THE POTOMAC AND THE CHESAPEAKE

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN

CHESAPEAKE BAY PROGRAM FINDINGS

In 1976, Congress directed the Environmental Protection Agency (EPA) to conduct a five-year, $25-million study of the Chesapeake Bay. The massive effort ultimately required six years and $27 million. Completed in 1983, it identified 10 primary water quality problems of the Bay, and chose three critical areas from the ten to receive intensive investigation: nutrient enrichment, toxic substances, and the decline of submerged aquatic vegetation. The major findings of the Bay Program were:

- *SUBMERGED AQUATIC VEGETATION (SAV) HAS DECLINED THROUGHOUT THE BAY.* The loss of submerged aquatic vegetation appears to be most severe in the northern Bay and western shore tributaries.

- *OYSTER SPAT SET HAS DECLINED SIGNIFICANTLY IN THE PAST 10 YEARS,* particularly in the upper Bay, western tributaries, and some Eastern Shore areas such as the Chester River. Trends in oyster harvest show a similar pattern.

- *LANDINGS OF FRESHWATER-SPAWNING FISH, SUCH AS SHAD, ALEWIFE, AND STRIPED BASS, HAVE DECREASED IN RECENT YEARS.* Spawning success of these and other semi-anadromous or anadromous species has also been fair to poor in most areas sampled. Harvests of marine-spawning fish, such as menhaden, have generally remained stable, or increased.

- *LEVELS OF NUTRIENTS (PRIMARILY NITROGEN AND PHOSPHORUS) ARE INCREASING IN MANY AREAS OF THE BAY, LEADING TO DECLINING WATER QUALITY.* Nutrient enrichment is most severe in the northern and middle Bay, and upper reaches of tributaries and large algal blooms have been observed. Only parts of the Potomac and James River, and some smaller areas currently exhibit improving water quality with regard to nutrients.

- *THE AMOUNT OF BAY WATER SHOWING LOW (OR NO) DISSOLVED OXYGEN IN THE SUMMER IS ESTIMATED TO HAVE INCREASED 15-FOLD IN THE LAST 30 YEARS.* Currently, much of the water deeper than 39.8 ft. (12.4m) is anoxic from early mid-May through September in an area reaching from the Bay Bridge to the Rappahannock River.

- *ELEVATED LEVELS OF HEAVY METALS AND TOXIC ORGANIC COMPOUNDS ARE FOUND IN BAY WATER AND SEDIMENTS.* Highest concentrations occur near urban or industrialized areas, and in the upper Bay. Some of the toxicants are being bioconcentrated by plankton, shellfish, and finfish.

Source: EPA, Chesapeake Bay: A Framework for Action: September, 1983.

After more than 10,000 years of developing into a major and generous resource, and after 350 years of being taken for granted and subject to divided management, the Chesapeake Bay is coming into its own. The "Save the Bay" motto originated by the Chesapeake Bay Foundation has taken on new meaning. With the Chesapeake Bay Restoration and Protection Plan in hand, a vast range and number of Bay citizens — farmers, watermen, homemakers, educators, researchers, resource managers, legislators and governors — are poised to clean up the Bay together.

The Potomac River, where the "steps of history" are so readily traceable, is a significant part of this effort. *The Potomac is an integral part of the Bay.* Its watershed is the second largest in the Bay system, and its long history of water quality control efforts make it an important model for the Bay as a whole.

"The Potomac and the Chesapeake," reiterates the commitment of the Interstate Commission on the Potomac River Basin (ICPRB) since 1940 to improve and enhance the Potomac watershed. It reaffirms the Commission's 1983 resolution to give "first priority" to utilizing ICPRB's technical, educational, and coordination capability and experience on behalf of the Bay cleanup.

Cleanup efforts by the Potomac Basin states (Pennsylvania, Maryland, Virginia, West Virginia, and the District of Columbia), with support from the Environmental Protection Agency, have been notable. Those efforts, complemented by those of ICPRB and upper estuary local jurisdictions through the Metropolitan Washington Council of Governments (COG), have effected substantial improvement in the "Nation's River" since the second Potomac Enforcement Conference of 1969. The Potomac can boast a success story: oxygen-demand and phosphorus loadings from point sources (wastewater treatment plants) have been reduced by some 95 percent, pollution-sensitive fish have been returning to the upper tidal river, and aquatic vegetation is showing signs of reestablishment. A better-looking river, more boaters, and fishermen are among the results.

Great progress has been made, but *the Potomac is cleaner, not clean.* There have been some mixed signals: nutrient levels still remain high, sediment keeps accumulating, and the sizeable 1983 algal bloom was disturbing. In a world of uncertainty, one thing is certain. The Potomac estuary, as is the whole Chesapeake Bay system, is one complicated body of water. Restoring and preserving both is no simple matter — the mysteries are being "peeled back," one layer at a time. There will be no "quick-fix" for the cleanup process; it will be a matter of decades, not years. The public is advised to be optimistic, but patient.

The immediate challenge is to "fine-tune" the cleanup with more-limited resources, rather than using the singular emphasis of high technology of the past. A cost-effective mix of both point and nonpoint source pollution abatement strategies must be used. New tools such as the Potomac Eutrophication Model (PEM), will help achieve the greatest benefit at the lowest cost.

A well-informed public will continue to be crucial. The Commission hopes this publication is a worthy contribution in that respect.

On the cover: Aerial view of the mouth of the Potomac. Photo by John Long/long shots.

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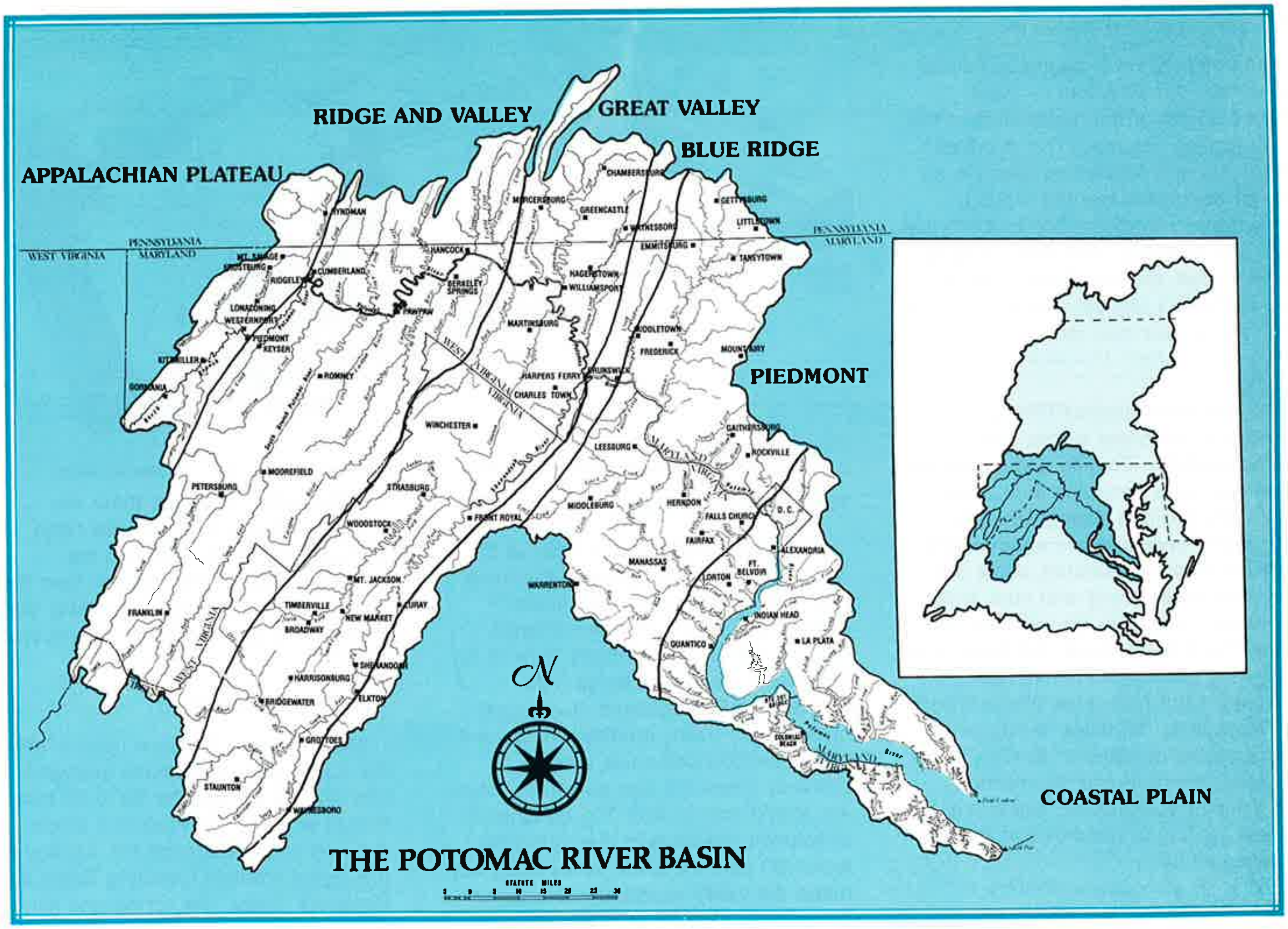


Not Only a River, a Basin

The basin of what is known as "The Nation's River," is like other basins: a geologic upland including mountains, ridges, and highlands to form a natural drainage area. The Potomac River flows 383 miles to meet the Chesapeake Bay. The tidal portion of the Potomac is a drowned river valley. The valley was flooded for the last time about 10,000 years ago as the glaciers of the last ice age melted and the sea level rose. The Potomac River is the principal stream that drains, with a complementary network of over 100 tributaries, an area of 14,670 square miles. It is water, not politics, that unifies portions of Pennsylvania, West Virginia, Virginia, Maryland, and all of the District of Columbia.

The Potomac watershed is small in comparison with other U.S. basins. The Missouri basin, for example, drains a land area more than 35 times larger. The uniqueness of the Potomac basin is in its variability. It traverses six distinctive physiographic areas as it travels 383 miles on its journey — beginning as a trickle in the West Virginia highlands and meeting the Chesapeake Bay with its broad, 10-mile mouth. These six areas (see page 4) have both shared and differing characteristics of climate, rainfall, stream patterns and distribution, groundwater characteristics and availability, topography, and soils. Coal exists only in one region; limestone is extensive in another; agricultural soils are in three parts of the basin, with highly fertile soils in one.

It is a region of warm, humid summers and moderately cold winters. The basin's average yearly rainfall ranges from 35 to 45 inches in much of the basin, and up to 60 inches at higher elevations in the western part. Precipitation is seasonally well-distributed and usually somewhat greater in the summer than in the winter. The basin rainfall generally favors agriculture, but does experience occasional, prolonged droughts. In most parts of the basin, periods of continuous snow cover are a few days to a few weeks long, the latter in the higher elevations.

The Potomac is known as a "flashy" river, because it is prone to floods in the higher spring flows and droughts in the dry autumns. The area is subject to intense summer thunderstorms and tropical hurricanes. About every two years, floodwaters rise to the brink of the Great Falls gorge. The largest recorded flow was 275 billion gallons per day in 1936 in the Washington, D.C., area. The lowest was 388 million gallons per day in 1966. Droughts have been a serious concern in the past, but are less so now with the construction of Bloomington Dam along with river and reservoir water supply coordination agreements between metropolitan Washington area jurisdictions. Groundwater is variable throughout the region, but more plentiful in the Great Valley and Coastal Plain regions.

Most basin residents rely on streams for their water or a combination of underground and surface sources. Most of the land is forested or in agricultural use (about 95 percent), and most of the basin's 4-million people (75 percent) live on less than five percent of the land area.

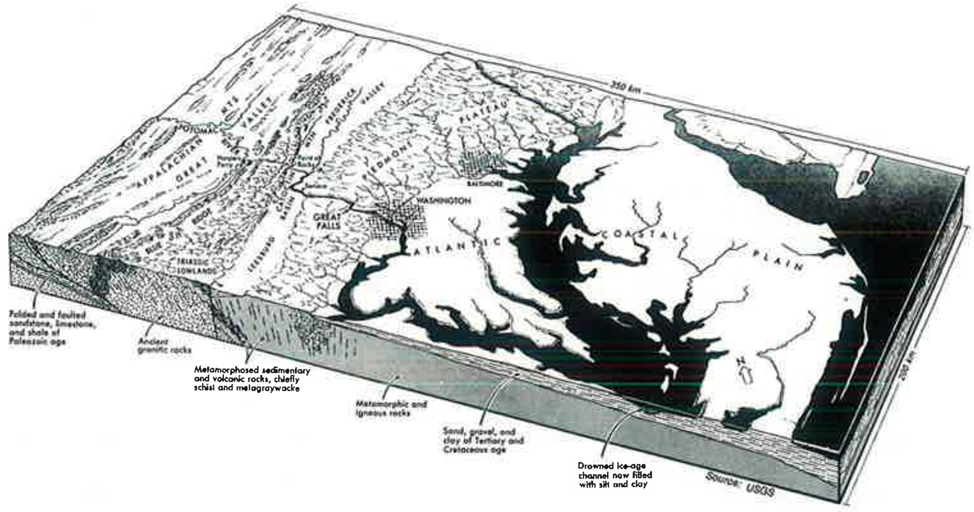
APPALACHIAN PLATEAU

The Potomac River begins at Fairfax Stone near the Maryland — West Virginia border at the headwaters of the North Branch Potomac. This sub-basin (about 7% of the Potomac basin) is an area of narrow valleys and rugged, steep ridges commonly 500 to 1,000 feet high, and reaching 3,000 feet along its eastern edge, the Allegheny Front. It has the basin's highest precipitation, 45 to 55 inches per year, with intense storms that subject the area to serious floods.

The mountain streams flow swiftly because of the steep slopes and low soil permeability. Erosion and landslides have long been problems here. This part of the basin is distinguished by horizontally bedded sedimentary rocks. They are mostly sandstone, shale and some limestone, along with coal, which has been mined here for well over 150 years. The acid drainage that flows from the mostly abandoned mines has rendered about half of the North Branch and more than 700 miles of tributaries almost devoid of aquatic life. Only a few tributaries support good recreational and fishing opportunities. There is a modest amount of groundwater that is usually very hard.

RIDGE AND VALLEY

The Ridge and Valley plus the Great Valley form the Ridge and Valley Province, which constitutes about 60 percent of the basin. This area is similar to the Appalachian Plateau, but with some distinguishing differences. The underlying rock formations, principally sandstone and shales, are what geologists call folded sedimentary rock. There is no coal here. The resistant sandstones have persisted to form the ridges, and the softer shales have eroded to form the narrow but fertile valleys. This unique configuration forms a series of parallel ridges and valleys that rise in typical elevations of 500 to 1,000 feet. Flow rates are generally higher here than elsewhere in the basin. The soils are thin and erodible. The low permeability and fractured rock allows for modest groundwater storage. This area has the lowest precipitation of the entire basin, averaging 32 to 35 inches per year. It is an area with high variability, experiencing both droughts and intense storms with periodic flash-flooding.



BLOCK DIAGRAM OF THE WASHINGTON-BALTIMORE REGION SHOWING PHYSIOGRAPHIC PROVINCES AND GEOGRAPHIC AND GEOLOGIC FEATURES

THE GREAT VALLEY

The Great Valley, also known as the Appalachian Valley, is one of the most important agricultural areas in the eastern U.S. It is part of a northeast-running corridor that ranges from 15 to 26 miles wide, and extends from Alabama to Pennsylvania. It is largely underlain by easily erodible shales and more common carbonate rocks—primarily limestone and dolomites, which are folded and faulted. The dominance of solution openings in the carbonate rocks (60 percent of the valley area) has made the valley essentially an aquifer throughout. Massanutten Mountain is the only evidence of the more-resistant sandstones that thrust upward from the valley floor to form a dramatic range of heights in excess of 2,000 feet.

The usual precipitation of 39 to 40 inches per year, along with the abundant ground water, means there is a large base flow. There is a fair amount of erosive land use. Leachate is a major concern, and thousands of subterranean cavernous chambers and aquifers through the carbonate rock areas make groundwater contamination an ever-present threat.

THE BLUE RIDGE

The Blue Ridge Mountains commonly rise and crest at 1,500 to 2,500 feet. Their highest point is Hawks' Bill, at over 4,000 feet. This province forms a narrow boundary of rock approximately 8 to 10 miles wide. Between 40 and 50 inches of rain falls annually on a heavily forested area with generally thin soils.

Most streams in the Blue Ridge are headwater tributaries of larger streams in the Ridge and Valley Province or in the Piedmont. However, there are several streams in larger inter-ridge valleys that flow directly into the Potomac River. All streamflow from the west of the Blue Ridge mountains flows through the gap at Harper's Ferry, W.Va.

THE PIEDMONT

The Piedmont Province (about 14% of the basin) generally slopes eastward from the Blue Ridge for 30 to 50 miles. Before entering the Piedmont proper, the river passes through the lowland in the highly erodible Leesburg Basin and Frederick Valley. The rolling and hilly terrain of the Piedmont proper overlies hard and resistant crystalline rocks. The erosion that has long been a problem in the area is a result of the combination of the erodible soils with long-term urbanization, agricultural land use, and rainfall. The Coastal Plain and the Piedmont commonly experience the most intense storms in the basin, sometimes as much as four inches in an hour.

THE COASTAL PLAIN

At Great Falls, the Potomac takes a series of plunges, dropping about 100 feet, and some 12 miles below Chain Bridge enters the soft sediments of the generally flat Coastal Plain (about 15% of the basin). The soils are naturally poor and infertile, and are excessively drained. Here the river comes under tidal influence, and eventually expands into a broad estuary. The water table is high in this area and vulnerable to pollution that limits the use of land for urbanization and agriculture. The annual precipitation is 40 inches, and flooding is often a result of the intense tropical storms to which it is subject.

LIVING RESOURCES

The most important criterion for any action related to the Chesapeake is, "What will it do to the biota?" Bay biologists emphasize this point. The biological system is the basis for almost all our uses. Fish harvests alone have been valued at approximately $750 million annually for the Chesapeake Bay region. For others in the "Land of Pleasant Living," the Bay's value is beyond estimate.

One thing is certain, the importance of the Bay cleanup momentum notwithstanding, knowledge about the biota and how the "pieces" of the Bay fit together is still limited. Unfortunately, there is a widely held public perception that both "the Bay and the Potomac have been studied to death." What is not generally understood is that: (1) Bay and Potomac research essentially dates only from the turn of the century and most of that, after World War II; efficient technological/scientific methods are of relatively recent vintage, and (2) the Bay system, the "great immense outdoor protein factory" that H. L. Mencken extolled, is enormously complex. The bumper stickers that say, "Save the Bay" are referring to a 64,000 square-mile area (14,670 sq. miles of which is the Potomac's basin), with 75 billion cubic yards of water and, over 2,700 species (apart from the human species, the latter of which continues to gravitate toward coastline living in increasing numbers). The studies have yielded very useful but only partial knowledge of parts of the Bay system — many aspects of the complete life cycles of even the more-important species remain missing. While research efforts continue, (given a big boost by the public's Bay commitment), management decisions that must be made on such concerns as fisheries pose challenges of no small magnitude.

The whole Bay system forms a largely mysterious complexity of a vast number of interdependent organisms and a variety of habitats. A total of 64 fish species have been documented in estuarine waters below Washington. We focus here on seven important Potomac shellfish and finfish, all of which depend on the relationship between the Potomac and the Bay: the oyster, blue crab, soft-shell clam, striped bass, shad, and the white and yellow perch.

The concern is the decline in fish abundance — the catches have been dropping dramatically. The main focus is on the failure of recruitment — the survival of larvae and juveniles — among Bay fisheries generally. Fishing pressure (sport and commercial), natural climatological factors (temperature, flow, etc.), and habitat (physical and chemical changes, pollution) all affect the bounty. Scientists are still confronted with incomplete knowledge, and they have not as yet identified any one cause for declines in harvests. Indeed, they warn, seeking simplistic answers is dangerous. The consensus grows that a combination of factors results in a "total stress" and the declining trends of recent years.

AMERICAN OYSTER

Over 30 percent of the oyster landings in the U.S. are from the Chesapeake Bay system. The oyster has been the Bay's most valuable money crop since the mid-1880s, when the annual harvests were more than 15-million bushels. The trend has been that of decreasing harvests of smaller oysters ever since. Current landings are only around 1 million bushels annually.

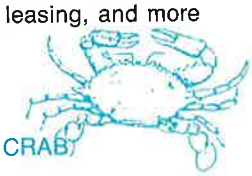
The heart of the Potomac's oyster fishery is now between its mouth and the confluence with the Wicomico River. In 1972, the freshwater flooding of Tropical Storm Agnes destroyed the portion of the fishery — an estimated 70 percent — from the Wicomico River up to Cedar Point. In spite of pollution problems, the lower Potomac still provides a good environment for growing oysters once they have "set" (when the larvae attach to substrate in order to mature). The Potomac's river bottom is hospitable, its lower salinity discourages oyster diseases, and predator oyster drills are absent. In this environment, a Potomac oyster can enjoy a lifetime of 10 to 15 years if not harvested.

It would appear that oyster production in the Potomac has always been characterized by major fluctuations (although good fishing data only date from the 1960s). The last peak occurred during the years from 1965-67, when the annual production averaged about 550,000 bushels. Since then, production has declined steadily, accelerated by Tropical Storm Agnes. During the last few years, yields have ranged between 30,000 and 175,000 bushels.

A good oyster yield depends on a good set. Oysters have a relatively complex life cycle: spawning takes place in open water, and the oyster goes through two larval stages before migrating to the bottom in search of a suitably firm substrate on which to set and mature to harvestable size (about 3 years). The Potomac setting pattern is erratic — low and typically irregular with good sets appearing only about every 10 to 15 years. The reasons for the pattern are unclear, though evidence suggests it may be normal. What is known is that oysters require a firm substrate to avoid sinking and smothering, and that temperature along with salinity are key variables in their survival.

Over-exploitation has been cited as one among several causes for low production, but sedimentation and over-enrichment by nutrients (both would affect dissolved oxygen levels and microscopic plant — phytoplankton — dynamics) are also concerns.

Shell and seed planting efforts by the Potomac River Fisheries Commission (PRFC) helped to increase production by up to 85 percent, according to some estimates (many watermen believe Mother Nature plays an important role). Some areas are better for growing oysters than others, and spat can be transplanted to areas with lower reproduction rates but with good environments for growth. Suggestions to alleviate the problem of irregular settings have been greater repletion efforts, additional bottom leasing, and more research.



ATLANTIC BLUE CRAB

While the oyster reigns in the winter Chesapeake, the Atlantic Blue Crab is the summer royalty. Common in marine waters from Nova Scotia to Uruguay, the pugnacious and speedy 10-legged crab with the brilliant blue claws (and red during spawning) is the second most valuable crop for the Bay. There are more crab eaters in the U.S. than any other part of the world (Japan runs second), and most of the crabs they eat come from the Bay. The Chesapeake provides the largest commercial crab fishery in the U.S., and the average annual catch is estimated at 60 to 70 million pounds.

The blue crab is truly an estuarine species, being found in nearly freshwater (mostly males) and nearly full-strength ocean water (mostly females). Its habitat varies from shallow embayments in the summer to deeper channels in the winter. It has a complex life cycle, and during its short lifetime (about 3 years), the crab will shed its shell at least 25 times in order to grow. The soft crab is a delicacy much in demand — while it constitutes only about 3.5 percent of the total Bay catch, it represents about 20 percent of the crab fisherman's income. The crabs mate (May-October) in the low-salinity waters of the upper estuaries. After mating, the majority of the males remain in fresher waters while the females head for the higher salinity spawning grounds. The optimum waters for crab growth appear to be the mid-salinity waters around 15 parts per thousand.

The eastern, lower Bay offers the best crab growing conditions, but the Potomac has a crab fishery on both the Maryland and Virginia shores. Both males and females can be found in the shallow waters along these shorelines from the river's mouth to the Route 301 Bridge in the summer. Above that point, mostly males, in relatively fewer numbers, sometimes venture to near the Nation's Capital during the drier summers.

The concern for the crab is not a decline in landings, but the wide harvest fluctuations. These fluctuations have been evident ever since landings have been recorded. Since 1966, Bay-wide blue crab harvests have jumped up and down between a high of 97 million pounds and a low of 45 million pounds. The reason for the wild fluctuation is not known, but does not currently threaten crab populations, and the supply meets the demand in most years.

The lower Bay area, where the sensitive crab larvae develop, is considerably less polluted than the upper Bay and its tributaries. Regulations discourage overfishing. More information about the life cycle of the crab is desirable, however. Natural conditions (salinity and temperature) play key roles in the cycle, but there are many unknowns. The geographic distribution, relative growth rate, seasonal migration, and over-wintering characteristics of the juvenile and adult crab are only generally understood. Not enough is known about environmental requirements or transport of the critical larval stages.

CLAMS

There are many species of clams in Chesapeake Bay, but most are too small to be harvested. Harvesting focuses on soft-shelled and hard clams. Of these, the soft-shell clam (called a "mannoe" by watermen) is the only one of any commercial significance in the Potomac. The Potomac is not salty enough for the hard clam.

The soft-shell clam is found throughout the Bay and its tributaries, the source for more than half of the total U.S. catch. The larger concentrations have occurred only in certain areas between the Potomac and the Chester Rivers. These clams are abundant on the Maryland side of the Potomac as far upstream as Mathias Point.

Historically, the soft-shell clam has been abundant in the Potomac estuary. Before the 1950s, however, the harvests were small because they had to be dug out by hand. The introduction of the hydraulic escalator harvestor in 1951 made them accessible to commercial fishing. Its distribution on the lower Potomac's sandy or sandy-mud bottoms is spotty. Commercial harvests in the 1950s were high, and the clams were much in demand from a New England market whose clam beds had been seriously depleted. The Potomac harvests began to dwindle, however, and by 1967 were at extremely low levels. Harvest fluctuations seem to be a natural occurrence, with pollution and fishing pressures providing additional stress. Bay clams are now limited to the southernmost region of their former range.

Reasons for the cyclic populations and die-offs are unknown. The clam beds were closed in 1972 following Tropical Storm Agnes, which caused a mortality of 90 percent in the already low stocks. It was hoped the closure would allow the stock to recover. Since the beds were reopened in 1976, however, the populations have not been reestablished in numbers sufficient to support a commercial fishery.

STRIPED BASS

There is no question that the striped bass, or rockfish, as it is called in Maryland, has been the undisputed king of the Chesapeake's food finfish. It has been the basis for the biggest finfish dollar crop not only in the Bay, but for the whole Atlantic Coast where "stripers" have provided a commercial fishery for over 200 years. It has accounted for about 50 percent of many commercial fishermen's take, and generates even more economically through the sport-fishing industry (more than $90 million yearly).

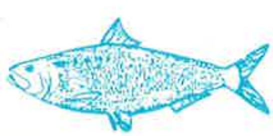
The decline in harvest yields over the last decade, therefore, is serious business for all Atlantic Coast fishermen. Their eyes turn toward the Bay, because studies have suggested that it is the source of some 70 percent of the East Coast's stock on the average, and perhaps as high as 90 percent in some years. The Potomac contributes about 20 percent to that stock, based on commercial landings.

The decline has been precipitous: 90 percent for both Atlantic Coast and Maryland commercial landings since 1973. Yearly harvests in the Potomac estuary are roughly half of 1960s average of more than one million pounds per year. In 1982, the total Potomac catch plummeted to 136,000 pounds, followed by a modest rebound of 600,000 pounds in 1984. Historically, rockfish populations show marked peaks and valleys, but the percentage of over all decline is significant. The variation is linked to spawning success and the survival of juveniles.

A semi-anadromous fish that can reach 50 to 60 pounds, the striped bass leaves saltier waters for tidal-fresh spawning grounds between April and May. Low salinities and desirable water temperatures make the Potomac one of the favored spawning areas. Its long reach of tidal fresh water makes it an unusually large nursery. The Maryland young-of-the-year index (an annual survey of juveniles averaging 2 to 5 months old) would suggest that the Potomac has had better rockfish spawning success than the Bay in general for the past several years. The upper Washington, D.C. area's fast waters have made it a spawning center in the past, but heavy urban pollution has forced the majority to spawn farther down in the 15 to 20 nautical miles above Maryland Point. District sport fishermen have been catching many 10 to 14 pounders for the last few summers. The fish move down into saltier waters as they grow, and the females migrate out of the Bay as far north as Nova Scotia before returning to spawn.

No scientifically proven single cause for low rockfish recruitment (egg and larval fish survival) has been established, though some scientists believe that there is an obvious connection between low recruitment and extensive habitat degradation. Overfishing has long been a concern (striped bass are vulnerable because they swim in schools), and environmental factors such as acid rain, viruses, toxics, temperature/oxygen "squeezes," abnormal flows, poor zooplankton densities, plus climatological factors all may be linked to lower recruitment.

Maryland, which harvests more rock than any other state, invoked a complete moratorium on catching striped bass that went into effect on January 1, 1985. The edict excludes the Potomac fishery, governed by PRFC. The PRFC has rejected the idea of a complete moratorium. Beginning in 1982 however, PRFC began to restrict fishing, and by 1984 had stringent regulations. In its view, there are so many unknowns in fisheries management, that the Commission's preference is to opt for a very limited and controlled fishery, a position firmed by the recent rebound in harvests. The PRFC now prohibits fishing between December 1 and May 31, and has set an 18" minimum length limit. The shortened fishing season should provide a reduction in catch, and the size limit should encourage reproduction by allowing females to spawn once before they reach harvest size.



AMERICAN SHAD

The heated debate over striped bass which frequently pits sportsfisherman, conservationists and resource managers in conflict with the Bay and Potomac watermen, does not extend to the shad. All these groups mourn the fact that there are not enough shad to get hot under the collar about.

The American shad is the largest member of the herring family on this continent. It has been considered a delicacy, both for its sweet meat and its large and heavy roe, since the 1700s. There were so many shad in the 18th century, that a single haul of the seine frequently yielded 5,000 shad, and thousands of barrels of them were salted and shipped to Baltimore and New York annually. The Potomac then boasted the largest shad fishery in the U.S. It was estimated that more than 22 million shad were taken in the 6-week spawning season of 1832. Fishing methods became more efficient and the shad were sought without pity until the Maryland conservation efforts of the early 1940s.

There is a correlation between the more aggressive fishing efforts and the decline of the shad. In 1899, some 2.5 million pounds were taken, and this yield generally was maintained through the 1960s. In the 1970s, however, the harvest declined dramatically: the 1978 Potomac catch was approximately 800,000 pounds and the figure dropped to 20,000 pounds in 1979. Some believe that the Soviet Bloc fishing fleets in the late 1960s and early 1970s seriously depleted the stocks. Fearing extinction of the shad, both Maryland and PRFC enacted a fishing ban in 1980.

Two reasons for depletion of shad stock are offered in addition to overfishing: the dams and weirs that form obstacles to spawning grounds and poor water quality. Chlorine residuals from sewage treatment and power plants are particularly suspect, and the adequacy of the food supply in recent years is not known.

This popular fish is smaller than the striped bass. The maximum weight is about 12 pounds, but in the 1970s, the few shad taken seldom exceeded three to four pounds. It is a minor subject of Bay research — there simply aren't enough shad to study. The general pattern of the shad's spawning behavior is well known. It spends three to four years in the Atlantic before it returns to the Bay's main rivers to spawn during April and May. The heavy eggs are spawned in tidal fresh shoals and can become buried in silt and mud and suffocate. The adult's stay in the Potomac is short, usually leaving by June. Most of the younger fish (about 2.5-inches long) are gone by the late fall. Little is known about its Atlantic migration. The hope is that the shad will continue to spawn in the less-urbanized rivers along the Atlantic Coast, and that they will eventually return in quantity to their historic home, the Bay and the Potomac.

THE PERCHES

Two other Bay/Potomac finfish that have been identified as being in decline are the yellow and the white perch. These two fish are popular sport fish; both provide a commercial fishery, though it is limited by their small size (usually less than 10 inches in length and a pound in weight). The white perch has the more desirable meat.

The yellow perch is the harbinger of spring for Potomac fishermen. It is the first spawner to arrive, joining the crocuses just after the ice breaks in late February. There is some overlap in the spawning areas of both fish, but the yellow perch goes farther upstream. It spawns until early April, preferring the narrow, slow-moving streams a few feet in depth. Aquia and Nanjemoy creeks, and the Potomac, Occoquan, and Wicomico rivers are active spawning areas.

The white perch arrives later, in April and May. In one year-long study, white perch were the most numerous food species caught — they were outnumbered only by two forage fish, the Bay anchovy and Atlantic menhaden.

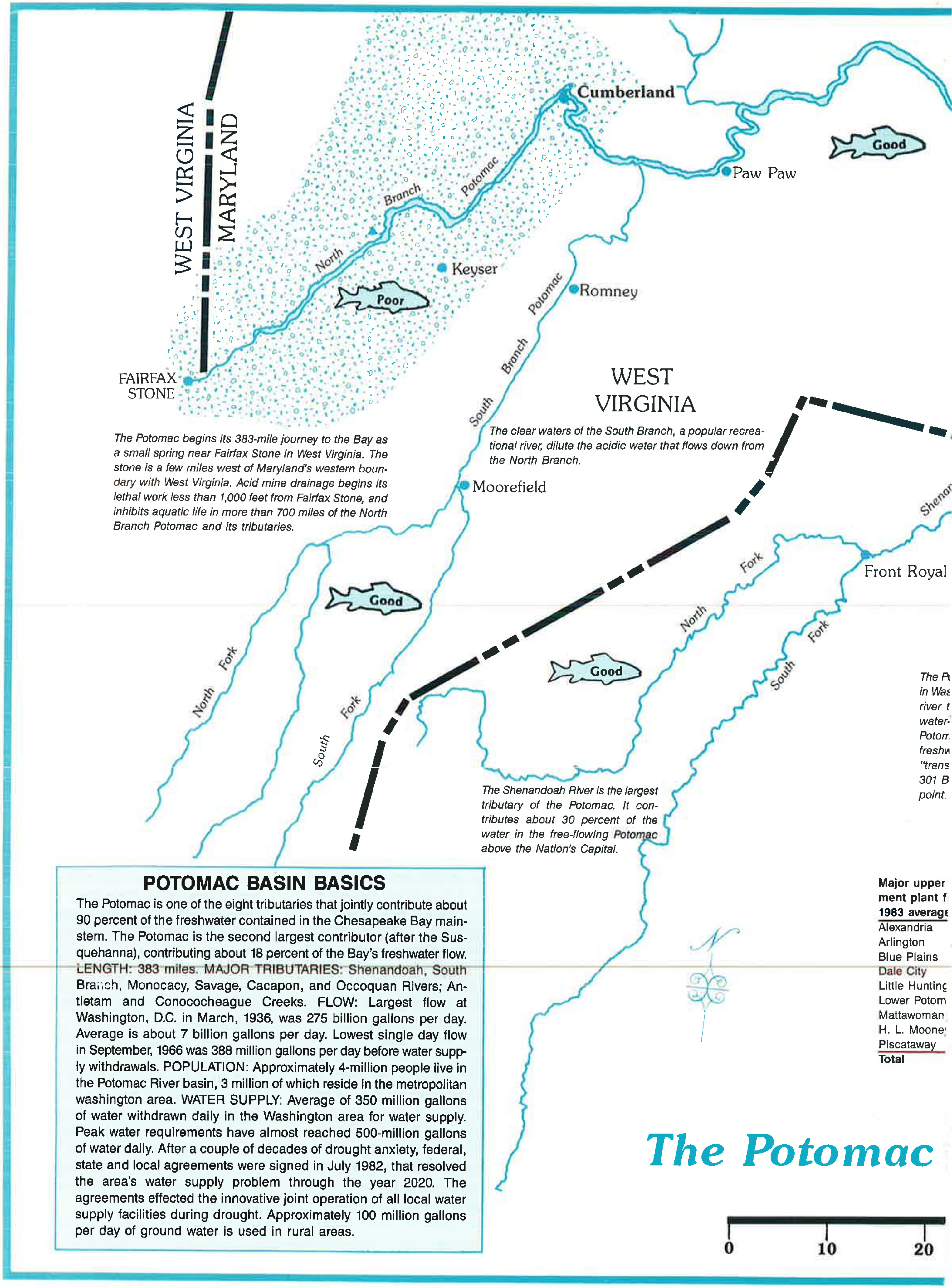
The white perch looks similar to a perch, but is actually a bass.

Both of these fish are similar in size but with different markings. Both fish appear to be indigenous to their home streams, and both were formerly considerably more abundant in the upper reaches of the Potomac near Washington.

According to a Maryland biologist who has been monitoring Maryland fish runs for almost two decades, both white and yellow perch have been on the decline, with that of the yellow perch the more dramatic. Over the last 20 years, the largest Potomac harvest figure for the yellow perch was 64,045 pounds in 1965. The smallest harvest was 182 pounds in 1982. The 1984 harvest was 352 pounds.

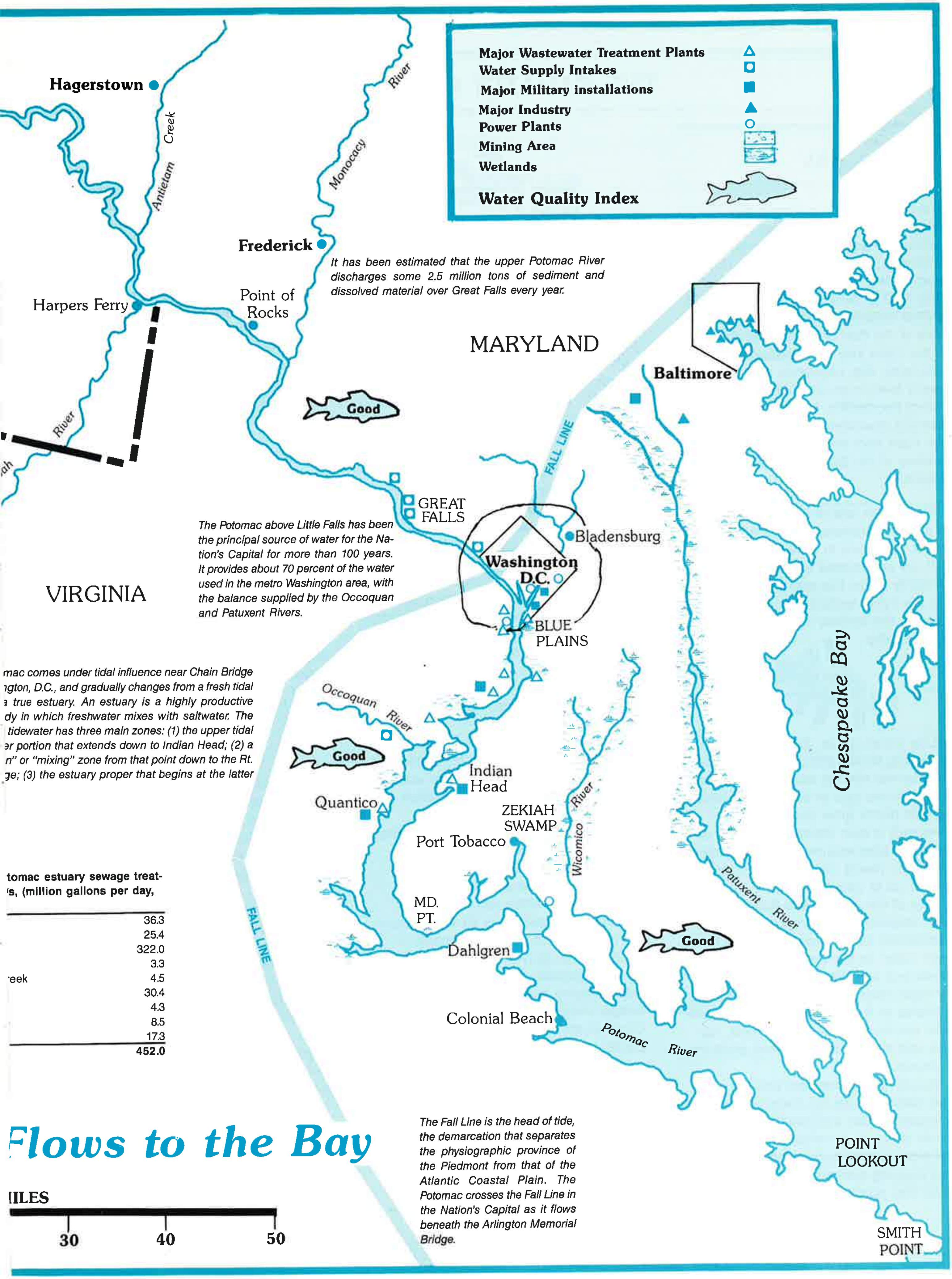
Over the same period, Potomac white perch populations, while fluctuating, have been consistently large. The total harvest of white perch hit a high of 556,218 pounds in 1969, and a low of 46,700 pounds in 1974. The 1984 harvest was 105,648 pounds.

Efforts to protect the striped bass may increase harvest pressures on both perches.



POTOMAC BASIN BASICS

The Potomac is one of the eight tributaries that jointly contribute about 90 percent of the freshwater contained in the Chesapeake Bay mainstem. The Potomac is the second largest contributor (after the Susquehanna), contributing about 18 percent of the Bay's freshwater flow. LENGTH: 383 miles. MAJOR TRIBUTARIES: Shenandoah, South Branch, Monocacy, Savage, Cacapon, and Occoquan Rivers; Antietam and Conococheague Creeks. FLOW: Largest flow at Washington, D.C. in March, 1936, was 275 billion gallons per day. Average is about 7 billion gallons per day. Lowest single day flow in September, 1966 was 388 million gallons per day before water supply withdrawals. POPULATION: Approximately 4-million people live in the Potomac River basin, 3 million of which reside in the metropolitan washington area. WATER SUPPLY: Average of 350 million gallons of water withdrawn daily in the Washington area for water supply. Peak water requirements have almost reached 500-million gallons of water daily. After a couple of decades of drought anxiety, federal, state and local agreements were signed in July 1982, that resolved the area's water supply problem through the year 2020. The agreements effected the innovative joint operation of all local water supply facilities during drought. Approximately 100 million gallons per day of ground water is used in rural areas.



It has been estimated that the upper Potomac River discharges some 2.5 million tons of sediment and dissolved material over Great Falls every year.

The Potomac above Little Falls has been the principal source of water for the Nation's Capital for more than 100 years. It provides about 70 percent of the water used in the metro Washington area, with the balance supplied by the Occoquan and Patuxent Rivers.

mac comes under tidal influence near Chain Bridge ngton, D.C., and gradually changes from a fresh tidal a true estuary. An estuary is a highly productive dy in which freshwater mixes with saltwater. The tidewater has three main zones: (1) the upper tidal er portion that extends down to Indian Head; (2) a n" or "mixing" zone from that point down to the Rt. ge; (3) the estuary proper that begins at the latter

tomac estuary sewage treat-
's, (million gallons per day,

	36.3
	25.4
	322.0
	3.3
'eek	4.5
	30.4
	4.3
	8.5
	17.3
	452.0

Flows to the Bay

The Fall Line is the head of tide, the demarcation that separates the physiographic province of the Piedmont from that of the Atlantic Coastal Plain. The Potomac crosses the Fall Line in the Nation's Capital as it flows beneath the Arlington Memorial Bridge.

THE QUALITY OF WATER

SAV

Since 1965, the Chesapeake Bay has experienced an unprecedented decline in submerged aquatic vegetation (SAV), according to the EPA Chesapeake Bay Program (CBP). The decline accelerated from 1972 to 1974. The pattern of drastic decline includes all species in all sections of the Bay, but it is most dramatic in the upper Bay and Western Shore tributaries. Bay vegetation may be at its lowest level in recorded history. The pattern of the decline, in plant density, diversity, abundance, and distribution, has been from the upper to lower reaches of the Bay and its tidal tributaries.

More often referred to as bay-grasses or simply, "grasses," SAV is not marsh grass, but refers to a variety of grasses that are submerged and that grow primarily below the water surface. They too are living resources, but we examine them in this section as indicators of water quality.

Like marsh grass, SAV is distributed according to its salinity tolerance. The SAV cannot tolerate excessive wave action, and the type of substrate in which aquatic plants grow (some float unrooted) is also important, as well as light and temperature. In relatively clear water, the plants can survive in water depths up to about 10 feet.

One of the three prime focuses of the CBP research, these important submerged plants have several significant "jobs" in the Bay. They are highly productive and are an important part of the food chain, forming a link between nutrients in the sediment and water column and invertebrates, fish, birds, reptiles and mammals. Waterfowl particularly depend on SAV.

Submerged plants also provide cover and nursery areas for many commercially important fish and shellfish. The plants serve as an effective erosion control mechanism, dampening wave action and trapping sediment running off the land. The plants act as nutrient buffers,

absorbing a good quantity of the troublesome excess nutrients. Seasonally, SAV is an important source of dissolved oxygen. Aquatic plants are indicators of water quality, since it is critical to their survival. In addition, they help us understand the interrelationship between plants and other ecosystem components.

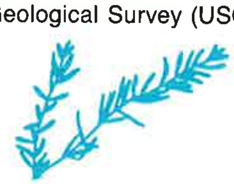
While there is no scientific way to measure the exact distribution of SAV 50 to 100 years ago, various historical accounts and sediment-core analyses indicate that SAV was very abundant throughout the Bay between 1700 and 1930. During the last 50 years, however, there were several distinct periods when SAV in large portions of the Bay have undergone major fluctuations.

As early as 1875, reports indicate that both the freshwater tidal portion of the Potomac and its estuary contained not only a diversity of aquatic plants, but had them in abundance. A 1916 map of the upper estuary in Washington, D.C., shows a narrow channel of water cutting through wide, shallow, vegetated borders.

All SAV species disappeared in the tidal freshwater portion of the Potomac in the 1930s (although the river was choked with water chestnuts, which are not considered SAV).

Eelgrass, of major importance to Bay watermen, was once abundant in the estuary up to the vicinity of Cobb Island. It disappeared from the lower estuary in the 1930s (and from other Atlantic Coast estuaries as well), returning in abundance only temporarily in 1965. By the early 1960s, only narrow zones of aquatic plants remained in the lower estuary below the Route 301 Bridge. Only the Port Tobacco/Nanjemoy Creek sustained an abundance of plants.

The first comprehensive survey of the tidal Potomac SAV began in 1978, under the U.S. Geological Survey (USGS), in



cooperation with the U.S. Fish and Wildlife Services. The four-year survey documented the present distribution and abundance of SAV and demonstrated a dramatic change from the early 1900s. Between 1978 and 1981 most of the 15 species of SAV were located in the "transition zone," between the upper tidal freshwater Potomac and the estuary. In 1983 SAV began its return to the tidal Potomac (a return that included the invasive *Hydrilla*). by 1985, SAV areal coverage reached more than 3,600 acres in the upper tidal fresh estuary.

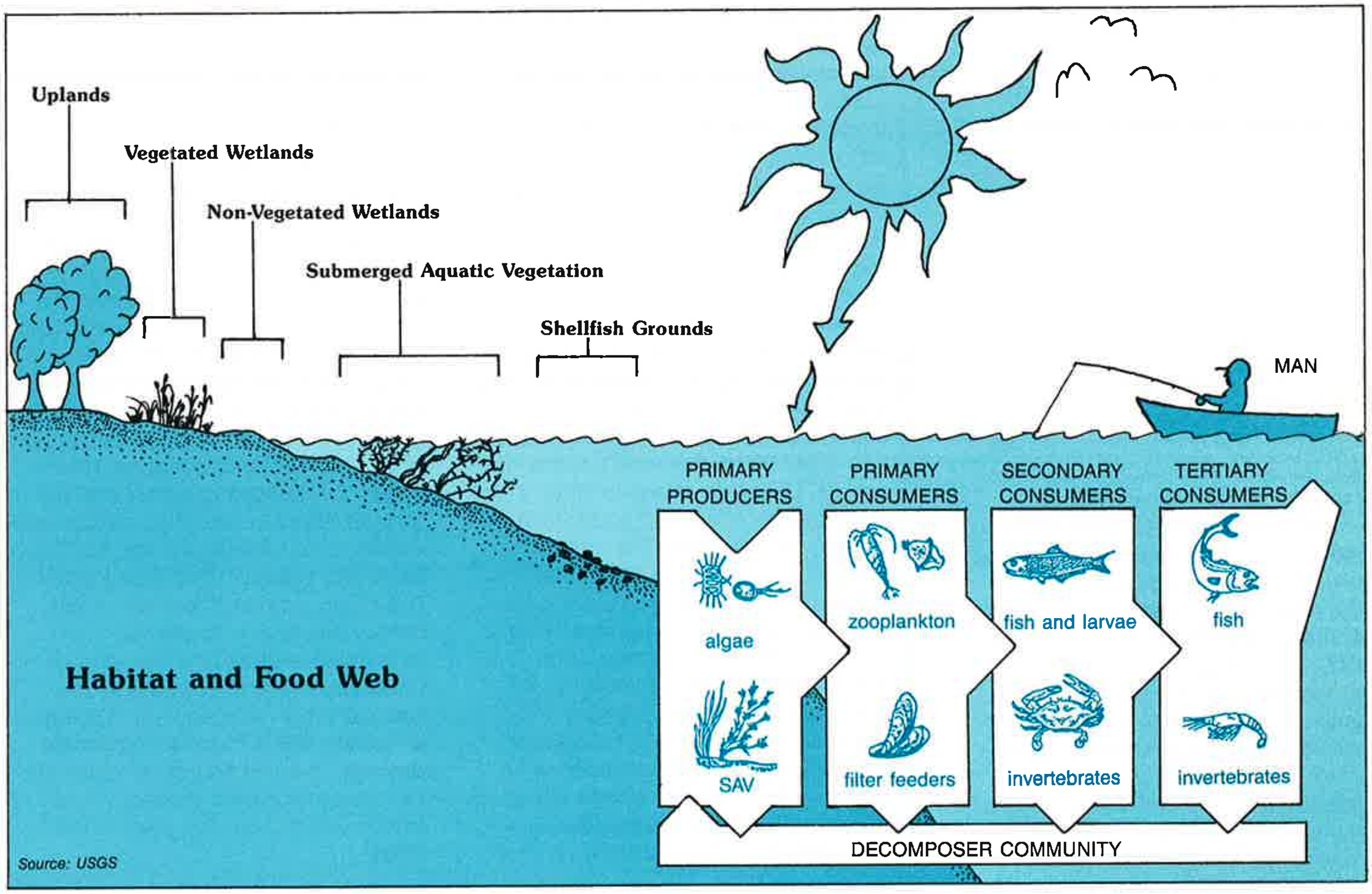
Hydrilla is considered a foreign invader. While boaters and others fear its

aggressive, choking behavior and awesome reproductive capability, others view any aquatic plant as a symbol of improving water quality. It has been demonstrating the aggressive behavior similar to that of the invading water chestnut of the 1930s and 1940s, and two later invasions of Eurasian watermilfoil.

Why did SAV decline? Scientists do not fully understand the complex interactions of a variety of factors that appear to influence SAV distribution and abundance. Probable factors include storm damage, light reduction, nutrient enrichment, and grazing pressure. Herbicides, which enter the water mainly from agricultural runoff, have generally been ruled out because of their rapid degradation of the water.

According to the CBP studies, however, there seems to be a relationship between SAV decline and runoff. All plants, including SAV, need light. Light penetration in the Potomac has been limited by heavy sediment loads, and from shading by extensive algal mats.

The return of some SAV in the Potomac is a good sign, however, the future of SAV is uncertain because it is not known why the plants declined, nor why some have returned.



The world that Potomac River and Chesapeake Bay species call home looks deceptively simple. It is not simple. It is a highly complex, inter-dependent and dynamic realm. Key to that world is the water itself which can vary widely, reflecting differences in temperature, salinity, and circulation plus a wide variety of interacting organic and inorganic materials. The river and bay species form five basic biological communities: the marsh dweller, bay grass, plankton, benthos or bottom dweller, and swimmer communities. All have differing physical and chemical requirements. These communities depend on one another to survive, playing the various roles of shelter, predator, or preyed upon in the complex network of feeding interactions called the food web.

The Potomac River demands dissolved oxygen (DO). Oxygen is probably the most crucial water quality characteristic. It is competed for by basic processes continually at work in the river: 1) the respiration of all living things in the water; 2) the decomposition or conversion of organic materials by bacteria and other organisms or by chemical processes. These processes take place both in the water column and in the bottom sediments. Oxygen enters the water by absorption directly from the atmosphere (wind, waves) or by plant photosynthesis. Dissolved oxygen requirements vary for aquatic species, but generally, waters with DO concentrations less than 5.0 milligrans per liter (mg/l) for extensive periods will not support good fisheries.

Because wastewater contains enormous quantities of oxygen-demanding organic materials, the nine major metro area sewage treatment plants (STPs) have been the prime focus of pollution control efforts for the last 15 years. As of June 1985, well over $1 billion had been spent to reduce oxygen-demanding STP wasteloads by some 95 percent from 1970 levels. The river's DO levels have risen significantly at the same time. At the Woodrow Wilson Bridge, below Washington, D.C., where DO measurements have been lowest historically, preliminary data showed levels ranging between 5 and 7 mg/l for 80 percent of the time during the summer of 1985. Oxygen-demanding materials also have been reduced at combined sewer overflows (an estimated 75 percent since 1960s) and through recently developed nonpoint source controls.

In spite of these great strides in reversing the long-term deterioration of the tidewater Potomac, there have been some violations in meeting the DO standard of 5 mg/l since 1982. These violations and considerations to expand metro area STPs and, therefore, increase wasteloads, have resulted in a proposal to further reduce oxygen-demanding materials through nitrification at more area STPs (it has been at Blue Plains since 1982). Nitrification breaks down organic nitrogen and ammonia into nitrates through exposure to oxygen before they enter the river. Nitrification is a controversial issue because of cost and several unanswered scientific questions.

The issue of low DO in the lower Potomac is the phenomenon of bottom-water anoxia (no oxygen) for around 75 to 90 square miles of bottom area, primarily below 30 feet, in the late summer. Some scientists believe this is a natural occurrence that may go back as far as Captain John Smith. According to USGS, the two main causes are: 1) the interaction and effect of tidal circulation, and 2) the depletion of oxygen by decaying algae that grow as a result of abundant nutrients in the water.

NUTRIENTS

According to the Chesapeake Bay Program, nutrient levels have increased in many parts of the Bay over the last several decades. These excess nutrients, primarily nitrogen and phosphorus, have contributed to water degradation. The upper, low-salinity reaches of almost all of the western tributaries, where populations are greatest, are highly enriched. Moderate concentrations of nutrients are found in the lower portions of the tributaries and eastern embayments.

Nitrogen (N) and phosphorus (P) are called nutrients because they are essential to plant growth. When they are available in low amounts, they cause no problem. Excessive nutrient levels, however, cause the growth of undesirable algae, reduced water clarity, and under some conditions, a depletion of oxygen. Plant growth requires these two nutrients in a ratio of 16 parts N to 1 part P. If availability of either nutrient drops below this general ratio, it is considered "limiting" to plant growth. Before a nutrient control strategy can be designed, the "limiting" nutrient must be determined.

Scientists are not certain where nutrients go and why, but they have a good idea where they come from. Nonpoint sources, especially agricultural land runoff, is a significant source of N enrichment. Point sources (industrial and municipal discharges) are the major sources of P enrichment.

According to USGS, approximately half of the Potomac's nutrient loadings entering the estuary come from the watershed upstream of the Fall Line, while the other half comes from below. Of the latter, roughly speaking, half comes from point sources, the other half from nonpoint sources. They concentrate in the upper tidal river, with an estimated 25 percent eventually making it to the Bay proper. The balance is recycled within the estuary, but scientists are not sure how.

Nutrient loadings and sources vary with the season: during periods of high river flow, the Potomac River contributes considerably more N and P to the tidal river than do metropolitan STPs. During low-flow periods, the river upstream of the Fall Line and the STPs below contribute approximately equal quantities of nutrients.

Sediment plays a significant role in nutrient transport and disposition, an old story in the Potomac (see box). Sediment is a carrier, adsorbing both nutrients, but primarily P. Sediment releases nutrients back into the water column under certain conditions. Sediment is not simply discharged into the Bay as through a pipe. The bulk of the sediment is trapped within the estuary, with greater accumulations generally taking place in the upper and middle estuary. The Potomac actually receives a net sediment contribution from the Bay proper. The biggest source of Potomac sediment comes from above the Fall Line, where some 50-million tons are eroded yearly. Most of that sediment remains above the Fall Line, stored on hillslopes, flood plains, and in channels. In an average year, the tidal Potomac receives about 1.5-million tons of sediment.

Declining concentrations of P in the upper and N in the lower Potomac estuary are part of the river's improvement. Over $1 billion has been spent to upgrade metropolitan Washington STPs; about $100 million is spent to operate them annually. The Blue Plains regional STP, the Potomac's biggest discharger, is the recipient of the lion's share of this money. As a result, metro area STP discharges of P have been reduced by 96.2 percent between 1970 and 1984. Some Potomac states are considering limiting phosphates in detergents. Maryland began limiting phosphates in 1985. N is not currently removed by the area STPs because of high costs and questions of effectiveness in the upper river. The goal of the State/EPA (upper tidal) Potomac Strategy is to maintain current nutrient discharge levels in the face of expanding treatment.

More attention is now being given to nonpoint sources of nutrients. Because they are diffuse, widespread, and intermittent in nature, they are difficult and costly to control. An increasing emphasis has been placed by both state and local jurisdictions on Best Management Practices (BMPs) in both agricultural and urban areas. Application of agricultural BMPs have not been as successful as hoped. In 1983, it was estimated that while 45 to 50 percent of the upper Potomac basin farmers entered conservation agreements, only 15 percent actually applied all the BMPs called for. The urban area has installed more than 3,500 stormwater structures or BMPs, such as porous pavement, wet or dry ponds, and infiltration devices.

EROSION AND SEDIMENTATION are natural processes that continually reshape the Bay and its tributaries. Man's activities, however, can accelerate this process significantly, and reduce their useful lifetimes. In the framework of geologic time (thousands of years), the question is not if the Potomac estuary will be filled in by sediment, but when. Given current sedimentation rates, dramatic changes are expected within 50 to 100 years in the upper tidal fresh Potomac that flows past the Nation's Capital. Sedimentation has a long history in the Potomac River basin, particularly in the Washington, D.C. area. When the basin's first settlers saw St. Clement's Island in 1634, it was described as about 400 acres; today it is less than 40 acres. The one-crop tobacco farming which "wore out" the soil in colonial times resulted in severe erosion. George Washington in 1783 described the tidal Potomac as an "inexhaustible fund of rich mud." Port Tobacco on the lower Potomac and Bladensburg on the Anacostia River were important Maryland seaports for decades, but the sites of their old docks are well inland today. Georgetown in Washington, D.C. constructed its deep wharf in 1762, but by the early 1800s, sea-going ships could no longer reach it because of siltation. The mechanization of agriculture and subsequent marked increase in land clearance caused the period of maximum basin-wide erosion from 1840 to 1920. Siltation resulting from upland settlement and deforestation, particularly in the notoriously erodible lower Piedmont, had caused dramatic changes in the Potomac that flowed by Washington, D.C. by the latter part of the 19th century. The wide and deep bays where Rock and Tiber creeks met the Potomac in the Federal City no longer existed. Constitution Avenue now follows the path of the filled-in Tiber Creek. The buildup of silt created the polluted Potomac mud flats, which were reclaimed and developed into the Tidal Basin and Potomac Park in the 1880s. The erosion rate was lowered in this century due to a reduction in agricultural land and the introduction of conservation practices in the 1930s. Post-war urban development in the late 1950s and 1960s increased sediment loadings from that source substantially, and county and state sediment laws were enacted to reduce them in the 1970s.

TOXICS

Unnaturally, and in some cases, alarmingly high concentrations of toxic heavy metals and organic compounds are found in Bay water and sediments, particularly around urban areas. There is no evidence that suggests that the metals buildup in Bay sediments poses a direct threat to human health. Not enough is known about the effects of long-term, low-dosage exposure to organics. The Chesapeake Bay Program, however, concluded that the present and future accumulation of toxic materials represents potentially serious threats to the Bay ecosystem, and could become a human health hazard if transmitted through the food chain.

Some are familiar (chlorine, pesticides)—some have unfamiliar initials (Cd, Cr, Cu, Ni, Zn)—some have intimidating polysyllabic names (polynuclear aromatic compounds, phthalate esters). They are the bewildering variety of toxic substances. They enter the Potomac and the Bay in various ways; industrial, wastewater treatment, and power plant effluents, agricultural and urban runoff, and from the atmosphere. Those toxics of greatest concern are chlorine, cadmium, copper, zinc, mercury, nickel, chromium, lead, atrazine, and linuron.

Currently, metals and organic pollutants are in low concentrations except in areas near major industrial activity (Baltimore and Norfolk/Hampton Roads). No massive toxic effect has been observed, but some serious biological losses have occurred in some spots and toxics are suspect. Some toxicants are being found in plankton, shellfish, and finfish. The most disturbing potential results from the close association of many toxic substances with sediments, which are accumulating. Toxics stored by sediments can be taken up by bottom-residing organisms, and reintroduced into the water column if those sediments are disturbed.

Toxics are not considered a severe problem in the Potomac because of the absence of heavy industry associated with toxic materials. Whereas some monitoring for heavy metals and organic compounds is done, it has had a low priority.

While not of immediate concern, metals and organic compounds exist in the Potomac, and some have been estimated in CBP research.

River sources above the Fall Line, and point (identifiable discharge sources) and atmospheric sources below the Fall Line contribute most of the metals to the Bay. The non-tidal Potomac is the second largest river source of the most troublesome metals except cadmium. The Potomac and the west Chesapeake basin are the largest sources of metals discharged from STPs. Of the three major metropolitan areas in the Bay, Washington, D.C., contributes about half of the estimated yearly loadings from urban runoff. Studies have indicated that the bulk of suspended sediment tends to sink with metals adsorbed to its surface within the estuaries. In this way, the Potomac may retain most of its metals contribution.

Of the more than 300 organic compounds detected in Bay sediments, most are toxic in certain amounts. Like metals, organic toxics cling to sediments. Research has not yet quantified the loadings of organic compounds, thus the Potomac's contribution is unknown.

Chlorine is a highly toxic disinfectant and biocide used in STPs, power plants, and public water supplies. The CBP estimated that 12,500 pounds of residual chlorine was being discharged from STPs alone to tidal waters daily in 1982. Over 40 percent of that discharge was attributed to Potomac STPs.

Efforts to reduce the use and potential impacts of chlorine have been stepped up in the Potomac. The river's largest STP, the Blue Plains regional wastewater treatment plant, will begin dechlorination in early 1988. Industrial pretreatment programs are beginning to go into effect as well. They will reduce the introduction of toxics coming into STPs not designed to remove them. New technology (burning toxics at high temperatures, the use of toxic-eating bacteria, etc.) holds promise for dealing with some toxic threats. Monitoring and regulation enforcement will continue to be key control measures.

POTOMAC WATER QUALITY SUMMARY

The ICPRB periodically disseminates water quality assessments of the Potomac's water and related land resources. Since 1974, these assessments have been based on data from the Baseline Water Quality Monitoring Network (BWQMN). The network is composed of 72 stations strategically located to provide information for basin-wide water quality appraisals.

The assessment uses four water quality status terms: "Excellent," "Good," "Fair," and "Poor." The status of the station is determined on the basis of evaluating mean yearly values for some 10 common physical/chemical parameters, plus biological data where available, and their deviation from normally accepted values considered necessary for fishable and swimmable waters. The opinions of water quality biologists also are considered.

The following is a summary of the *Potomac River Basin Water Quality* report based on evaluation of 1982-83 data:

Water in the Potomac River basin is generally Good overall and is suited for the maintenance of aquatic life resources, recreation, water supply, and other uses. Of the 72 stations, 48 (66%) were rated as having Fair-Good or better water quality. A summary of the status of all stations showed that 4 stations (6%) were rated Poor, 3 stations were rated Poor-Fair (4%), 17 stations were rated Fair (24%), 13 stations were rated Fair-Good (18%), 29 stations were rated Good (40%), and 6 stations were rated Good-Excellent (8%). Based on a 10-year trend scan, Potomac River basin water quality shows no evidence of degradation, and gradual improvements are being demonstrated. A larger variety of fish are again making the Potomac their home. A largemouth bass sport fishery has developed in the metropolitan Washington area to the point of sustaining professional fishing guides. Recreational boating has increased significantly over the last five years.

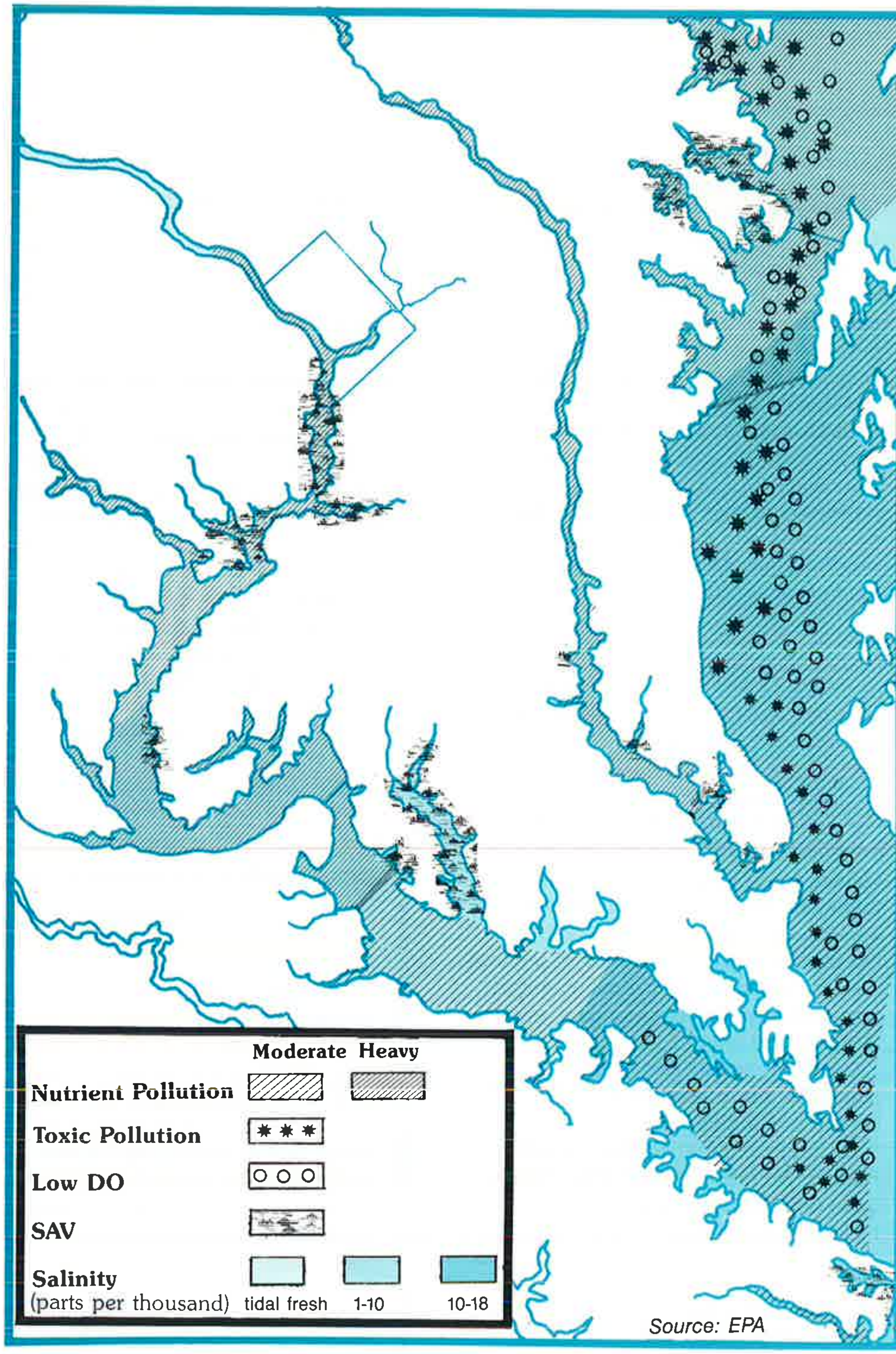
MONITORING

Monitoring means many things to many people. For our purposes here, monitoring is the systematic sampling and measurement of variable environmental characteristics, such as temperature, salinity, biomass, etc. It describes the concentration or abundance and distribution of changing characteristics that can result in a good "snap-shot" at one point in time, or the current status of the river and Bay conditions. If performed over a long enough time, the data generated may reveal a trend that can answer the frequently asked question, "Is the Potomac better, or worse?" Monitoring can be relatively simple or quite complicated, particularly since it is done against a backdrop of both man-made and meteorological changes. Data are also collected for pollution control compliance purposes and research, but their requirements are more stringent, and the data are produced generally to test an hypothesis.

Monitoring in the Potomac has a long history, beginning in the late 19th century. The length of record for many variables is good and the data gathered helped to solve many immediate problems. The problem that Potomac River and Chesapeake Bay cleanup managers and scientists have faced is that much of the data cannot be compared. Much of it was gathered in different ways, using different methods, presenting analysts with "apples and pears," and consistency and accuracy of the data cannot always be verified.

Data collection has improved significantly since the early 1970s, much of it the result of federal legislation. In 1974, for example, ICPRB conceived the Baseline Water Quality Monitoring Network (BWQMN) in an attempt to answer the need for comparable basin-wide information. The Metropolitan Washington Council of Governments (COG) began their coordinated upper Potomac Estuary network in 1982. EPA initiated the first Bay-wide coordinated data management attempt in 1984 (see box). These programs are linked, and it is hoped that the linkage will yield accurate and comparable data not only to solve problems in the short-run, but over a long enough time (15-20 years) so that major conclusions as to how the system works can be reached.

Major concerns include the need to integrate biological data with water quality data and improved public understanding of and support for monitoring efforts.



The monitoring of the surface water of the Bay proper and its tributaries can best be described as a multi-layered cake. More than 165 stations currently make up the Bay-wide EPA/state cooperative **Chesapeake Bay Monitoring Program** created in 1984 by the Chesapeake Bay Executive Council. Fifty of these stations form the **Main-stem Monitoring Network,** a complex arrangement involving two states (Va. & Md.), nine funding sources, five laboratories, and several institutions. Nineteen physical, chemical, and biological parameters are being monitored 20 times a year to develop a "base-line" or characterization of the Bay's health. Linked to the core Bay program are the **Potomac Baseline Water Quality Monitoring Network** (BWQMN) and the **Coordinated Potomac Regional Monitoring Program** (CPRMP). The BWQMN is a cooperative Potomac basin state program comprised of 72 stations, 32 of which are part of the nationwide EPA CORE sampling network. The CPRMP was organized by COG in 1982, and is operated and funded by state and local governments to monitor the metropolitan Washington area Potomac. In addition to these efforts, a variety of government agencies, and scientific and academic institutions gather data for specific projects.

SELECTED READING

Army Corps of Engineers. Baltimore District. *Hydrilla in the Potomac River and Tributaries.* Draft State Design Memorandum and Environmental Impact Statement. September, 1985.

____. *Chesapeake Bay Study — Summary Report.* 1984.

____. *Chesapeake Bay Future Conditions Report.* 1977.

____. *Chesapeake Bay Existing Conditions Report.* 1973.

Bandler, Beverly. *The Potomac in Washington.* Interstate Commission on the Potomac River Basin (ICPRB), 1983.

____. *State of the Potomac: Issues for the 1980's.* ICPRB, 1981.

Capper, John, Garrett Power, and Frank R. Shivers, Jr. *Chesapeake Waters, Pollution, Public Health, & Public Opinion 1607-1972.* Tidewater Publishers, 1983.

Citizens Program for the Chesapeake Bay, Inc. *Choices for the Chesapeake: An Action Agenda.* (Pre-1983 conference workshop recommendations.) 1983.

Chesapeake Bay Commission. *Choices for the Chesapeake: The First Biennial Review of the Action Agenda.* 1985.

____. Annual Reports to the General Assemblies of Maryland and Virginia. 1982-1985.

Chesapeake Executive Council. *Chesapeake Bay Restoration and Protection Plan.* Environmental Protection Agency (EPA); September, 1985.

____. *First Annual Progress Report* under the Chesapeake Bay Agreement; December, 1985.

Chesapeake Research Consortium (CRC). *Background Papers on Chesapeake Bay Needs in Research and Related Matters.* 1981.

Cronin, L. Eugene. *The Values of the Living Resources of Chesapeake Bay.* CRC, 1983.

____, ed. *Ten Critical Questions for Chesapeake Bay in Research and Related Matters.* CRC, 1983.

____. *The Chesapeake Bay: Productive? Polluted? Planned?* CRC, 1982.

____. *Pollution in Chesapeake Bay: A Case History and Assessment.* CRC, 1982.

Cummins, James D. *1984 Fisheries Survey of the Potomac and Anacostia Estuaries in Washington, D.C.,* prepared for D.C. Environmental Control Division. 1985.

Eastman, Paul W. "The State of the Potomac River Basin-1985." ICPRB, 1985.

Environmental Protection Agency. *Chesapeake Bay Program: Findings and Recommendations* (A Summary Report). 1983.

____. *Chesapeake Bay a Framework for Action.* 1983.

____. *Chesapeake Bay: A Profile of Environmental Change.* 1983.

____. *Chesapeake Bay Program Technical Studies: A Synthesis.* 1982.

____. Chesapeake Bay: *Introduction to an Ecosystem.* 1982.

Flannigan, Frances H., ed. *Choices for the Chesapeake: An Action Agenda.* (1983 Chesapeake Bay Conference report.) 1984.

Flynn, Kevin C., ed. *Nonpoint Pollution Control: Tools and Techniques for the Future.* Proceedings. ICPRB, 1981.

GKY and Associates, Inc. *Tidewater Potomac Cleanup: A Decade of Progress.* EPA, 1982. (Reprinted by ICPRB, 1982.)

Interstate Commission on the Potomac River Basin (ICPRB). *Toxic and Hazardous Substances in the Potomac Basin.* Proceedings. July, 1979.

Jaworski, Norbert A. "A Historical Perspective of the Upper Tidewater Potomac." EPA, 1982.

Klingel, G. C. *The Bay.* New York: Dodd, Mead & Co., 1951. (Reprinted, Johns Hopkins U. Press, 1984.)

Librach, Austan S. "Remaining Problems in Potomac River Estuary Water Quality Management." Metropolitan Washington Council of Governments (COG), 1982.

Lippson, A. J., ed. *Life in the Chesapeake Bay: An Illustrated Guide.* The Johns Hopkins U. Press, 1984.

____ *et al. Environmental Atlas of the Potomac Estuary.* Martin Marietta Corp and Md. Department of Natural Resources

____ ed. *The Chesapeake Bay — An Atlas of Natural Resources.* The Johns Hopkins U. Press, 1973.

Maryland. — Department of Health & Mental Hygiene. *Maryland Air and Water Quality Atlas.* 1984.

____. Office of the Governor. *Maryland's Chesapeake Bay Program.* Annual Report. 1984.

Mason, William T. and Kevin C. Flynn, eds. *The Potomac Estuary: Biological Resources/Trends and Options.* ICPRB and Md. Power Plant Siting Program, 1976.

____. *The Freshwater Potomac: Aquatic Communities and Environmental Stresses.* Proceedings. ICPRB, 1978.

McHarg, Ian L. *Design with Nature.* Doubleday/Natural History Press, 1969.

Metropolitan Washington Council of Governments. *Potomac River Water Quality 1984 — Conditions and Trends in Metropolitan Washington.* Annual Report. November, 1985.

____. *Urban Runoff in the Washington Metropolitan Area: Final Report, Washington, D.C. Area Urban Runoff Project.* Prepared for U.S. EPA Nationwide Urban Runoff Program, 1983.

Rasin, V. James. *Potomac River Water Quality 82-83.* ICPRB, 1985.

Schubel, Jerry. *The Living Chesapeake.* The Johns Hopkins Press, 1982.

Sherwood, Arthur W. *Understanding the Chesapeake: A Layman's Guide.* Tidewater Publishers, 1973.

Thomann, R.V., et al. *The 1983 Algal Bloom in the Potomac Estuary.* Prepared for Potomac Strategy State/EPA Management Committee. March, 1985.

Tilp, Frederick. *This Was Potomac River.* 1978.

U.S. Geological Survey. *Distribution and Abundance of Submersed Aquatic Vegetation in the Tidal Potomac River and Estuary, Maryland and Virginia, May 1978 to November 1981.* 1985.

____ *A Water-Quality Study of the Tidal Potomac River and Estuary — An Overview.* 1984.

____. *The River and the Rocks.* 1980.

Virginia. Council on the Environment. *Virginia's Chesapeake Bay Initiatives.* First Annual Progress Report; September, 1985.

Warner, William W. *Beautiful Swimmers-Watermen, Crabs and the Chesapeake Bay.* Little Brown & Co., 1976.

CITIZEN INFORMATION

BE PART OF THE SOLUTION

- Get informed;
- Apply conservation practices in your daily life;
- Tell your elected officials what you believe should be clean-up priorities;
- Support clean-up programs through financial contributions and/or volunteer participation.

KEY POTOMAC/BAY AGENCIES & INSTITUTIONS

Federal

U.S. Environmental Protection Agency, Region III (EPA), 841 Chestnut Bldg., Philadelphia, PA 19107. 215/597-9800 Chesapeake Bay Liaison Office: 410 Severn Ave., Annapolis, MD 21403. 301/266-6873.

Regional

Interstate Commission on the Potomac River Basin, Suite 300, 6110 Executive Blvd., Rockville, MD 20852-3903 301/984-1908.
Potomac River Fisheries Commission, P.O. Box 128, Colonial Beach, VA 22443. 804/224-7148.
Chesapeake Bay Commission, 60 West St., Suite 200, Annapolis, MD 21401. 301/263-3420.
Chesapeake Bay Critical Area Commission, Dept. of Natural Resources, Tawes State Office Bldg., Annapolis, MD 21404. 301/261-1402.
Chesapeake Research Consortium, P.O. Box 1120, Gloucester Pt., VA 23063. 804/642-7153.
Chesapeake Bay Institute, The Johns Hopkins University, 4800 Atwell Rd., Shady Side, MD 20764. 301/867-7550.
Chesapeake Bay Trust, 60 West St., Suite 200A, Annapolis, MD 21401. 301/269-2941.
Metropolitan Washington Council of Governments (COG), Environmental Programs, Suite 200, 1875 Eye St., N.W., Washington, DC 20006. 202/223-6800.

State

District of Columbia — Dept. of Consumer and Regulatory Affairs, 5000 Overlook Ave., S.W., Washington, DC 20032. 202/767-7370.
Maryland — Dept. of Health & Mental Hygiene, Office of Environmental Programs (OEP), P.O. Box 13387, Baltimore, MD 21202. 301/383-6476. Dept. of Natural Resources (DNR), Tawes State Office Bldg., 580 Taylor Ave., Annapolis, MD 21401. 301/269-3041.
Pennsylvania — Dept. of Environmental Resources (DER), Box 2063, Fulton Bldg., Harrisburg, PA 17120. 717/787-2657.
Virginia — Virginia Council on the Environment, 903 Ninth St. Office Bldg., Richmond, VA 23219. 804/786-4508. Virginia State Water Control Board, P.O. Box 11143, Richmond, VA 23230. 804/257-0056.
West Virginia — Department of Natural Resources (DNR), District 2, P.O. Box 1930, Romney, WV 26757. 304/822-3551.

HOT LINE NUMBERS

National Pesticide Telecommunication Network, for answers to any questions about pesticides, toll-free, 24-hour: 1-800-858-7378
Soil Conservation Society of America, to receive information about conservation programs toll-free: 1-800-THE-SOIL
USEPA toll-free, round the clock for reporting suspected violations of environmental laws and regulations 1-800-438-2474

District of Columbia (202)
Mayor's Command Center, Office of Emergency Preparedness (24 hrs.) . . 727-6161

Maryland (301)
Natural resources emergency, (DNR) (24 hrs.) 267-7740
Water Pollution/Chemical Spills, (OEP) (weekdays) 225-5700
(other times) 243-8700
Fish Kills, (OEP) 269-3238
Oil Spills, (DNR) (weekdays) 269-3551
(other times) 269-3181
Sediment Problems 1-800-DNR-SOIL
"Catch-A-Poacher" 1-800-492-1138

Pennsylvania (717)
Bureau of Water Quality Control (day) 787-8184
(night) 787-4343

Virginia (804)
Pollution Response Program (oil spills, fish kills, water pollution, chemical spills) (24 hrs.) 257-0080
Dept. of Emergency Services (hazardous materials, waste questions) 323-2300

West Virginia (304)
Pollution/spill/discharges 1-800-642-3074
Poaching Hotline 1-800-NET-GAME

AVAILABLE PUBLICATIONS

There are several publications available for Potomac and Bay watchers. ICPRB's free newsletter, the *Potomac Basin Reporter,* is published 10 times a year and is the best way to keep current on the entire Potomac watershed. The *Chesapeake Citizen Report* is a free quarterly newsletter published by the Citizens Program for the Chesapeake Bay, Inc. (address above). **For a free list of available community and clean-up guides and other useful publications, contact ICPRB.**

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