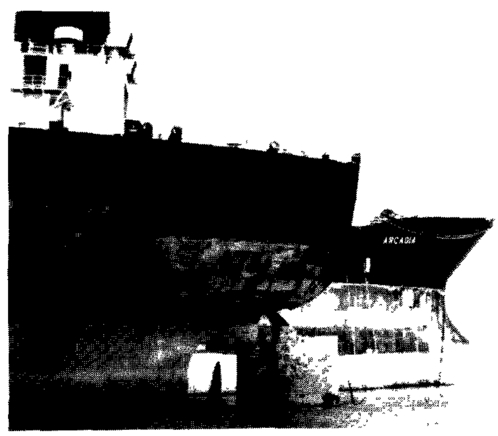
With water quality criteria supplemented by knowledge of living resources, habitat protection, current pollution loadings, and control techniques, use of the model will enable target loadings to be developed for tributaries and the Bay for phosphorus and nitrogen. To that end, the states, D.C., and EPA are also working with STAC to review nutrient control strategies to further define point and nonpoint contributions, and clarify the roles of phosphorus and nitrogen in the decline of water quality and living resources.

TOXIC CONTAMINANTS

The states, D.C., and EPA are moving toward developing a Baywide toxics management strategy, linking programs like biomonitoring under the National Pollutant Discharge Elimination System (NPDES) permits, assessing environmental risks from existing and abandoned hazardous waste sites, area specific studies, pretreatment, monitoring for TBT, and intensive monitoring in small watersheds for pesticides (and nutrients) in runoff and groundwater. Several projects are already underway. NOAA, in its National Status and Trends Program, is examining the long-term health impacts and levels of contamination at two benthic surveillance and six mussel watch stations in Chesapeake Bay. Under the Bay Program coordinated monitoring efforts, sediment is being collected at selected stations in the main Bay and principal tributaries and analyzed for heavy metals and organic chemicals.

Two area specific studies are underway. The Baltimore Harbor integrated environmental management study is examining how EPA's regulatory programs for air, land and water impact environmental decisions in Baltimore. In Virginia, the Virginia Water Control Board (VWCB) is developing a comprehensive management plan for the Elizabeth River. In addition, EPA in cooperation with the VWCB, is assessing the relative toxicity of effluents and water, the toxicity and environmental impacts of shipyards, and working toward the transfer of technology for marine chronic toxicity testing from EPA to the Commonwealth.

Monitoring and research on toxic contaminants are necessary to assess sources of pollutants and their impacts in order to improve present enforcement and revise NPDES permits in the future.



Commercial vessels in Baltimore Harbor.

INTERIM REPORT

By mid-summer 1987, the information gathered and analyzed through the Phase II program development process will be summarized in an interim report. The report will contain the proposed living resources and habitat requirements. Other information to be developed for the report includes material on pollution control technologies and their costs, studies of population growth and land use change projections, preliminary review of the effectiveness of present point and nonpoint control programs, and initial economic studies of the value of the Bay. Fact gathering for the various portions of the report has begun.

The EPA Chesapeake Bay Program, the states, and D.C. plan to hold public meetings on the report following its release.

Monitoring— The State of the Bay

INTRODUCTION

This section summarizes the Second Annual Report of the Monitoring Subcommittee, "The State of the Bay," to be published early in 1987. The report covers the period from June 1984 through September 1985 which includes two summers and the intervening winter. These data are the baseline from which the success of the efforts to restore and protect Chesapeake Bay will be measured.

The years 1984 and 1985 were very different; 1984 was quite wet and 1985 quite dry. These conditions cause components of the Chesapeake to react very differently. Such differences from year to year make it difficult to distinguish natural annual variability from long-term trends in environmental quality. A monitoring strategy is being developed so that the small changes which should result from control of pollution and harvest pressures may be detected.

Both summers had periods of anoxia, but severity and duration were substantially greater in 1984, probably resulting from different frequencies and magnitudes of rainfall events as opposed to remedial actions. During anoxic periods, large pools of ammonia nitrogen and phosphorus develop in deeper waters.

A young eagle.

Courtesy of US Fish & Wildlife Service

These pools are mixed periodically by tide and wind events, apparently feeding phytoplankton (plant plankton) in surface waters several times a summer. Extensive surveys have found oxygen-poor waters extending further into Virginia's portion of the Bay than earlier believed.

Nutrient inputs to the Bay and nutrient recycling from deeper water result in phytoplankton and zooplankton (animal plankton) growth. Phytoplankton and bacteria form the base of a complicated food chain, beginning with small protozoans, progressing through larger forms such as copepods and the planktonic larval stages of barnacles and shellfish, to other plankton and fish.

In 1986, the Monitoring Subcommittee noted a few hopeful signs. At sites such as Barren Island on the east side of the Bay, submerged aquatic vegetation beds are coming back strongly, some where none had been before. This could lead to increased numbers of waterfowl in the future. While many species of birds are still in trouble, ospreys and eagles are rebounding. The striped bass controls appear to be succeeding. If the relatively strong 1982 "rockfish" year-class spawns successfully as "adults" in 1988 and water quality is adequate, overall striped bass populations may increase. State fishery teams are working together to assess the Bay's principal commercial fish stocks. They are learning how baymouth circulation may control the success of blue crab populations, one of the prime Chesapeake commercial fisheries.

Shellfish are still under severe stress, and high salinities, while conducive to better spat strike as in 1982, allow spread of diseases like MSX and dermocystidium, and predators such as the oyster drill.

In general, benthic populations have greater biomass in the lower portions of the tributaries and the lower Bay than in the deep waters of the upper Bay. Deep areas of the mainstem which become anoxic lose their benthic populations quickly. Populations along the edges of the main channel of the Bay are also stressed when wind events set the low oxygen water "rocking," allowing it to move up into these shallower areas.

In the tributaries and upper Bay most organisms are concentrated in the upper few inches of sediment. They feed primarily by sweeping up decaying plankton and runoff-borne particulates from the sediment surface. In the clearer, oxygen-rich waters of the lower Bay, large numbers of benthic organisms feed on bacteria colonizing the sediments. In turn, spot, croaker, sea trout and others feed on the benthic species. A healthy benthic community, fostered by adequate water quality conditions, is critically linked to the harvested species.

THE HARVEST: FINFISH

Harvestable anadromous fish, estuarine or marine fish that spawn in freshwater, continued to decline in numbers in 1985. Spawning remained poor, and abundance of juveniles low. However, there are hopeful signs for Bay finfish. The most important anadromous fish, the striped bass or "rockfish," appears to be benefiting from recent protective regulations, and there is optimism about the hatchery release program.

The full ban on striped bass fishing in Maryland and the partial ban in Virginia are relieving the fishing pressure on the 1982 year class, the last successful spawn from the upper Bay. Striped bass spawning in other portions of the Bay has been improving in recent years. A marked increase in striped bass has been observed in Virginia since 1981, and large numbers of stripers were caught in unregulated D.C. waters in 1985.

Harvesting of striped bass was banned because of concern about the drastic declines in commercial fishery landings for both the Chesapeake and Atlantic (Figure 2). The landings reveal poor recruitment into the fishery since the 1970 year-class. The 1982 year-class of rockfish is the object of protection because it is the first year-class considered of adequate abundance since 1970. While Virginia is optimistic about the number of rockfish in its waters, recent stock assessment work has confirmed that the 1982 year-class is the only reasonably abundant one in Maryland. Data reveal very few fish older than the 1981 year-class in the Potomac, and a very low ratio of females—the egg layers on which good year-classes depend—to males. The Potomac pattern appears to be the general case for Maryland's portion of the Bay.

Maryland striped bass spawning stocks have been low; lowest in 1982 and 1983, and slightly higher in 1984 and 1985, primarily due to the protected 1982 year-class males. Striper egg and larval abundance also remained low. Intensive Maryland habitat studies, which seek to relate water quality and other habitat factors to larval abundance, are currently underway. A combination of low pH and low hardness, which

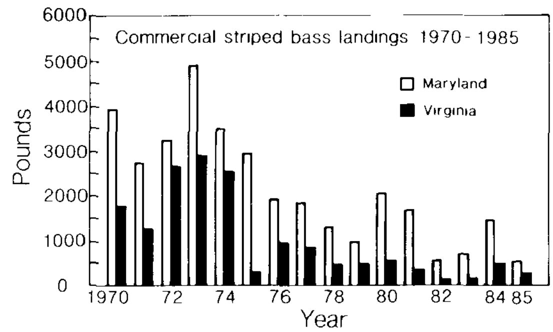


Figure 2: Commercial Striped Bass Landings. Data from NOAA National Marine Fisheries Service. 1978–1985 data are preliminary. Catches are recorded in Maryland in 1985 in spite of the moratorium due to NOAA's method of dividing total Potomac River catches between the states.

tends to mobilize naturally high levels of aluminum found in some Eastern Shore rivers such as the Choptank, may be causing significant larval mortality.

There is a high natural mortality rate in the early life history stages of striped bass. The mortality rate declines considerably, however, when individuals reach the juvenile or "fingerling" (2-5 month old) stage. Juvenile or young-of-year abundance firmly establishes the strength of the newly recruited year-class, and allows projections of its contribution to the economic fishery in subsequent years. Both Virginia and Maryland survey juvenile striped bass annually. Young fish are trapped either by seine net (MD) or by seining and trawling (VA), the young stripers are counted, and the totals averaged. Due to differences in sampling techniques, the juvenile indices in Maryland and Virginia are not directly comparable.

In Maryland, year-classes with a juvenile index of 8 or greater have been considered good because historically they have apparently supported a commercial fishery of 2 million pounds of stripers annually. Since the 1970 year-class with an index of 30, however, Maryland juvenile indices have been alarmingly low. The '"adequate" 1982 index of 8.4 was followed by low indices in 1983 (1.4), 1984 (4.2) and 1985 (2.9). The 1985 juvenile year-class (2.3) was only average.

Hatchery rearing may be a bridge to an improved fishery. Striped bass are now being reared in U.S. Fish & Wildlife Service and Maryland hatcheries until the fall, when they are less vulnerable and big enough to be released into the Bay. Experimental tagging and tag recovery programs were initiated in Maryland in late 1985. Their results have not yet been assessed.

Stocks of other anadromous fish such as shad, river herring, and yellow perch remain at all-time lows. Harvests of marine-spawning fish, dependent on oceanic rather than Bay conditions, are relatively good. During 1984–85, harvests of ocean spawners remained stable or increased.

THE HARVEST: SHELLFISH

With oyster reproduction, survival, and harvests declining seriously over the last decade (Figure 3), the higher spatfall in both Maryland and Virginia in 1985 was good news. Over the 1984-85 monitoring period, however, spat (newly set oysters) survival rates remained unexplainably low. No changes were noted in the dismal picture for softshell clams, but the blue crab fishery remains healthy, though unpredictable.

The significant effects of rainfall and temperature on the productivity and the health of the Bay's resources is evident when one examines the condition of the Bay's shellfish and crabs, particularly in 1984 and 1985. While there has been no long-term trend in rainfall/salinity, there has been a distinct trend toward warmer falls and winters over the last ten years. The spring of 1985, with below normal rainfall, was followed by the third warmest autumn in 30 years. The drier and warmer fall of 1985, along with higher salinities, resulted in a considerably longer spawning season than that of 1984. The oyster spawning season extended beyond the normal June-September period into late October.

As a result, both Maryland and Virginia had high spatfall. Virginia's spatfall was moderate to heavy during the 1984 and 1985 spawning seasons. The heavier spat sets generally occurred in 1985, particularly on the James River seed beds. There was considerable temporal and spatial variability in the spatfall. The occurrence of heavy spatfalls despite low brood stock underscored the importance of local weather and climate in the determination of year-class strength.

Although its 1984 spatfall continued a downward trend, Maryland found high numbers of spat on its 55 key oyster bars in 1985. The greater spatfall was welcome, but was limited mainly to the mouth of the Potomac River and Maryland's Eastern Shore tributaries. This area is greatly reduced compared with that area where high spat sets were recorded between 1938 and 1965.

The survival of spat to yearling continues to be of prime concern. In this regard, 1984 and 1985 were not exceptions. In Virginia, the statewide poor survival of spat to yearling was evident in the oyster bar surveys that followed the heavy 1985 spawning season. Predation by the blue crab may play an important role in the low survival rate and unidentified water quality factors may also be of significance.

MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus*) can pose serious disease threats to the oyster industry. Maryland's lower Bay waters experienced some Dermo mortalities and conditions conducive to MSX infestation in 1985. Mortalities resulting from the latter may be seen in 1986. Conditions in 1984 and 1985 were not conducive to the spread of pathogens in Virginia.

The stocks of Maryland's softshell clams continue to be low; 1984 and 1985 harvests were each only about 1 million pounds. Hard clam harvests are being sustained in Virginia. The crab fishery remains the one source of "good news" for the Bay's fisheries. Historically, crab harvests have fluctuated wildly yet the fishery remains unthreatened. Baywide crab harvests were 59 million and 46 million pounds in 1984 and 1985, respectively.

SAV HABITAT AND NURSERY

Submerged aquatic vegetation (SAV) has been the focus of intense Baywide study since 1978 because of its overall importance and widespread decline since the 1960s. Communities of SAV provide habitat for

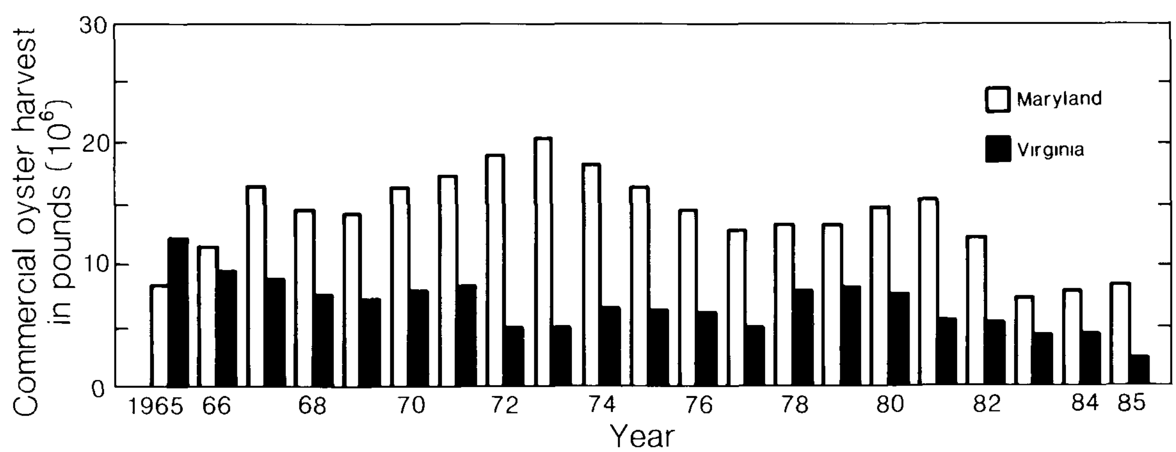


Figure 3: Commercial Oyster Harvests. Data from NOAA National Marine Fisheries Service. 1978-1985 data are preliminary.

many species which use the plants as a food source or as protection from predators. SAV reduces currents and baffles waves, allowing materials to settle which improves water clarity. The plants bind sediments to their roots, preventing erosion of underlying material. They also absorb nitrogen and phosphorus which helps to control nutrient input to the Bay and may possibly absorb toxicants as well.

A key to the study of SAV has been the documentation of patterns of plant distribution and abundance through aerial photography and field surveys. In 1984, EPA's Chesapeake Bay Program began to coordinate a multi-agency effort to record and map SAV.

In 1985 and 1986, the program was jointly funded by the Maryland Department of Natural Resources (MDNR), EPA, U.S. Fish & Wildlife Service (F&WS), the Virginia Council on the Environment (through the Virginia Institute of Marine Sciences) and the U.S. Army Corps of Engineers. Scientific ground surveys were combined with information from aerial photographic surveys through EPA's Environmental Photographic Interpretation Center (EPIC). More groundtruth information came from fifteen charterboat captains (through MDNR's Watermen's Assistance Program) and 150 citizen volunteers organized by the F&WS, Chesapeake Bay Foundation and the Citizens Program for Chesapeake Bay, Inc.

All the information was used to produce maps for 164 topographic quadrangles throughout the Bay. Those maps indicate not only the distribution of SAV, but also the species of grasses, and the sources of the reported information.

Survey results show that between 1984 and 1985 the area covered by SAV increased 26 percent. The increase was not consistent Baywide, and total reported coverage is much less than it was in 1965. The increase may be due to dry conditions rather than pollution control efforts; still, the signs are hopeful.

The largest increase was found mid-Bay, along the Eastern Shore. There was a slight decrease in the upper Bay, and little change was observed in the distribution and abundance of SAV in the lower Bay. There has been a slight improvement in the rate of decline of migratory waterfowl numbers, especially in areas where SAV has resurged.

There was a slight decrease (4.5 percent) in the abundance of SAV in the upper Bay zone, with declines revealed in three of the four sections studied. There was a 142 percent increase in the sparsely vegetated Eastern Shore section, principally along the Elk and Sassafras rivers. All western shore rivers had SAV beds. Two-thirds of this zone's SAV was in the Susquehanna Flats area; thirteen species were reported, although the zone is dominated by wildcelery, Eurasian watermilfoil, and hydrilla. Redhead grass and widgeongrass dominate in the Eastern Shore area.

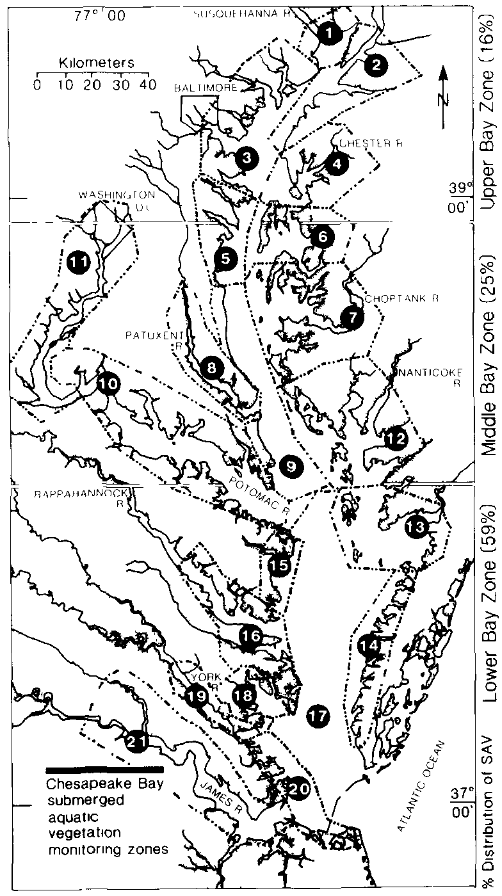


Figure 4 1984–1985 SAV Aerial Survey Map SAV Surveys report data according to this segmentation plan

The 1985 SAV "good news" was the increase in grasses in all sections of the middle Bay zone over the previous year, resulting in a 389 percent increase for the entire zone. Even the Patuxent River, while still sparsely vegetated, showed a 401 percent increase (22 acres in 1984 to 109 acres in 1985). In the Potomac River, increases were seen in both the upper (140 percent) and the lower (59 percent) sections. Ten species of Bay grasses were found in the upper Potomac section, with Eurasian watermilfoil and hydrilla the most prevalent. Widgeongrass was found to be the dominant aquatic plant in the mainstem of the middle Bay zone. The greatest changes were in the Choptank River and in the middle section of the Eastern Shore. The Severn, South, Rhode, and West rivers had no SAV beds reported, but SAV was reported on the western shore, particularly in Herring Bay, where none had been observed in 1984.

There were no major changes in SAV in the nine sections of the lower Bay zone between 1984 and 1985. The largest change occurred in the Reedville section, where the 1985 survey revealed a decrease of 34 percent in SAV distribution from 1984. Most of the Bay's grasses (59 percent) are in the lower Bay zone, with 68 percent of this zone's vegetation located along the Eastern Shore bayside. Bay grasses are still absent in two of the six areas of historical abundance in the lower Bay. Widgeongrass and eelgrass are the dominant SAV in the lower Bay.

Healthy SAV was experimentally transplanted on the Susquehanna Flats, and in the Choptank, Piankatank and York rivers. Another encouraging sign is that these SAV beds have, in many areas, survived and propagated.

THE WATER QUALITY BASE

FLOW, SALINITY AND DISSOLVED OXYGEN

The U.S. Geological Survey has monitored the flows of major tributaries into the Bay for many years. Over the last eighteen years, the average monthly flow of the Susquehanna River at the Conowingo Dam has been 41,950 cubic feet per second (cfs). Average flows in 1984 were 19 percent above normal; in 1985 they were 27 percent below normal. There were also major seasonal differences between these two years: the 1984 summer flows were much higher than those of 1985.

River flow patterns in each tributary are unique because rainfall, topography, land use, and other factors differ among basins. In the Patuxent River, flows in 1984 were close to the long-term average (421 cfs), but 1985 flows were 50 percent below average. In the James and Rappahannock rivers, flows were 34 and 54 percent higher than normal in 1984 because of above average winter and summer discharge. Drier conditions followed with flows 20 and 35 percent below normal. In November 1985, tropical storm Juan produced heavy rainfall in western and southern Bay watersheds. The James and Potomac rivers experienced major flooding, while the storm had minimal effect on the Susquehanna.

Salinities were higher and the vertical salinity gradient (the difference between surface and bottom salinity) was less pronounced in the lower-flow summer of 1985. Surface salinities were approximately 6 parts per thousand (ppt) higher and bottom salinities about 3 ppt higher during the summer of 1985. In the Patuxent estuary, salinities were 4 to 7 ppt higher and stratification (defined layers of water) was reduced in 1985 compared to 1984. Stratification differences between the two summers are reflected in bottom water oxygen concentrations.

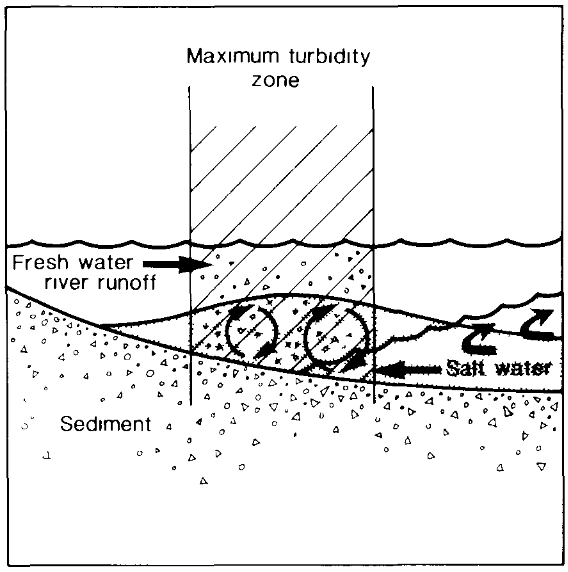


Figure 5: Stratification. Freshwater streamflow and saltwater intrusion form two wedges of water moving in opposing directions.

Dissolved oxygen (DO) levels are high for much of the year, when water temperatures are low and the water column is well mixed. In the late spring and summer, however, high oxygen demand in the sediments and the settling of organic material into the lower water column, coupled with limited downward mixing of oxygen, cause oxygen depletion in deeper waters.

Stratification has a significant influence on the DO characteristics of an estuary (Figure 5). The mixing of surface and bottom waters is inhibited as the boundary layer between the lighter, fresh water and the denser, salt water acts as a barrier to oxygen replenishment from the atmosphere to the deeper Bay waters. As the warm season progresses, biological activity depletes the amount of dissolved oxygen in the isolated, deeper water. As the amount of freshwater inflow increases, stratification tends to become more pronounced. Averaged longitudinal DO profiles for the summers of 1984 and 1985 demonstrate that high freshwater input in 1984 resulted in more extensive regions of low DO waters.

In the mainstem, there were several differences between the two years, especially in the spatial extent of low DO waters (DO less than 1 milligram per liter). In 1984, these hypoxic waters extended well into Virginia's portion of the Bay, reaching as far south as the mouth of the Rappahannock River. This did not happen in 1985, when wind and tides caused more frequent reoxygenation events and reduced the duration of hypoxic conditions that summer.

The summer 1984–85 monitoring results show that mainstem deep water dissolved oxygen concentrations are more dynamic than expected. Even during the summer of 1984 when the density stratification was unusually strong, two major reoxygenation events were also documented in the deep trough region of the Bay. At least two such events were documented in the summer of 1985. This means caution must be used when comparing current data with data from past years.

In the Rappahannock River, the clearly defined stratification in the summer of 1984 appeared to have effects on bottom water DO concentrations similar to those observed in the mainstem: summer DO depletion was severe and prolonged. In the Patuxent River, the effects of DO levels from the difference in stratification between the summers of 1984 and 1985 were not as clearcut as the effects on the mainstem. The observed differences between oxygen behavior in the Patuxent and in the Bay indicate that factors other than salinity stratification influence DO conditions. Topography, localized storm events, periodic exchanges with mainstem waters, and the biological impacts of nutrient loadings—conditions unique to each basin— can also affect DO concentrations.

CHLOROPHYLL

Chlorophyll is found at the highest levels in the tidal-fresh portion of the tributaries from spring to early fall. Plankton growth follows tributary enrichment by nutrient-laden spring flows. The mainstem's highest concentrations occur in the late winter and early spring. The die-off and settling of this organic matter contribute to the spring oxygen demand in both the water column and sediments. This demand leads to the development of deep trough hypoxia/anoxia in the mainstem during the summer.

Chlorophyll patterns in the tributaries were similar in 1984-85. The highest chlorophyll levels in the tributaries were observed in the warmer seasons in tidal and freshwater; in the cooler months the higher chlorophyll levels were found near river mouths. Generally, the nutrient rich upper reaches of the Patuxent and Potomac had higher chlorophyll levels than those of the James or Rappahannock. The Patuxent had the highest concentrations of all the major tributaries.

The lower Potomac estuary experienced average chlorophyll values of 40 µg/l during spring 1985, with a peak in May over 90 µg/l. Summer 1985 chlorophyll levels peaked at 100 µg/l in the tidal-fresh reaches of both the Potomac and Patuxent rivers.

The peak chlorophyll concentrations in the tidal-fresh regions of the James and Rappahannock were 20-50 µg/l and 20-40 µg/l respectively, with levels decreasing downstream to below 10 µg/l near the river mouths. In general, the upper Bay mainstem had higher chlorophyll levels than those found in the central and lower Bay mainstem; the lowest levels were found at the mouth of the Bay. The higher upper mainstem levels are largely the result of the greater supply of nutrients from the Susquehanna River and other upper Bay sources.

Chlorophyll levels showed strong seasonal patterns with pronounced differences between mainstem surface and bottom waters. During the late winter of 1984-85 and the spring of 1985, a large region of high chlorophyll values (30-40 µg/l) was observed in bottom waters. During summer hypoxia, bottom chlorophyll was very low (under 5 µg/l). Sporadic peaks of surface phytoplankton growth (30-50 µg/l) could be seen during summer, chiefly in the central and upper Bay. In the lower Bay, near the York River, surface chlorophyll was generally low (5-15 µg/l).

NUTRIENTS

Nutrients are a major focus of the Bay restoration effort. While light, temperature, plankton grazing and mixing in the water column play roles in plant productivity, the levels of nitrogen (N) and phosphorus (P) are the key elements in undesirable Bay over-enrichment. Annual loads of total nitrogen and total phosphorus relative to mean annual flow for the past 8 years are shown in Figure 6.

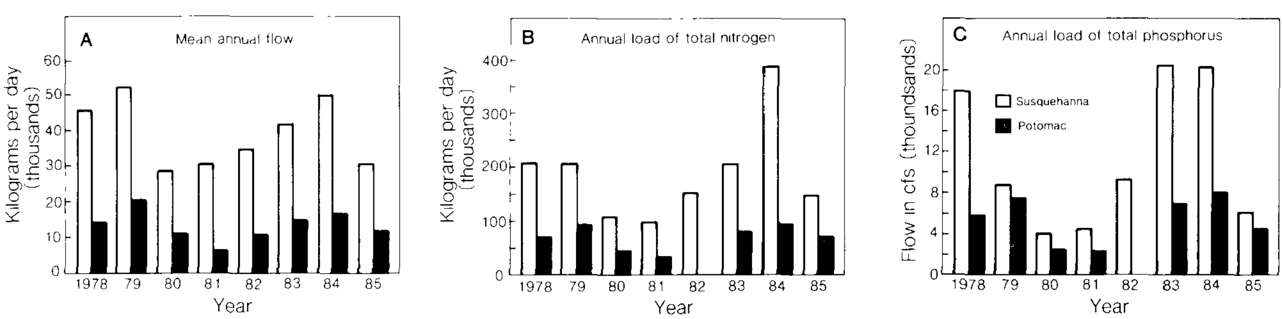


Figure 6 A, B, and C Annual Nutrient Loads. Mean annual flow and total annual loads for nitrogen and phosphorus in the Susquehanna and Potomac rivers, showing the relationship between streamflow and nutrient loadings due to rainwater runoff.

Between July 1984 and September 1985, levels of total nitrogen (TN) in mainstem surface waters ranged between 1 and 2 mg/l at the head of the Bay and from 0.4 to 0.7 mg/l in the lower Bay. The higher upper Bay levels reflect the strong influence of Susquehanna River input. In summer months, bottom water concentrations of inorganic N (and P) are high, but surface water concentrations are generally low due to nutrient uptake by algae.

Values of TN were higher (at or above 2 mg/l) in the tidal-fresh regions of the Patuxent and Potomac rivers than in the upper Bay mainstem (Figure 7A). In the tidal-fresh portions of the James and Rappahannock, however, TN levels were comparable to those found at the head of the Bay. In all the tributaries, TN declined somewhat in the salinity transition zones, and declined further in the lower estuaries to levels around 0.5 mg/l.

The nitrogen enrichment found in the tidal-fresh regions of the tributaries results from both point and nonpoint source contributions. Peaks in N during winter and spring high flow periods can be attributed to high nonpoint source loads.

The pattern of total phosphorus (TP) concentrations is similar to that for nitrogen, but is not quite as clearly defined (Figure 7B). In the mainstem surface waters, TP peaked in the turbidity maximum region at about 0.05 to 0.08 mg/l and declined down-Bay to levels generally less than 0.04 mg/l.

During summer hypoxia in the deep trough region, P fluxes from the sediments into the overlying

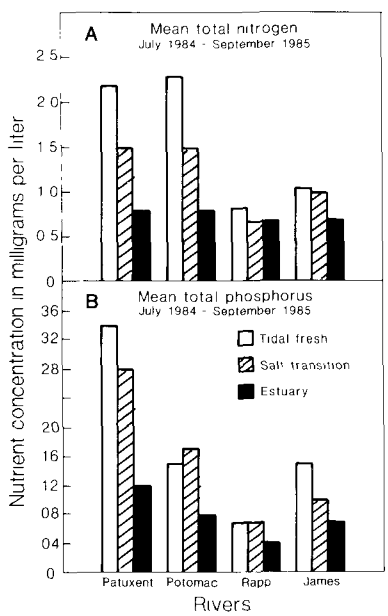


Figure 7 A and B: Tributary Nutrient Concentrations. Mean concentrations of nitrogen and phosphorus for the 1984-1985 monitoring period in selected tributaries showing general location of major nutrient concentrations.

water. As with the bottom water accumulation of inorganic N, these higher P levels may nourish summer algal populations when and where vertical mixing occurs.

Tributary TP levels in 1984-85 reveal differences between rivers. The Patuxent River had the highest TP levels of the four major tributaries, with concentrations in the tidal-fresh, transition, and lower estuarine zones approximately 0.30-0.35, 0.25, and 0.1 mg/l, respectively. The Potomac and James rivers had similar TP levels of approximately 0.15, 0.1-0.2, and 0.05-0.10 mg/l in tidal-fresh, transition, and estuarine reaches, respectively. The lowest TP values were found in the Rappahannock River, and were approximately 0.05-0.10, 0.05-0.10, and 0.03-0.05 mg/l, respectively. TP showed surprisingly little seasonal variation.

Together, the Susquehanna, Potomac and James rivers represent 84 percent of the freshwater flow to the Bay. The exact proportion of the total input load represented by these rivers must be determined by extrapolating monitoring data to cover unmonitored portions of the Bay watershed. Methods of extrapolation range from simple flow-based techniques to sophisticated computer models.

Based on the monitoring data, it is apparent that a simple flow-based model is not very accurate. Considering only the flow and nutrient loads for 1984 and 1985 it is clear that, of the three rivers, the Susquehanna was the major contributor of flow and nutrients to the Bay. However, of the Susquehanna, Potomac, and James rivers, the Susquehanna's nutrient loadings (66 percent TN and 42 percent TP) were not proportional to its flow (63 percent). If a simple flow-based model were used, a 21 percent overestimate would result. Factors unique to each watershed also influence the magnitude of the loads delivered to the estuary and must be considered in estimating nutrient loadings.

Still, the strong influence of river flow on nutrient loads is evident in both long-term records of annual loads and seasonal loads calculated from the 1984-85 monitoring data. In years and seasons when river flows are high, nutrient loads are also high.

SEDIMENT AND TOXIC CONTAMINANTS

SEDIMENT

Monitoring in 1984-85 confirmed a strong north to south turbidity gradient in the mainstem. Generally, turbidity is high in the upper Bay because of the Susquehanna's large flows and the turbidity maximum zone; it decreases gradually toward the mouth of the Potomac.

The maximum turbidity zone in the Bay mainstem occurs up-Bay of Baltimore near Aberdeen, Maryland. Monitoring of this area revealed typically low secchi depths (0.2 to 0.5 meters) and high total suspended solids (TSS) values (15 to 25 mg/l). Just above the Potomac's mouth, the secchi depths range from 1 to 3 meters and the TSS values from 5 to 10 mg/l.

In the central Bay, from the Potomac's mouth to the mouth of the Rappahannock, there is sometimes an increase in turbidity. Here the secchi depths in 1984–85 were between 0.9 and 2.9 meters, and the TSS values ranged from 10 to 40 mg/l. From the Rappahannock to the Bay's mouth, the waters increase in clarity. At the mouth, secchi depth readings ranged from 1 to 3 meters, and TSS values from 5 to 15 mg/l.

Lower Bay western shore waters are generally more turbid than those along the Eastern Shore. The earth's rotation causes relatively clear oceanic water to be deflected eastward as tidal currents move up-Bay, and substantial quantities of more turbid water are added by the discharges from western Bay tributaries. Between their turbidity maximum zones and their confluence with the Bay, the tributaries have turbidity and TSS patterns comparable to those of the Bay. Unlike the main Bay, tributaries like the Patuxent, Potomac and James have large stretches of tidal-fresh water where extensive high turbidity areas can result, not only from resuspended sediment, but also from algal blooms.

The Susquehanna's sediment loadings (an average of 1.8 million tons annually) correspond strongly with river flow and are delivered directly into the mainstem. In wetter periods, typically winter and spring, sediment loads are much higher than in the summer and fall, when flows are generally lower. The Susquehanna is unusual because several reservoirs can trap sediment and moderate loadings. The result is that the sediment contribution is often proportionately lower than its flows.

The Patuxent contributes only 0.5 percent of the Bay's freshwater flows, but its sediment loadings are proportionately higher. In the Patuxent's maximum turbidity zone (near Lower Marlboro), spring TSS peaks exceeded 80 mg/l. This high turbidity results not only from loadings, but also from the natural bottom-to-surface mixing in the water column. Secchi depths of 0.2 meters and less were observed in the 1984–85 monitoring period.

The Potomac is the second largest source of freshwater to the Bay, but it proportionately contributes the most sediment to the Bay system. An estimated 1.5 million tons are discharged at the fall line in an average year. Most of this sediment remains in the upper and mid-estuary.

The Potomac's sediment loadings in 1984 and 1985 were 22 and 126 percent higher than average. The higher figure reflects the effects of tropical storm Juan; approximately 1,134,000 tons of sediment was discharged from the upper Potomac basin in November 1985.

In 1985, the average secchi disc readings for the Potomac in Washington, D.C., where algal blooms also contribute to turbidity, ranged from just over 1.1 meters down to 0.6 meters. Most of the sediment laden Anacostia River within the District of Columbia had secchi depth readings under 0.3 meters. The share of the total sediment loadings into the Bay from Virginia's James River is 16 percent. The upper reaches of both the James and Rappahannock have comparable secchi depths (0.6 m), and both show a steady decrease in turbidity from their tidal-fresh portion to their mouths. Their lower estuarine zones are markedly different. The James carries a heavier load of TSS than the Rappahannock (13.3 and 5.5 mg/l, respectively, at the fall line), and tends to remain turbid longer. The average secchi reading in the lower James ranges from 0.9 to 1.4 meters, and from 1.4 to 1.8 meters in the lower Rappahannock.

TOXIC CONTAMINANTS

Of the 44 pollutants for which samples were analyzed, a total of 26 organic pollutants were detected in sediments, clams, and worms in samples collected during 1985 in Maryland waters for the coordinated monitoring efforts of the Bay Program. Polynuclear aromatic hydrocarbons (PAHs) were the most prominent organic contaminants detected, ranging from 10,000 parts per billion (ppb) in Baltimore Harbor to less than 1 ppb at the mouth of the Potomac. The majority of these PAHs were produced by combustion of carbonaceous fuels. Pesticides were detected in sediments and biota at four of the eight stations sampled. Polychlorinated biphenyls (PCBs) were found only in Baltimore Harbor sediments.

Analysis of the average concentration of the four most abundant trace metals (zinc, chromium, copper, and lead) in sediments and clams in 1985 revealed that, though high concentrations were found in sediments associated with Baltimore's industry, relationships between sediment/metal and sediment/biota concentrations were not consistent. In clams, some metals varied considerably over the course of the year. Zinc and copper tended to be higher in clams than in sediments, while lead and chromium were higher in sediments than in tissues.

Both clams and worms living in relatively sandy sediments had lower body burdens of organic chemicals than those of animals living in sediments low in

CHESAPEAKE

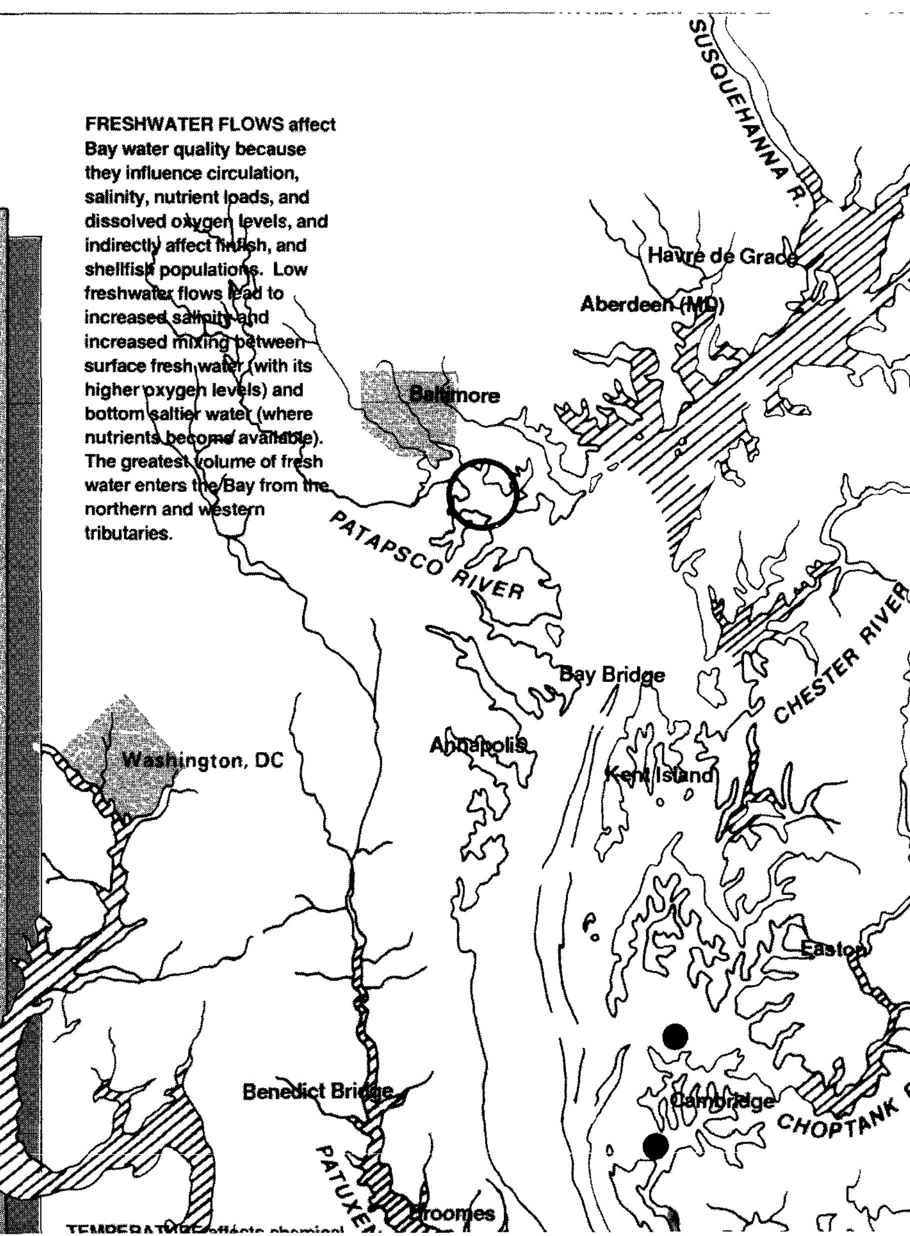
In 1976, Congress directed the Environmental Protection Agency (EPA) to conduct a study of the Chesapeake Bay. Completed in 1983, the study found:

- Bay submerged aquatic vegetation had declined.
- Oyster spat set had declined.
- Landings of freshwater- spawning fish had decreased.
- Levels of nutrients were increasing in many areas.
- The amount of summer Bay water showing low (or no) dissolved oxygen had increased significantly.
- High levels of heavy metals and toxic organic compounds had accumulated in Bay water and sediments.

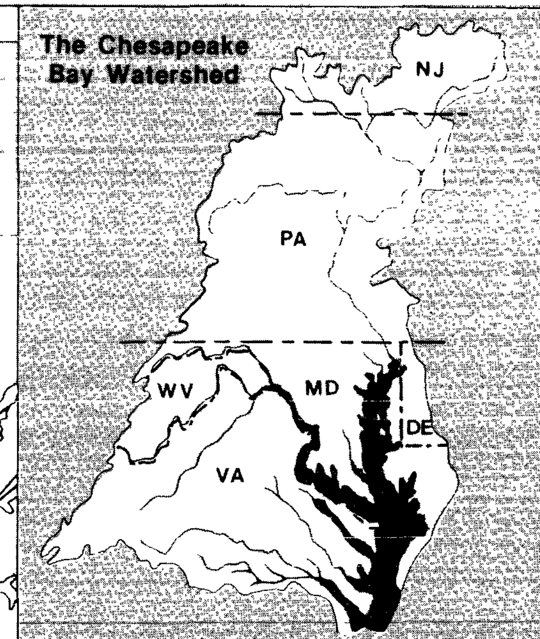
Bay monitoring collects comprehensive data for a current description of the Bay. Collected over time, monitoring data may reveal trends. The Chesapeake Bay Monitoring Program, begun in 1984 by the Chesapeake Bay Executive Council, is a Bay-wide EPA/state cooperative effort. Comprising over 165 stations, the program combines efforts of Maryland, Pennsylvania, Virginia, the District of Columbia, several federal agencies, 10 institutions, and over 30 scientists. Nineteen physical, chemical, and biological characteristics are monitored 20 times a year in the mainstem Bay and many tributaries. A volunteer citizen monitoring program was started in the summer of 1985.

The following are monitored because they are key indicators of the Bay's health:

NUTRIENTS are a major focus of the Bay restoration program. Levels of nitrogen and phosphorus are the key to excessive phytoplankton growth and decomposition, which depletes dissolved oxygen. Stored and released by bottom



FRESHWATER FLOWS affect Bay water quality because they influence circulation, salinity, nutrient loads, and dissolved oxygen levels, and indirectly affect finfish, and shellfish populations. Low freshwater flows lead to increased salinity and increased mixing between surface fresh water (with its higher oxygen levels) and bottom saltier water (where nutrients become available). The greatest volume of fresh water enters the Bay from the northern and western tributaries.



THE CHESAPEAKE BAY WATERSHED drains a 64,000 square-mile area in New York, Pennsylvania, Maryland, Virginia, West Virginia, Delaware, and Washington, D.C. The Bay receives some 90% of its fresh water from 5 major northern and western shore tributaries: the Susquehanna, Potomac, James, Rappahannock, and York rivers; and is fed the balance by about 150 lesser rivers and creeks. The waters drained by the basin have a broad range of geochemical characteristics. Land use in the watershed has been estimated: forests (54%), agricultural land (36%), urban land (7%), and wetlands (3%).

SALINITY is a key factor in the distribution of the Bay's living resources, which have different salinity tolerances and requirements. The Bay's salinity levels vary, are graduated vertically and horizontally due to freshwater flows, and are higher along the Bay's eastern shore. Salinity generally reaches a yearly low in the spring.

CIRCULATION of Bay waters transports plankton, fish eggs, shellfish larvae, sediment, dissolved oxygen, minerals, nutrients, and toxicants.

TEMPERATURE affects chemical

SEDIMENT suspended in the water column blocks light needed for photosynthesis. When sediments sink to the bottom, they change the character of the Bay's floor. Sediment is significant in nutrient and toxic transport, deposition, and recyling: sediments adsorb nutrients and bind metals and organics. Sediment deliveries to the Bay system are highly seasonal and unique to each tributary.

TOXICANTS (both organic compounds and heavy metals) have been found in Bay water and sediments at high levels. While not an acute threat, toxicants are present in the tissue of the Bay's living resources. Toxicants enter the Bay system from a variety of sources—point sources (industrial facilities, sewage treatment, and power plants), and nonpoint sources (urban and agricultural runoff, dumpsites, and the atmosphere).

PLANKTON are the mostly microscopic plants (phytoplankton) and animals (zooplankton) that drift with the Bay's currents. Phytoplankton are the first link in the food chain, but an overabundance causes imbalances. Zooplankton are usually the prime consumers of phytoplankton and are often critical food for larval, juvenile, and some adult fishes.

BENTHOS, collectively the millions of animals (like worms, oysters, and clams) that live on or burrow in the bottom of the Bay, are good indicators of water quality and are important in the food chain.

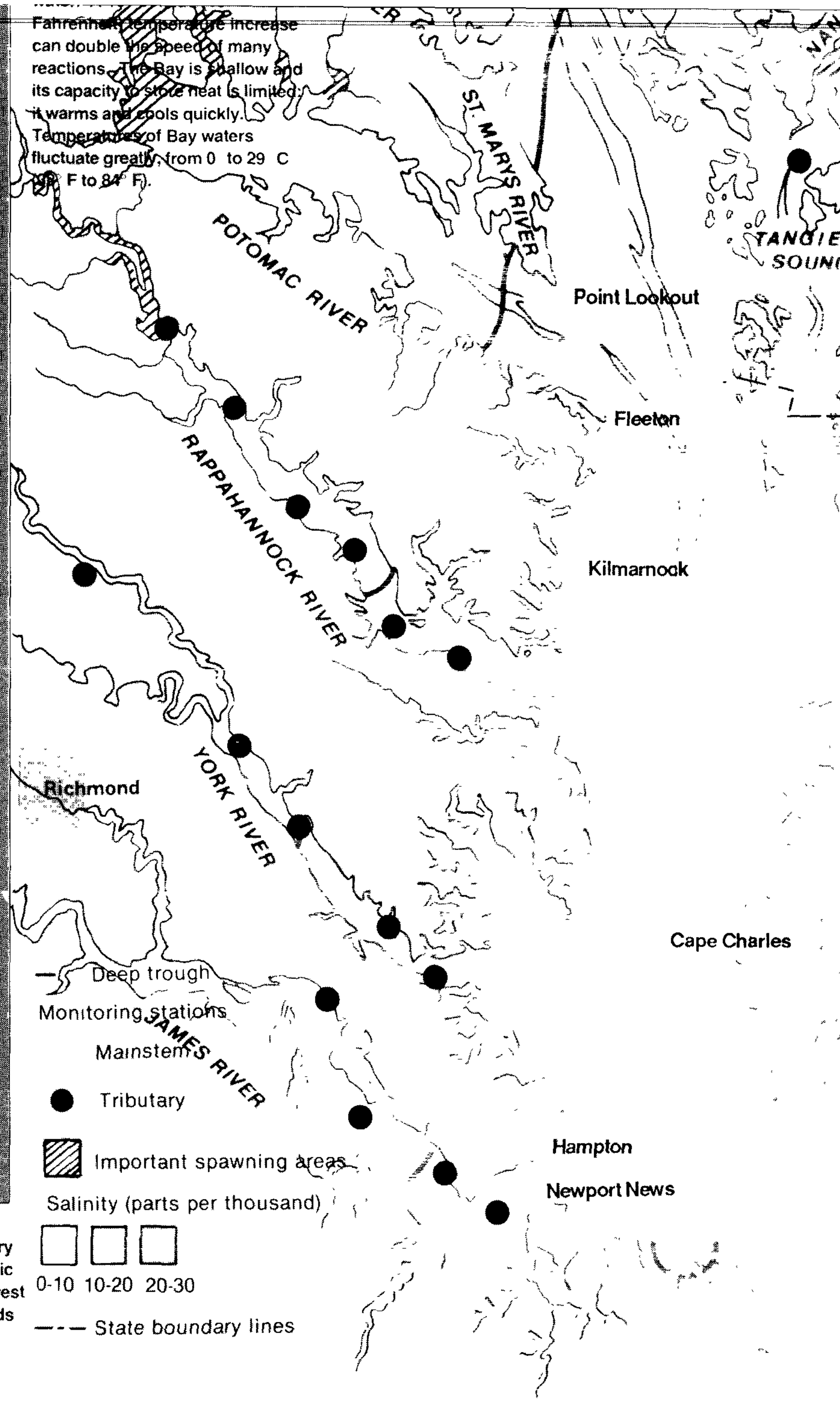
FINFISH AND SHELLFISH are crucial to the Bay ecosystem. Numbers of harvestable anadromous fish have decreased, with continued poor spawning and low abundances of juveniles. Harvests of marine-spawning fish, which depend on the ocean rather than the Bay, are relatively good. Shellfish harvests remain at all-time lows due to poor reproduction and larval survival rates, plus increased demand and harvesting, weather, and disease. Crab harvests remain variable but high.

SUBMERGED AQUATIC VEGETATION (SAV) is a Bay restoration priority due to its place in the food chain (particularly as a food source for waterfowl) and its significance as a habitat and nursery area. The steep SAV decline since the 1960s is believed to be related to man's activities.

THE FALL LINE forms the geological boundary between the Piedmont Plateau and the Atlantic Coastal Plain. Ranging from 15 to 90 miles west of the Bay, it is marked by waterfalls and rapids because of a sharp drop in elevation of approximately 1,100 feet.

Fahrenheit temperature increase can double the speed of many reactions. The Bay is shallow and its capacity to store heat is limited; it warms and cools quickly. Temperatures of Bay waters fluctuate greatly, from 0 to 29 C (32 F to 84 F).

streamflows on top and seawater (heavier) intrusion on the bottom form two wedges going in opposite directions. The opposing movement of these two wedges affects circulation



OXYGEN is required by most living organisms. It enters Bay waters from the atmosphere and as a byproduct of plankton and aquatic plant photosynthesis. Low oxygen (hypoxia) or no dissolved oxygen (anoxia) will stress or kill fish and other organisms. Surface water is at or near saturation all year, while deep bottom waters go from saturation to nearly zero.

THE CHESAPEAKE BAY:

- was formed 10,000 years ago when melting glaciers flooded the Susquehanna River Valley;
- is the largest estuary in the contiguous United States and one of the most productive estuaries in the world;
- has a mainstem over 195 miles (314 km) long, which ranges in width from 3.4 miles (5.5 km) near Aberdeen, MD. to 35 miles (56 km) near the mouth of the Potomac River;
- has 7,000 miles of shoreline and a surface area of over 2,200 square miles, a figure that doubles with the inclusion of its tributaries;
- has a volume of roughly 18 trillion gallons of water; if its entire tidal system were drained, it would take more than a year to refill with water from rivers, streams, and runoff;
- is generally shaped like a shallow tray with an average depth of less than 30 feet except for a few deep troughs running along much of its length;
- has tributaries that provide spawning and nursery sites for several important species of fish;
- is home for 200 fish species and boasts extensive finfish and shellfish harvests, representing an annual commercial value of approximately $1 billion;
- supports some 2,700 plant and animal species;
- is a major stop along the Atlantic Migratory Bird Flyway;
- is both a commercial and recreational resource for the more than 12 million people who live in its basin;
- had more than 122,000 pleasure craft registered in the state of Maryland alone in 1979;
- has two of the U.S.'s five major North Atlantic ports;
- receives waste from about 3,000 point-source dischargers in Maryland and Virginia and another 2,000 dischargers in its upper drainage basin; and
- receives 1.5 billion gallons of treated sewage effluent per day.

The crab industry appears unthreatened

sand and higher in organic carbon. Since the latter sediments had higher toxicant concentrations, especially in areas near heavy industrial activity, it appears that bioaccummulation depends on both the organic content in sediment and the grain size. In the lower Bay, Virginia sampled and examined sediments for organic chemicals at eight stations. Virginia scans samples for a wide range of hydrocarbon toxicants. Hundreds of compounds were detected in some samples. As in the upper Bay, PAHs were most abundant, but were not excessively high.

The spatial distribution of concentrations appears to reflect both the particle size distribution of the sediments and toxicant input from rivers. Coarse-grained sediments found near the mouth of the Bay contained low PAH levels. The PAH concentrations were generally higher near river mouths than in the mainstem.

Drawing conclusions for the lower Bay based on a comparison of 1979 and 1984-85 sampling is difficult because the sampling stations were not identical and there are too few stations for an area the size of the lower Bay. However:

- The 1984-85 samples show increases in overall toxicant concentrations since 1979;
- There is a slight but insignificant decrease in total concentrations in 1985 from 1984;
- At Hampton Roads, total PAHs increased fourfold from 1984 to 1985 possibly reflecting decreased sediment particle size with a concomitant increase in toxicant adsorption.

The National Oceanic and Atmospheric Administration (NOAA) studies the bioaccumulation of toxics in coastal regions nationwide. In the Bay, NOAA focuses on contaminants in sediments, Atlantic croaker livers, and oysters.

General use of the pesticide DDT declined significantly during the late 1960s and was banned in 1972. Analysis of historical data reflects this decline. Oyster body burdens of DDT and its metabolites decreased steadily from 1965 to 1977. Results also indicate that DDT concentrations (in sediments) are highly correlated with liver concentrations for Bay Atlantic croaker, which eat benthic animals. Studies elsewhere have associated sediment containing PAHs with the occurrence of cancer in fish. Although cancerous lesions were not found in Bay croaker and spot, occurrences of other types of lesions were correlated with concentrations of total PAHs in sediment.

Sample sites in the upper Bay yielded consistently higher levels of metals in oyster tissue than sites in the lower and central Bay. The relative roles of contamination and natural processes have not been determined.

PLANKTON AND THE FOOD CHAIN

The Bay is one of the most productive estuaries in the world. The plankton form the base of this productive food chain. In order to understand the food chain foundation, a new cooperative Baywide program for plankton and benthic monitoring began in 1984-85. Plankton were sampled at 23 Bay stations simultaneous with the collection of water quality data. Phytoplankton activity is greatest in the freshwater and transition zones (0.5 – 5.0 ppt) of the Bay and its tributaries where there are high nutrient concentrations. Benthic samples were also collected at 86 stations.

Maryland's 12-month sampling revealed high productivity in the upper freshwater portions of the Patuxent and the Potomac; the highest productivity was found near the Chesapeake Bay Bridge where salinity ranges from 5-18 ppt. The upper two freshwater and transition stations in the mainstem of the Bay showed the lowest productivity. These stations are located at the mouth of the Susquehanna, where high productivity was inhibited by high turbidity.

The seasonal pattern of phytoplankton growth in 1984-85 was typical: high late summer productivity due to long days and warm water; a fall peak followed by low winter productivity; and a major spring peak following an influx of nutrients with the spring freshwater inflows.

Productivity and seasonal patterns in the Potomac and Patuxent were similar. The Patuxent, however, had higher and more frequent peaks of productivity. Patuxent River carbon fixation rates (a measure of organic production) were 40 percent higher than Bay rates, and chlorophyll *a* values (a measure of biomass) were 50 to 200 percent higher.

Fish egg and larvae survey underway aboard the University of Maryland research vessel "Orion."
Photographer Kent Mountford

In terms of composition, diatoms were dominant during the late winter/spring and fall blooms. Small coccoid green cells were numerically dominant in the Maryland part of the Bay the rest of the year. During 1984-85, large quantities of phytoplankton settled into deeper Bay waters where their decomposition further depleted oxygen levels in bottom water.

Virginia plankton sampling of the mainstem was limited to July-September in 1985. The data indicate diverse population patterns with distinct differences in phytoplankton composition and concentrations between the central and lower Bay, significantly greater abundances and diversity in the deeper water layer, and a greater diversity and concentration of species near the Bay's mouth.

During 1984-85, microzooplankton were sampled in Maryland's portion of the Bay, and mesozooplankton were sampled in both states' waters. As with phytoplankton, higher biomass was found in the upper freshwater and transition zones. Maryland sampling revealed nothing surprising: shrimp-like crustacean copepods were the dominant zooplankton. In Virginia's lower Bay, isolated and unexpected high concentrations of copepods were found.

Zooplankton seasonal peaks occurred. Coupled with phytoplankton growth, there were spring and fall peaks which were more pronounced in less saline waters. Monitoring results support the concept of "coupling" between phytoplankton and zooplankton; the seasonal microzooplankton peaks coincided with the phytoplankton peaks or followed them by one month; mesozooplankton peaks coincided with the phytoplankton peaks during the spring bloom, but at other times aligned more closely with microzooplankton abundance. This phenomenon also suggests an important link between phytoplankton and the larger mesozooplankton in the food chain during much of the year.

Over the last several decades, the duration and extent of low DO in Bay bottom waters during summer months have increased. With decreasing oxygen levels, the abundance of short-lived benthic species that are less suitable prey for finfish and crabs has increased, while the availability of preferred longer-lived benthic species has decreased. Lower standing stocks and abundance of benthic biomass were found in the deepwater mud habitats where summer hypoxia/anoxia occurs.

The deep central portion of the Bay in Maryland, the lower half of the Potomac River, and the upper Bay in Virginia support the lowest benthic biomass; the greatest benthic biomass is found in the brackish and low salinity habitats. A summary of the more notable findings from the 1984-85 benthic sampling follow:

- Effects of anoxia are most apparent in deep waters just downstream from the Bay Bridge where anoxia is generally most severe. Stress from hypoxia/anoxia also appears to have affected benthic communities at two Virginia stations: in the deepwater mainstem and in the lower Rappahannock;
- Areas not experiencing anoxia confirm that year-to-year fluctuations in salinity are a major factor influencing long-term benthic trends;
- In the Patuxent River, populations of a clam (*Macoma balthica*) dependent on organic-rich sediment deposits have declined since 1980. In this situation, using *M. balthica* as an indicator of carbon in the sediment, a decrease in population is considered to be a positive sign. This suggests that secondary sewage treatment and sediment controls are having a beneficial effect.

Programs to Bring Back the Bay

PROGRESS OF STATE PROGRAMS

PENNSYLVANIA

Pennsylvania's Chesapeake Bay Program is based on the premise that solving the Bay's problems will ultimately benefit the Commonwealth's farmers. Soil loss from Susquehanna River basin croplands exceeds the state average of 5.5 tons per acre per year by 34 percent. Helping farmers to adopt practices to keep soil and nutrients on farmlands and out of the streams will help to maintain soil productivity and improve farm economics.

The state's Departments of Environmental Resources (DER) and Agriculture, Cooperative Extension Service, conservation districts, the federal Soil Conservation Service (SCS), the Agricultural Stabilization and Conservation Service (ASCS) and many volunteers, in cooperation with farm organization programs, are helping farmers improve their land management. County conservation districts administer DER's cost share program with oversight provided by the State Conservation Commission. In 1985, the Commission established a Chesapeake Bay Advisory Committee which provides Bay-related recommendations and support to education efforts. Additionally, in 1986, Pennsylvania joined the Chesapeake Bay Commission.

NONPOINT SOURCE POLLUTION CONTROL PROGRAM

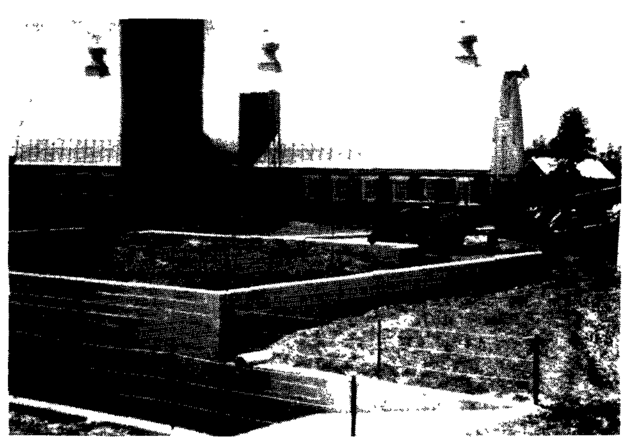
The Commonwealth of Pennsylvania continued to concentrate on the development and implementation of a comprehensive, four-part agricultural nonpoint source pollution control program in FY86 with a commitment of $4.35 million, half of which is EPA Bay implementation grant funding. (Total financial commitments in Pennsylvania since 1984 approach $10 million.) The four-part program includes: planning, education, financial assistance, and technical assistance.

Educational activities are conducted to provide information to landowners and the public to foster understanding of the need for nutrient management, erosion control and water quality improvement. The Pennsylvania Association of Conservation District Directors, Inc. assists DER in coordinating educational activities.

Demonstration projects continue to play a major role in the education program. Efforts focus on analysis of soil, manure, and the movement of nutrients through the soil profile. The mobile nutrient laboratory is a particularly effective educational tool to reach farmers. Farmers are provided on-farm analysis of soil, manure, and water to encourage them to adopt best management practices (BMPs) as part of a nutrient management program.

Several other projects focus on increasing the use of reduced tillage and spreading manure on woodlands. Projects involving alternative use and handling of pesticides are in progress. Several crop management associations have recently been formed and are proving to be a useful means of information transfer to farmers.

To accelerate the installation of BMPs, technical assistance is provided for the planning, design, layout, and installation of BMPs on farms in targeted areas within the Susquehanna River Basin. Technical assistance is also provided to local water suppliers to promote water conservation.



Manure storage facilities are an important best management practice to reduce nutrient runoff.

Contracts were signed by farmers in the high priority watersheds to implement nutrient management and soil conservation practices. To date, 103 contracts have been signed to implement BMPs and complete nutrient management programs over a multiyear period. This represents a small part of the total of $2.8 million in financial assistance available to this program. After agreeing to implement a nutrient management plan, farmers are eligible to receive as much as 80 percent cost-sharing for BMPs, to a maximum of $30,000.

POINT SOURCE TOXICS CONTROL STRATEGY

DER continued to implement its Point Source Toxics Control Strategy to address EPA's priority pollutants and other toxicants through its federally delegated NPDES Permit Program.

The Departments of Environmental Resources and Health and the Fish Commission conducted a special statewide PCB sampling study in 1985. The study found that fish contaminated above Food and Drug Administration (FDA) recommended levels were primarily bottom dwellers that feed on material found in the sediment. Most sport fish sampled did not show levels of contamination above FDA recommendations, if at all, in edible tissues.

SEWAGE TREATMENT PLANT PROGRAMS

The Commonwealth's Environmental Quality Board approved a package of regulations in March 1985 to enable Pennsylvania to apply for delegation of EPA's Pretreatment Program; delegation is anticipated in FY87. In the meantime, DER continued to assist EPA in carrying out the program in Pennsylvania. Of 35 municipal treatment programs, 33 have approved programs.

In February 1986, Pennsylvania initiated the development of a comprehensive rural sewage management project in the Village of Millmont, Union County. This is the second such project developed by Pennsylvania to research and evaluate alternative and innovative technologies for sewage disposal.

FISHERIES PROGRAMS

The program to restore American shad to the Susquehanna River has shown significant progress. For the period from 1972 through 1985, a total of 5,400 American shad were captured at the Conowingo Pool fish trap for possible transportation upstream for spawning. In the spring of 1986, 5,193 shad were captured. Of this number, 4,200 were transported upstream for spawning in the Susquehanna River near Harrisburg.

GROUND WATER PROGRAM

Development and implementation of a comprehensive Ground Water Quality Management Program continued. As a pilot project, three ambient ground water quality monitoring systems were established within high priority ground water basins in Pennsylvania. This enabled DER to assess the effectiveness of this method of monitoring before finalizing its Ground Water Monitoring Strategy. DER is now proceeding to implement the monitoring program.

Pennsylvania received final program authorization (primacy) from EPA in January 1986 to carry out a federally-delegated Resource Recovery and Conservation Act (RCRA) Program.

DISTRICT OF COLUMBIA

The goal of the District's Bay Program is to improve water quality in the Potomac and Anacostia rivers, thereby promoting and protecting the living resources in those waters and the Bay.

The Bay cleanup efforts within the District are shared between the Departments of Public Works (DPW) and Consumer and Regulatory Affairs (DCRA). DPW designs and constructs demonstration projects and continues to operate and upgrade the Blue Plains Wastewater Treatment Plant. DCRA develops, implements and enforces construction erosion regulations and other nonpoint source control efforts. The agencies share development and distribution of public information which occurs as an integral part of their programs.

COMBINED SEWER OVERFLOW (CSO) ABATEMENT PROGRAM

Because of the age and design of the District's sewer system, large quantities of raw sewage mix with rainwater during periods of heavy precipitation. While many provisions are made to reduce overflows, substantial volumes of sewage are discharged directly to the Anacostia, Rock Creek, and Potomac rivers. Through the CSO Abatement Program, discharges of combined sewage will be controlled by structural changes. DPW will construct inflatable weirs (dams) to hold stormwater until it can be transported to the Blue Plains Wastewater Treatment Plant for treatment. Swirl concentrators will be constructed to treat wastewater by centrifugal action before it is discharged to the Anacostia. Once operational, swirls are expected to reduce the annual overflow volume and the frequency of overflows in the Anacostia River by 50 percent.

PRETREATMENT PROGRAM

In 1985, the Council of the District of Columbia enacted the Wastewater Systems Amendment Act. In June 1986, the Department of Public Works promulgated rules and regulations which direct the pretreatment program, enabling the District to monitor toxic compounds identified by EPA. Regulations for compost use, discharge permits, wastewater treatment facility construction, and water quality management are in various stages of promulgation.

BLUE PLAINS SEWAGE TREATMENT PLANT

In 1985, Blue Plains treated 299 million gallons per day (MGD) of wastewater from Maryland and Virginia counties as well as the District. Blue Plains is the largest advanced wastewater treatment plant in the United States. Processes utilized for treatment include secondary treatment, nitrification, and phosphorus removal. Blue Plains has been performing better than required in the removal of phosphorus from the waste stream. Regional users and EPA will invest an estimated $100 million to expand treatment capacity to 370 MGD. The District will add another $50 million.

About 1,300 pounds of chlorine is discharged daily from Blue Plains. Though an excellent disinfectant, chlorine is toxic to many aquatic organisms. To protect living resources in the Potomac and the Bay, DPW has begun constructing dechlorination facilities at Blue Plains to be completed in 1988.

Activated sludge treatment at the 299 MGD Blue Plains wastewater treatment facility.
Courtesy of District of Columbia Department of Public Works

PHOSPHATE BAN

The District's phosphate ban became effective in September 1986. However, since January 1986, Blue Plains officials have witnessed a 26 percent decrease of influent phosphorus concentrations compared with the 1985 load. They attribute the majority of the decrease to Maryland's phosphate ban. Because distributors of detergents operate regionally, phosphate products were removed from store shelves in D.C. well as Maryland after Maryland's ban began in December 1985. Once both bans are fully operational, the influent phosphorus concentrations to Blue Plains are expected to be reduced by 30 percent.

The Bay Program estimates that Blue Plains will experience a 15 percent savings in operating costs. The Bay Program estimates that annually an estimated $29 million could be saved from a Baywide phosphate ban due to a decrease in chemical usage and reduced sludge disposal costs.

STORMWATER MANAGEMENT

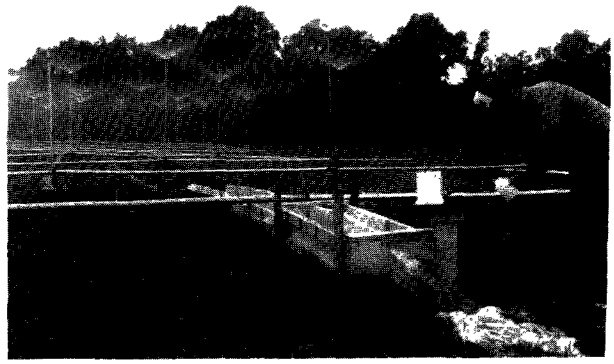
DCRA's Stormwater Management Program became fully staffed in February 1986. Stormwater management regulations have been drafted to implement DC Law 2-23, the Soil Erosion and Sedimentation Control Act, and are in review. The new regulations will require developers to contain runoff on construction sites and release it at or below pre-development rates. The Stormwater Management Program also issues a number of guides to inform citizens on how they can control pollution.

EPA's Chesapeake Bay Program emphasis on nonpoint pollution control and its grants has enhanced the programs of the DC Soil and Water Conservation District (SWCD). The DC SWCD hosted the Fifth Annual Erosion and Sedimentation Control Program

Administrators Conference to discuss government programs at all levels as well as private sector initiatives. The DC SWCD also sponsors high school education programs and awards.

FISHERIES MANAGEMENT PROGRAM

The new Fisheries Program began participating in NOAA's Stock Assessment by inventorying the anadromous fish in the District. A recreational fishing survey was conducted to establish baseline information. Draft regulations to manage anadromous and resident fish populations were published. Following review of the license fee schedule, promulgation will be completed.



Virginia's rainfall simulator is used to demonstrate the effectiveness of conservation tillage practices in reducing erosion. Photographer Anne Weinberg

VIRGINIA

Virginia's Chesapeake Bay Initiative Program includes 30 initiatives in nine agencies of five different secretariats. Virginia's commitment for Chesapeake Bay Initiatives has totalled $58,851,193 to date. (Of this total, $8,004,954 is from EPA grants.) This includes $14,937,604 for projects during the 1984-86 biennium and $43,913,589 for 1986-88. Of the funds allocated for 1986-88, $20,400,000 is for sewage treatment plants. Overall program coordination and tracking is provided by the Council on the Environment.

POLLUTION ABATEMENT

Virginia concentrates its Chesapeake Bay efforts on a variety of programs designed to reduce the quantity of pollutants entering the Bay and its tributary waters.

FARMS. Pollutant-carrying runoff from agricultural land is being reduced through a combination of education and cost-sharing grants designed to encourage farmers to improve their land management. So far, 1,444 farmers have installed BMPs on 58,594 acres as a direct result of state cost-sharing funds. This has resulted in 333,930 tons of sediment which otherwise would have eroded from farm fields each year. This also has reduced the sediment load to streams and rivers by approximately 31,260 tons and phosphorus carried by soil particles by 33,760 pounds. Another 51 farmers are installing facilities to manage 114,407 tons of animal waste each year from their livestock operations.

The education component of Virginia's program demonstrates the value of using BMPs and convinces farmers to install BMPs voluntarily. One of the best means of demonstrating the value of BMPs in a clear, convincing way is through the rainfall simulator, which reproduces the effect of a typical summer cloudburst. It is set up over two side-by-side farm plots, one of which has been conventionally tilled, the other using no-till. A demonstration in Essex County showed that the no-till plot produced half the total runoff, one-tenth of the sediment and phosphorus loss, and one-fourth the nitrogen loss, in comparison with the conventional plot.

URBAN AREAS. The use of urban BMPs is being encouraged through cost-sharing and technical assistance. Eleven projects in seven localities include porous asphalt pavement, an infiltration trench and grassed waterway, streambank stabilization, an "urban marsh," and a "wet pond" (manmade rainwater detention basin). Monitoring at the wet pond site indicates that the pond is effective in removing up to 87 percent of the silt and 80 percent of the phosphorus from the runoff. It also removes up to 65 percent of the lead and zinc. While this wet pond project is relatively small, its efficiency at pollutant removal is significant. It and other projects serve to demonstrate the urban BMP concepts and promote voluntary use of similar practices in other urban areas.

SEWAGE TREATMENT PLANTS. Other significant sources of nutrients are the 476 municipal sewage treatment plants (STP) in the Virginia portion of the Chesapeake Bay basin. Virginia has become directly involved in the financing of municipal STPs. The newly created Virginia Water Facilities Revolving Fund makes construction loans available to localities at low interest rates. Limited grant funds are also available.

The Virginia Resources Authority was created to provide low-interest financing alternatives to localities. Three bond issues have financed a total of $63,620,000.

Another initiative concerns the correction of faulty sewer lines. Forty infiltration and inflow problem areas exist in the Virginia Bay basin. Eliminating them should result in significant reductions in the number of occasions when rainfall causes STP overflows and discharges of untreated sewage into the Bay and its tributaries. Four projects are currently underway with another six planned for FY87. The Commonwealth has also instituted a pilot nutrient removal program in three localities. Preliminary results from the York River STP biological nutrient removal process indicate that the level of phosphorus discharged has been reduced about 80 percent—from 8 mg/l to less than 1 mg/l.

The State has made significant strides in reissuing discharge permits so that the limitations imposed on treatment plants remain current. In addition, a State standard for chlorine has been adopted, and efforts are underway to develop nutrient standards and toxicity reduction strategies.

LIVING RESOURCES AND HABITAT IMPROVEMENT

A number of Virginia's initiatives affect habitat in the Bay and its tributary waters, and complement on-going programs such as the management of tidal wetlands and subaqueous lands.

CHLORINE REMOVAL OR REDUCTION. One effort is directed towards reducing the amount of chlorine used and discharged by sewage treatment plants. Ten localities have been awarded grants totaling $1.8 million for either dechlorination or alternative disinfection at their sewage treatment plants. Another $1.7 million has been allocated for future projects. Prior to the Bay cleanup effort, 6,670 lbs of chlorine were being discharged each day; this amount will be reduced to 3,905 lbs per day. Because many of the localities reducing or eliminating chlorine in STP discharges are adjacent to spawning and nursery areas, an increase in fishery populations is anticipated as the young marine organisms are able to reach maturity.

FINFISH. Fishery management plans set goals, objectives and strategies for increasing stock, improving habitat, managing harvest, and ensuring the proper collection of fisheries data. The first plans to be developed are for striped bass and oysters.

SUBMERGED AQUATIC VEGETATION. An experimental program was started to reestablish SAV beds and determine what causes their decline. Thirty acres of eelgrass were transplanted in the first two years of the program with ten to seventy-five percent survival rates. Losses are attributed to winter ice scour, turbidity, accidental dredging, cownose ray and crab uprootings, and other biological factors under investigation. Still, growth in some areas has been phenomenal; at one site each transplanted plug has proliferated by an average of 100 times. Efforts to reestablish SAV beds, including seed planting, are continuing.

SHELLFISH GROUNDS. While maintaining its commitment to protect the public from contaminated seafood, the State is also working to reopen condemned shellfish grounds by correcting the causes of the contamination.

To date, 3,740 acres of productive shellfish grounds have been reopened, making $1,288,288 in shellfish available to commercial harvesting during the first harvest year. These areas should continue to produce shellfish valued at about half this amount in each subsequent year. The cost to the State has been $115,016 for an overall benefit/cost ratio of about 11 to 1.

OYSTER ROCK REPLETION. Another initiative added $1,000,000, an increase of 50 percent, to the oyster repletion program. As a result, the Marine Resources Commission was able to plant approximately 3.8 million bushels of shell and 68,500 bushels of seed oysters between 1984–86. There are plans to plant another 2 million bushels of shell in each year of the 1986–88 biennium as well as to develop alternative methods of supplying shell for repletion.

OYSTER HATCHERY. In 1985, VIMS began the operation of an oyster hatchery which will in future years help to ensure availability of seed oysters for both remote setting by oystermen and for scientific research. To date, 221 million oyster larvae have been raised for in-house research and use by industry.

RESEARCH

Numerous research projects are on-going, including the analysis of water quality and living resource monitoring data. The findings of these studies are coordinated and shared throughout the State and Bay region.

Technicians use high power water guns to plant oyster shells for improved oyster habitat.
Courtesy of Maryland Department of Natural Resources

MARYLAND

Since signing the Chesapeake Bay Agreement, the State of Maryland has allocated over $130 million to support 35 Bay initiatives. Over 1,700 BMP projects are being installed with 3,000 applications pending, and there has been substantial improvement in industrial and municipal compliance.

In Maryland, a number of different agencies are involved in Bay cleanup: the Department of Natural Resources, the Department of Agriculture, and the Office of Environmental Programs. In addition, a number of councils and commissions have been established to carry out specific tasks, such as the Critical Areas Commission and the Governor's Council on the Bay.

DEPARTMENT OF NATURAL RESOURCES PROGRAMS (DNR)

The DNR implements resource restoration and management activities focused on finfish, shellfish, SAV, land use, erosion and stormwater management, recreation/conservation, and education.

Using $50,000 in State General Funds, the DNR selected 18 locations for SAV transplanting demonstration projects. Preliminary results are encouraging.

In order to ameliorate dwindling oyster harvests, in 1985 DNR planted dredged oyster shells, fresh oyster shells and oyster seeds on 565 acres at a cost of about $505,000. In 1986 about 5.6 million bushels of dredged shell, 461,000 bushels of fresh shell, and 315,000 bushels of oyster seed were planted at a cost of about $2 million.

Maryland is also involved in a joint DNR, Fish & Wildlife Service (F&WS) striped bass stocking and tagging program, releasing about 200,000 tagged fish in 1985.

In the land use arena, the Chesapeake Bay Critical Areas Commission is Maryland's major achievement. The Commission set up criteria and guidelines to assist local governments to regulate growth and development within the 1,000 foot "critical area" zone surrounding the Bay and its tributaries.

Non-tidal wetland activities focused on completing the digitization of the F&WS National Wetland Inventory Maps for the western shore in FY86. Other actions included reviewing projects for potential impact on non-tidal wetlands and implementing the initial phases of a wetland assessment and monitoring system.

In FY85 and 86, the Maryland Environmental Trust negotiated conservation easements on 2,470 acres (8 miles of shoreline) and reduced the permissible population density on these easements from 1 dwelling unit per 5 acres to 1 unit per 55 acres. DNR awarded over $1.46 million in State General Funds for stormwater management grants-in-aid funds during FY86. This brings the total expenditure of the program to $2.64 million. In efforts to retain existing forestland, four Bay watershed foresters prepared 93 forest management plans for 7,878 acres within the critical area. In addition, sediment control plans on 3,471 acres were prepared, development site reviews were performed on 2,864 acres, and 124 acres of trees were planted along two miles of shoreline.

Supporting the freshwater conservation initiatives, DNR staff provided technical assistance for the establishment and maintenance of water conservation programs in several counties.

DNR contracted with the Interstate Commission on the Potomac River basin for a study to analyze operation rules for reservoirs in the Potomac River basin to determine if it is possible to increase freshwater inflows to Chesapeake Bay during low flow periods. Up to 10,000 acre-feet of water may be available without significantly affecting water supply, flood control, and water quality purposes of upstream reservoirs. Up to 100,000 acre-feet of additional storage may be available in reservoirs in the Susquehanna River basin.

DNR receives an annual appropriation of $500,000 designated specifically for research. To date, nine projects have been funded, including stormwater management, nutrient modeling, resource management and toxic substances.

To demonstrate the effectiveness of stormwater BMPs in reducing pollution, and as an incentive to local governments to undertake similar projects, the OEP administers a cost-share effort to help local governments implement stormwater runoff controls. Six projects are now underway.

Shore erosion control demonstration projects have been undertaken to protect 8,895 linear feet of

Grasses are planted on exposed shoreline as a nonstructural erosion control practice.
Courtesy of Maryland Department of Natural Resources

shoreline at a cost of $20–$80/foot ($250,000 Md/$345,000 EPA). For privately owned lands, a total of 21 matching grant projects have been selected for shoreline stabilization. These projects incorporate a total of 6,158 linear feet of shoreline protected at an average cost of $53/foot ($327,283 MD).

DEPARTMENT OF AGRICULTURE PROGRAMS

The Department of Agriculture's efforts in Bay cleanup focus on assisting in the implementation of best management practices. The Department created 17 new positions in FY86. That expansion enabled completion of 952 soil and water conservation plans in FY86. The Department was authorized $5 million of state funds and received $1 million in EPA funds for agricultural cost-sharing. More than 3,000 farmers have applied for funds to implement best management practices.

Since 1983, in the agricultural nonpoint area, over 1,700 projects have been completed at a cost of $4 million. The goal is to have conservation plans on all farms in Maryland's priority watersheds by 1989 and on every farm in the State by 1994.

Outreach and education activities continued to encourage better land management and implementation of BMPs. In addition, the Department formally adopted regulations to govern the design, construction, operation, and maintenance of agricultural drainage projects.

PROGRAMS—THE OFFICE OF ENVIRONMENTAL PROGRAMS

The Office of Environmental Programs (OEP) within Maryland Department of Health and Mental Hygiene manages programs under authorities delegated by state and federal laws and regulations. OEP is responsible for implementing programs related to point and nonpoint water pollution, air pollution, safe drinking water, toxic substances, hazardous wastes, and community health.

The OEP's point source control programs have shifted from study and planning to construction and implementation. Every sewage treatment plant (STP) in the State has been affected; with the completion of the Havre de Grace plant's upgrade in late 1986, all major plants in the State have achieved secondary or advanced treatment capabilities. This translates to a 40 percent improvement in the plants' ability to remove conventional pollutants.

Phosphorus removal technology is now on line at 17 STPs throughout the State. At 120 of the 150 STPs in the state, chlorine is being removed. Nitrogen removal capability, now being initiated at two Patuxent River facilities with an additional two to come, will help to determine the cost and effectiveness of nitrogen removal processes in the Patuxent basin. The results will indicate whether nitrogen removal should be implemented at treatment plants throughout the Bay basin. As a result of implementing pretreatment in Baltimore City, there have been significant reductions in heavy metals. In addition, the State now considers the Back River Treatment Plant sludge to be clean enough for on land disposal.

In 1986, the Waste Management Administration more than doubled the number of enforcement actions it took against noncomplying industries over the number of 1985 cases; from 39 to over 80. The compliance rate of the 163 publicly owned treatment works increased from 39 percent in 1983 to an estimated 60 percent in 1986.

OEP is funding two major research projects: a Patuxent River model and an investigation of carbon cycling processes in Chesapeake Bay. The Patuxent River Water Quality Model will evaluate the interactions of numerous conditions within the Patuxent ecosystem. It will provide managers with a tool for predicting the effects of various nutrient control strategies.

The project on carbon cycling is investigating plankton populations in relation to the processes of carbon and oxygen cycling. The study also focuses on how algal blooms affect benthic oxygen demand. The research will provide answers to questions about how carbon cycling and deposition contribute to anoxia in the Bay.

PROGRESS OF FEDERAL PROGRAMS

DEPARTMENT OF DEFENSE

With the signing of the Joint Resolution on Pollution Abatement with the EPA in 1984, the Department of Defense (DoD) pledged to give priority consideration to funding pollution control projects and studies which would enhance the Bay's quality.

Two major ongoing studies were initiated in the fall of 1985. The first is a three part study to determine the relative impact of DoD activities on the water quality and living resources of the Bay and its tributaries. Phase I of this study screened 66 DoD installations to identify existing and potential water quality impacts. Current efforts are concentrating on 37 installations which have been identified as needing further study. The second study is a pilot program to enhance the operation of wastewater treatment facilities. Demonstration projects are now being conducted.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NOAA's involvement in the cleanup of the Chesapeake Bay is focused primarily on the restoration of living resources. In FY85, NOAA signed a Memorandum of Understanding with the EPA, established a new Estuarine Programs Office (EPO) responsible for the coordination of NOAA activities within the Chesapeake Bay Program, developed a NOAA Chesapeake Bay Study Plan, sponsored and coordinated a number of Bay research related seminars, and continued active involvement of its offices in the Chesapeake Bay area. In sum, NOAA spent about $5 million in Chesapeake Bay during FY85.

A federal/state/academia Chesapeake Bay Stock Assessment Committee (CBSAC) has been formed, at NOAA's suggestion, to determine the effects of climate, fishing pressure, and contaminants on fishery stocks. CBSAC has established a framework for its activities and funded initial research to improve fishery statistics and stock assessments.

During 1985, Maryland and Virginia Sea Grant researchers examined the cause and dynamics of oxygen depleted Bay waters. Researchers are also examining the effects of low dissolved oxygen bottom waters on the Bay's living resources.

NOAA's National Marine Fisheries Service (NMFS) is examining the etiology of diseases in such Chesapeake Bay species as the soft clam (*Mya arenaria*), menhaden, shad, and river herring. It coordinates with and assists the Mid-Atlantic Fishery Management Council and the various fishery commissions dealing with Chesapeake Bay in the development of their Fishery Management Plans. NMFS also publishes annual commercial and recreational fishery statistics of Chesapeake Bay.

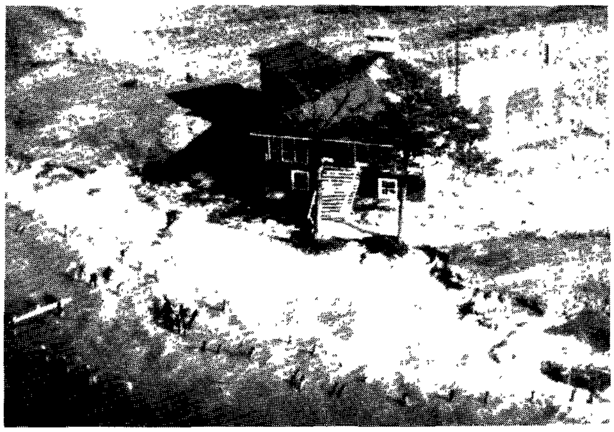
NOAA's National Ocean Survey (NOS) produces nautical charts, tide and current tables, atlases and catalogues, detailed field surveys, and coordinates coastal resource management through grants to states and a National Estuarine Research Reserve Program. Along these lines NOS is developing a National Estuarine Inventory Atlas (delineating some of the physical characteristics of 185 estuaries) and a National Coastal Pollutant Discharge Inventory. Both include Chesapeake Bay. Ultimately these data will be used in the water quality models being developed by the Chesapeake Bay Program.

In FY85, Maryland, Virginia, and Pennsylvania received NOAA funds (under Section 309 of the Coastal Zone Management Act) to coordinate interstate coastal management programs. Maryland is assessing habitat quality in spawning areas and studying habitat quality and circulation in the Eastern Bay; Virginia is examining nutrient loads, fishery statistics, and improved data management; and Pennsylvania has applied its grant toward the assessment of toxics in surface waters and collection of nutrient and sediment runoff data.

NOAA's National Environmental Satellite Data and Information Service (NESDIS), with the Virginia Institute of Marine Science, produces a quarterly and annual summary document, "Marine Environmental Assessment—Chesapeake Bay," which examines weather impacts on marine environmental activity (e.g. commercial fishing, boating, pollution events, and shipping). NESDIS has also transferred tidal and current information to the Chesapeake Bay Program to assist in the development and calibration of hydrodynamic models.

ARMY CORPS OF ENGINEERS

The Corps of Engineers is involved in numerous projects affecting the water quality and living resources of the Bay. The Chesapeake Bay Shoreline Erosion Study, authorized in June 1983, is the first comprehensive study of the critical erosion problems affecting the Bay. The reconnaissance phase report, completed in March 1986, recommends development of a



Shoreline erosion can have costly and devasting effects.
Courtesy of the US Army Corps of Engineers

comprehensive plan for 135 miles of identified critically eroding shoreline. The second part of the study will examine the feasibility of a range of possible solutions and is to be completed by September 1989.

At the request of Maryland and Virginia, the Corps began the Potomac River Hydrilla Study in 1984 to evaluate the cost-effectiveness and environmental impacts of hydrilla control. The final report was approved in March 1986. The recommendation for mechanical harvesting of about 290 acres over ten years by Maryland and Virginia is being successfully implemented. In 1984, EPA's Bay Program initiated a multiyear effort to map and record the distribution of SAV. The Corps contributed $161,000 and $60,000 to this work in 1985 and 1986. Extensive data were collected through aerial photography and field surveys between 1984 and 1986. This effort will enable Bay researchers to quantify the link between improved water quality and improved habitat.

In late 1985, the Dredging Division of the Water Resources Support Center at Fort Belvoir, Virginia initiated a series of meetings with federal and state agencies from Maryland and Virginia to discuss the beneficial uses of dredged material in the Bay and to develop a list of potential sites for habitat restoration. Five potential oyster enhancement sites have been identified, and additional fisheries habitat candidate sites are under review.

UNITED STATES GEOLOGICAL SURVEY

The USGS has several programs directly related to assessing the water quality in major tributaries of Chesapeake Bay as well as evaluating the effectiveness of agricultural and urban BMPs in various geologic formations of Pennsylvania, Maryland and Virginia. In the Susquehanna, Choptank, Patuxent, Potomac, Rappahannock, Mattaponi, Pamunkey, and James rivers, the USGS is collecting suspended sediment and chemical data, including nutrient data at the fall line.

In Pennsylvania's Conestoga River, the USGS operated a surface and ground water agricultural BMP monitoring program for the fifth year. USGS is monitoring the nutrient loadings from two headwater farms in York and Adams counties. In the Lower Susquehanna basin, the Susquehanna River Basin Commission (SRBC) is assessing the differences in nutrient loadings between base loads and storm events at thirteen sites.

In the Patuxent River basin, the USGS began collecting hydrologic information at thirteen sites to evaluate BMPs during FY86. Also in Maryland, drilling and instrumentation has recently been completed in three infiltration basins to determine their effectiveness in confining urban stormwater as well as to quantify the effects of infiltration on ground water quality.

A geographic information system is being used in Virginia's Elizabeth River to assist in hydrologic interpretations. The first phase of the project, which began in April 1986, is to input data on land and water uses, pollution sources, and critical habitats. USGS will assist in interpreting transport directions and the impact of contaminants as a function of surface and ground water movement.

SOIL CONSERVATION SERVICE

The Soil Conservation Service (SCS) philosophy and strategy are to integrate water quality considerations into all of its programs and activities. In FY86, SCS

SCS Accomplishments for BMP Implementation (1984–1986):

	MD	PA	VA
Conservation Plans prepared (acres)	155,000	142,730	232,000
Technical help to farmers (numbers)	13,000	14,070	14,000
Soil saved (tons)	231,000	1,285,430	571,000
Animal waste systems (number)	58	245	57

increased resources in the districts and the three states participating in the Bay Program with a total of $1,140,000 and 31 staff positions. In addition, it provided one fulltime SCS Liaison and Resource Conservationist headquartered at the Chesapeake Bay Liaison Office. SCS obligated $17,785,000, which included 215 staff years, in FY86 to benefit water quality throughout the Chesapeake Bay area. Major SCS activities included: providing technical assistance for agricultural and urban BMPs; supplying technical standards and specifications for the states' cost-share programs; providing training for conservation district technicians; and educating farmers to encourage participation in volunteer nonpoint source pollution control programs.

SCS achievements in water quality improvement are dependent upon close cooperation of federal, state, and local units of government, and conservation districts. Through this cooperation, SCS achieved several accomplishments in FY86. SCS assigned staff to the MD Department of Agriculture, PA Department of Agriculture, PA Bureau of Soil and Water Conservation, and VA Division of Soil and Water Conservation to assist with the implementation of state cost-share programs and demonstration watersheds, train conservation district technicians, and develop standards, specifications, and program guidelines.

SCS and USGS are working together to develop a GIS for the Bay watershed. SCS is providing soils and land use information. In addition, SCS along with other USDA agencies initiated action to implement the 1985 Farm Bill which will compliment Chesapeake Bay cleanup efforts.

ENVIRONMENTAL PROTECTION AGENCY

The EPA is the lead federal agency in the Chesapeake Bay restoration and protection effort. It staffs the Chesapeake Bay Liaison Office in Annapolis and has provided close to $24 million (1984–1986) for its Chesapeake Bay Program.

Annually, approximately $7 million is provided in grants to Bay states for projects to control agricultural and urban nonpoint source pollution problems. These grants supplement state cost-sharing and education efforts which encourage farmers and others to use BMPs.

EPA provided $1.6 million (1984–1986) to support Bay mainstem monitoring efforts in Maryland and Virginia. An additional $1 million was supplied for the Data Management Center in Annapolis which stores and processes monitoring data and carries out the mathematical modeling efforts underway to predict point and nonpoint source pollution loadings.

The Citizens Program for the Chesapeake Bay, Inc. received grants totaling nearly $638,000 (1984–1986) for public information, citizen monitoring, support of the CAC, and citizen participation.

The Chesapeake Research Consortium (CRC), through a cooperative agreement with EPA, supports the STAC. CRC also assists the Bay Program in obtaining scientific and technical advice and analysis to support monitoring and modeling.

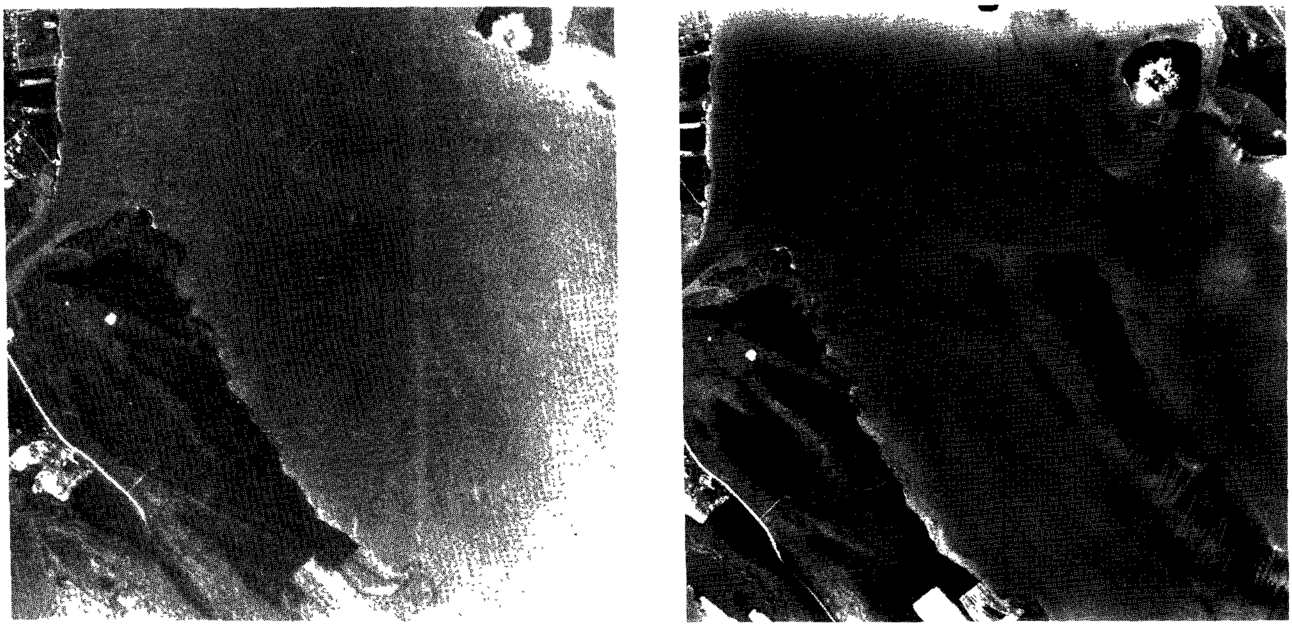
In addition to efforts coordinated under the Chesapeake Bay Program, the EPA is already involved in numerous federal programs which benefit the Bay. In FY85, $170 million was provided for wastewater treatment facility upgrading and construction in Bay states. In FY85, $15 million was provided for states to support baseline environmental programs and special water quality efforts supporting point and nonpoint source control programs. Under Superfund and RCRA, the Agency performs on-site investigations and cleanup programs, and issues waste disposal permits. The EPA is responsible for enforcing the National Environmental Policy Act (NEPA) and wetlands provisions of the Clean Water Act.

U.S. FISH AND WILDLIFE SERVICE

Since signing a Memorandum of Understanding (MOU) with EPA, F&WS has done extensive work in monitoring and analyzing water quality data, and relating the results to living resource health. F&WS has also played an important role in public relations. The broad aim of the F&WS nonpoint source work is to document water quality conditions and relate them to land use practices and affected biological resources.

One of the highlights of F&WS research is its Choptank watershed program. For two years, water quality was sampled at 35 stations in the Choptank Watershed in order to develop recommendations for the agricultural community on which BMPs are most beneficial to water quality. In related work, F&WS has identified six subwatersheds with nitrate concentrations higher than 5 ppm.

F&WS point source studies included sampling three National Permit Discharge Elimination System (NPDES) outfall sites for organisms and sediment in 1985. Analysis of the Chesterfield, Virginia power



Aerial photographs show the dramatic resurgence of SAV off the coast of Barren Island on the Eastern Shore from 1984 to 1985.
Courtesy of US EPA, Environmental Photographic Interpretation Center

plant fly ash site indicated high selenium levels in the settling area. At the Indian Head Maryland U.S. Naval Explosive facility, several inorganic metal levels appeared high. In 1986, F&WS revisited all 1985 sites and added bioassay testing and histopathology analysis. Preliminary results from the first two sites indicated chronic toxicity to small invertebrates.

F&WS is involved in several activities to track and assess key Chesapeake Bay living resources, particularly SAV. In both 1985 and 1986, F&WS jointly supported comprehensive aerial photography and a Baywide map report program of SAV.

The Service also completed a list of Chesapeake Species of Special Emphasis (CHESSE's) and began trend analysis on 35–40 waterfowl species on this list. A special study of black duck habitat changes in three eastern shore counties was completed. A report on this project and one on the status of ospreys on the mid-Eastern Shore are due early in 1987. A report on the photo-interpretation of shoreline alterations in two western shore Maryland counties between 1950 and 1980 will be released in the spring of 1987.

The broad aim of the F&WS Striped Bass Program is to supplement and restore low breeding stocks. In the autumn of 1985, F&WS cooperated with Maryland fisheries personnel to release about 200,000 specially tagged, 4–10 inch rockfish into rivers where parent fish were taken in spring. Maryland's production goal in 1986 was 1 to 1.5 million released fish. Virginia joined the program in 1986. Both states used federal and state hatcheries for fish rearing.

F&WS had a very active public information program in 1985–86. The Service developed and set up exhibits at numerous public events. It has produced a coloring book on the mythical Chessie monster and several fact sheets on Bay fish and wildlife species. F&WS worked with the Corps of Engineers to produce a guide for SAV identification, and the Service cooperated in a television film on striped bass.

Courtesy of US Fish & Wildlife Service

PROGRAM SUPPORT

Program support functions provide the administrative and analytic services needed to knit together the substantive elements of the Chesapeake Bay Program. These functions include public information/participation, data management and analysis, grant and contract administration, committee support, and provision of technical advice and coordination.

PUBLIC INFORMATION / PARTICIPATION

The Citizens Program for Chesapeake Bay, Inc. (CPCB) continued to produce educational and informational materials and to organize opportunities for interested citizens to become directly involved in the Chesapeake Bay Program.

Highlights of the year included distribution of the first printing of 21,000 copies of "Baybook: A Guide to Reducing Water Pollution At Home." Initial response to the publication was so enthusiastic that CPCB solicited funds from a number of agencies, organizations and corporations, and was able to produce a second printing of 36,000 copies. Baybook is being distributed through soil conservation districts, garden stores, and community and civic associations. CPCB also produced a brochure describing the kinds of services it provides to the public. The brochure was mailed to garden clubs, service organizations, schools, and community groups. Four issues of Chesapeake Citizen Report were published and distributed to over 12,000 people.

The volunteer monitoring program was expanded. The success of the initial efforts on the James and Patuxent rivers, where 30 volunteers continue to take weekly samples, led to the establishment of a program on the Choptank River under the auspices of the Maryland Department of Natural Resources. Planning and recruiting for a program on the Conestoga River in Pennsylvania began in the fall of 1986. CPCB staff also assisted the City of Annapolis in training volunteers for Back Creek. They trained the West River Association to start a citizen monitoring group on that river. The handbook which CPCB developed has been revised and is used by each volunteer. Data have been entered into the computer at the Chesapeake Bay Liaison Office in Annapolis, MD. Monitors are kept informed about the program through a bimonthly newsletter called "Rivertrends."

CPCB expanded its program into Pennsylvania by awarding three contracts to the Pennsylvania Association of Conservation District Directors, the League of

Volunteers testing water quality of Jug Bay Wetlands Sanctuary on the Patuxent River in Maryland
Courtesy of Citizens Program for the Chesapeake Bay Inc

Women Voters and the Susquehanna River Tri-State Association. These groups conducted a wide variety of educational activities, including town meetings, tours, slide shows, educational brochures, a farm survey and a series of fact sheets on the Susquehanna's connection to the Bay. In May 1986, CPCB hired a full-time staff person in Harrisburg who is working with citizens and agencies.

The citizen volunteers submerged aquatic vegetation (SAV) monitoring project initiated on a small-scale in 1985, grew to a sizable effort in 1986. Yacht clubs and marinas were enlisted to participate in mapping submerged grasses. Over 500 citizen volunteers participated.

In Virginia, the need for timely information related to the new river basin citizen advisory committees was met with the creation of a monthly newsletter called "Chesapeake River Report." The newsletter highlights statewide issues of interest and focuses each month on specific activities in each of Virginia's major river basins. It is being used as a model for similar publications in the other states.

The CPCB provides staff support to the Citizens Advisory Committee (CAC) and its five issue oriented task forces. In 1986, support included participation on the task force which developed a Bay Program Communication Strategy, secretariat support for four quarterly meetings of the CAC, and numerous task force activities. CPCB also assisted the CAC to submit testimony to Senator Charles Mathias for an oversight hearing concerning future directions for the Bay Program.

The Chesapeake Citizen Directory was updated. This involved contacting over 300 agencies and organizations. The new edition of the directory includes a number of groups not included in the first publication. CPCB staff participated in numerous citizen organization meetings, worked with Chesapeake Bay Foundation (CBF) and the Junior League of Annapolis to develop a slide show for homeowners, gave many presentations to groups, and filled hundreds of requests for information. Staff helped plan a major Bay-related conference in Baltimore County, Maryland, produced an exhibit on citizens monitoring, participated in a number of outdoor festivals, and consulted with organizations needing help to arrange Bay-oriented functions.

The goal of monitoring within discrete watersheds was pursued. A project to develop a handbook for rivershed associations was initiated and the CPCB staff assisted with the planning of and participated in several basin events. These events included a Chester River workshop and a Baltimore County River and Streams conference. Mailing lists are being coded by basin to allow easy access to citizens in particular watersheds.

DATA MANAGEMENT

Achievement of the goals of protecting and restoring Chesapeake Bay relies directly on acquiring, analyzing, and presenting data. The integrity of Chesapeake Bay Program (CBP) data directly affects the ability of governments to formulate justifiable laws, regulations, and policies. Data management includes editing, reformatting, and documenting incoming data in addition to appraising and potentially incorporating new methods of data organization such as a geographic information system (GIS).

Chesapeake Bay data are stored and managed at the CBP Computer Center in Annapolis, MD. The data base now includes a fully documented historical component dating back to 1880. It also contains the information from CBP's water quality monitoring program that began in June 1984 which includes water chemistry data for the main Bay and tidal tributaries. Climatic, shoreline location, bathymetric, and biological data have also been contributed.

Additional software applications installed in FY86 have placed increased demand on the CBP Computer Center. A watershed model and steady state, water quality model have been loaded onto the computer. A geographic information system has also been installed to provide analysis and presentation of data with varying spatial resolution.

To meet the FY86 demand on the Computer Center, EPA and the CBP partners purchased additional equipment and software. Contractor support staff doubled from FY85 to FY86 up to 12 members. EPA hired a full-time Data Management Coordinator to oversee Computer Center operations and to function as the CBP contact for data processing support.

The Data Management Subcommittee has produced documentation standards and data submission policy for water quality and biological data. These plans have become the cornerstone of CBP grants and contracts to ensure that data are produced in quality assured formats. Additional policy and plans have been developed for CBP GIS and Computer Center FY87 procurement needs.

OTHER SUPPORT

Another important management element performed through CBLO staff is the coordination of monitoring activities through support of the Monitoring Subcommittee and management of the mainstem monitoring grants to Maryland and Virginia. The Modeling and Research Subcommittee (MARS) activities on the watershed model, steady-state model, and planning for the time-variable model required extensive technical and contract management support in 1986.

Grant and contract administration, including processing awards, modifications, evaluation of deliverable products, and closeouts is essential to the management of most Bay Program work. Finally, committee support is provided by the Chesapeake Bay Liaison Office. The Executive Council and Implementation Committee and their five subcommittees are joined by numerous ad hoc task forces requiring preparation of agendas, briefing materials, reports, and minutes.

Technical support is provided to the Program through the services of the STAC, Chesapeake Research Consortium, the Model Evaluation Group and Chesapeake Bay Program staff. CBLO staff supplements the Citizens Program efforts in public information, media relations and other public affairs activities.

Outlook

Through an effective partnership of state, federal and regional agencies, and citizens concerned about the Bay, we have made progress in the past two years. Still, the Chesapeake Bay Program has only begun. We have much to do to restore and protect the living resources and water quality of the Bay.

We have much to learn about the Bay ecosystem. For example, we do not fully understand how nutrients and toxic substances are transported and modified as they move within the ecosystem. We have not clearly defined how nutrients are released from the sediments and how they can then contribute to the algae and dissolved oxygen problems. We also need to better understand the fate and transport of toxic contaminants, both organic chemicals and heavy metals, in the estuarine environment. Without a clearer knowledge of their behavior, it will remain difficult to propose and adopt criteria and standards for these contaminants.

Despite the unknowns, our programs are developing and will improve. As we learn more about the Bay ecosystem and better define goals, programs are modified to make them more effective. As we change programs, we may also modify how and through whom they are implemented. Through the Agreement partnership, we have created new institutions—committees cutting across agencies, states, and the region. What we learn through the partnership will lead us to form more effective working arrangements. As we move forward, other estuarine programs around the country are tracking our progress and using our Program as a model for structuring their own cleanup efforts.

The activities of each federal agency and political jurisdiction for the Bay will continue to be reported to the people of the region. The Bay Program will also address public concerns and welcome advice about the Bay's problems from a variety of sources. Our program, policies, and laws are important, but without the long-term support and participation of an informed citizenry we cannot succeed. Only long-term public support will enable the necessary work to continue. People of the region and the nation must understand that the Bay's problems have no instant solutions. Decades of hard, creative work and many dollars will be required.

The Executive Council pledges to continue the work to bring back the Bay. The three new governors who have taken office in Virginia, Maryland, and Pennsylvania since 1985, have reaffirmed the commitment to the restoration and protection effort.

Although ours is a long-term effort, we are proud of the incremental improvements already attained, and hope to be able to point to accelerated progress in the near future.