A Report to the Citizens of the Bay Region

www.chesapeakebay.net

Chesapeake Bay Program
A Watershed Partnership

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April 2007

CHESAPEAKE BAY

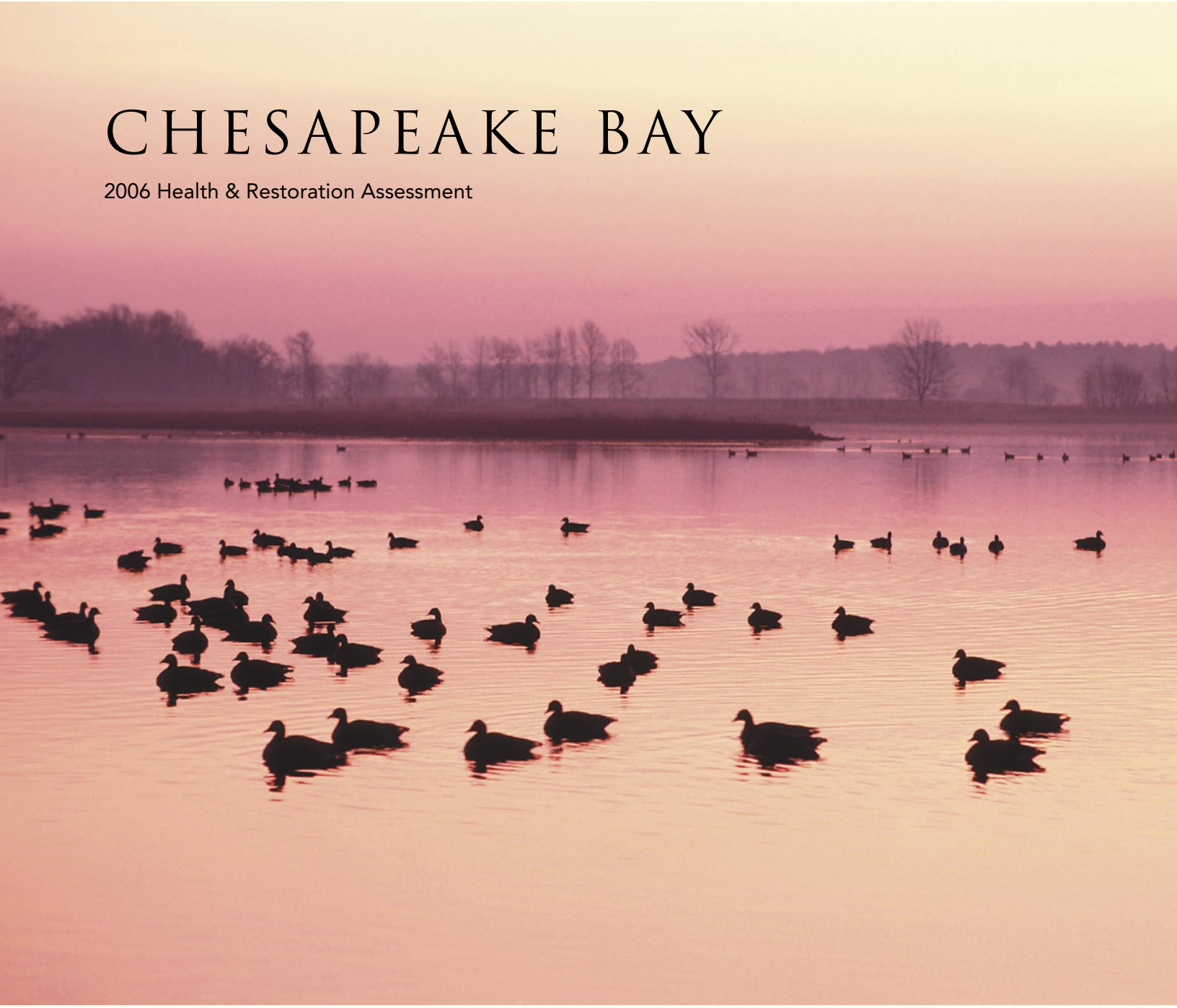
2006 Health & Restoration Assessment

PART ONE: **Ecosystem Health**

Chesapeake Bay Program
A Watershed Partnership

CHESAPEAKE BAY

2006 Health & Restoration Assessment



The Chesapeake Bay Program is a unique regional partnership that directs and conducts the restoration of the Chesapeake Bay by bringing together local, state and federal governments, non-profit organizations, watershed residents and the region's leading academic institutions in a partnership effort to protect and restore the Bay.

The Chesapeake Bay Program signatories – the state of Maryland; the commonwealths of Pennsylvania and Virginia; the District of Columbia; the U.S. Environmental Protection Agency representing the federal government; and the Chesapeake Bay Commission representing Bay state legislators – have committed to reducing pollution, restoring habitat and sustainably managing fisheries since signing the Chesapeake Bay Agreement of 1983.

Subsequent agreements have augmented the original program, and most recently culminated in signing Chesapeake 2000, an agreement intended to guide restoration activities throughout the Bay watershed through 2010. Chesapeake 2000 also provided an opportunity for the headwater states of Delaware, New York and West Virginia to join in regional efforts to improve water quality of the Bay and its tributaries.

To learn more and find out how you can help, visit the Chesapeake Bay Program website at www.chesapeakebay.net

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ABOUT THIS REPORT

The Chesapeake Bay is an estuary – a place of transition between the land and the sea, where incoming fresh water mixes with salty ocean water. The Chesapeake Bay is a productive ecosystem and is the largest estuary in North America, home to more than 3,700 species of plants and animals.

A healthy Bay requires balancing the needs of the region's people and economy with the needs of the Bay for clean waters and ample habitat for aquatic life. The goal of Bay restoration is to restore this balance by reducing pollution, protecting critical habitat and ensuring sustainable populations of fish and shellfish.

The *Chesapeake Bay 2006 Health and Restoration Assessment* is presented this year in two parts. *Part One: Ecosystem Health* draws on the most up-to-date monitoring data gathered by Bay Program partners to assess the overall health of the Bay ecosystem last year.

Progress toward a restored Bay is tracked with 13 indicators grouped in three priority areas that represent major components of the Bay ecosystem. Quantitative restoration goals have been set for most of these indicators. For each indicator, a chart shows, as a percent of the goal, current status and a history of progress toward achieving the goal. A summary bar chart shows the current status of each indicator with respect to its restoration goal.

Although there are a number of smaller-scale success stories, the overall ecosystem health of the Chesapeake Bay remains degraded. For more than twenty years, restoration efforts have managed to offset the impact of the region's growing population while making modest ecological gains in some areas. Major pollution reduction, habitat restoration, fisheries management and watershed protection actions taken to date have not yet been sufficient to restore the health of the Bay.

In *Part Two: Restoration Efforts*, key restoration actions are measured against long-term goals.

We hope that, by presenting data in this manner, watershed residents can better understand the health of the Bay relative to what is needed for a balanced ecosystem.

Electronic versions of the *Chesapeake Bay 2006 Health and Restoration Assessment* reports can be found at www.chesapeakebay.net/press.htm. For more information about the data, methodology and restoration goals discussed in this report, please visit www.chesapeakebay.net.

HEALTH ASSESSMENT SUMMARY

INTRODUCTION

The human population in the Chesapeake watershed is now growing by more than 170,000 residents annually. The cumulative impact of centuries of population growth (currently over 16 million) and landscape changes has taken its toll. For over 20 years, restoration efforts have been underway to reverse the decline of the Chesapeake Bay's health. Progress is not calculated on a day-to-day basis, but by using detailed scientific data that have been carefully analyzed and interpreted; we can see changes in the health of the Bay over time. Change is occurring, but slowly.

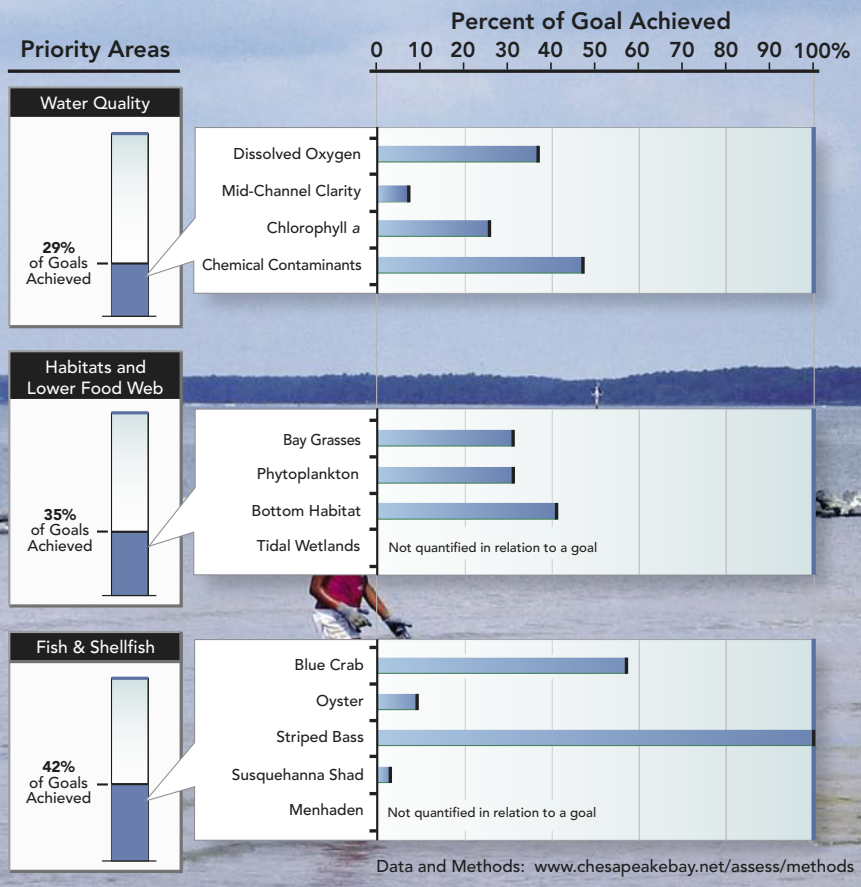
Water Quality – Most of the Bay's waters are degraded. Algal blooms fed by nutrient pollution block sunlight from reaching underwater bay grasses and can lead to low oxygen levels in the water and fish kills in some areas. Sediment from urban development, agricultural lands, as well as some natural sources, is carried into the Bay and clouds its waters. Portions of Chesapeake Bay tidal tributaries are contaminated with chemical pollutants that can be found in fish tissue. In 2006, less than one-third of Bay water quality goals were met.

Habitats and Lower Food Web – The Bay's critical habitats and food web continue to be at risk. Nutrient and sediment runoff have harmed bay grasses and bottom habitat, while disproportionate algae growth has pushed the Bay food web out of balance. Currently, the Bay's habitats and lower food web are at about one-third of desired levels.

Fish and Shellfish - Many of the Bay's fish and shellfish populations are below historic levels. Blue crab abundance has been below management targets for the past ten years. American shad are recovering slowly, while other species like striped bass (rockfish) show mixed signals. The striped bass population has increased over the past decade in the Chesapeake Bay. Scientists attribute the increase to responsible fisheries management. While biomass remains high, scientists are concerned about the species' health.

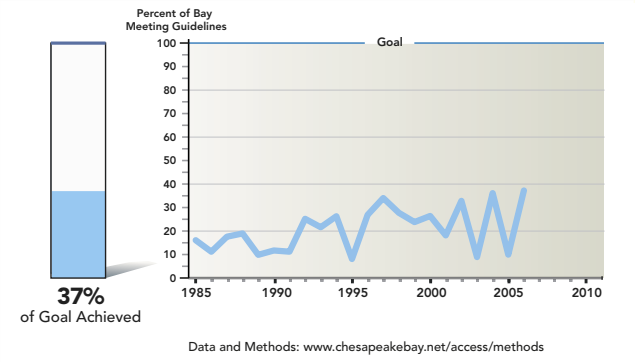
As ecosystem-based goals are not yet developed for menhaden, those data are not included in the average this year. Currently, the Bay's fish and shellfish are at about two-fifths of desired levels.

SUMMARY: 2006 BAY HEALTH ASSESSMENT

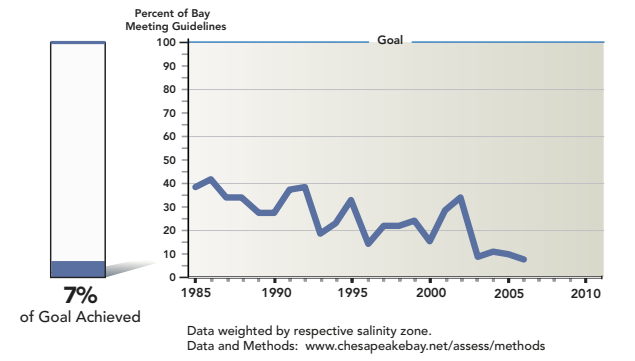


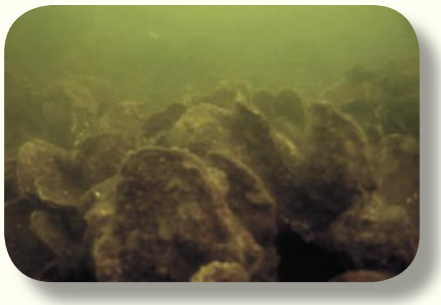
Data and Methods: www.chesapeakebay.net/assess/methods

DISSOLVED OXYGEN



MID-CHANNEL WATER CLARITY





WATER QUALITY

To support a vibrant Chesapeake Bay ecosystem, waters must become clearer, oxygen levels higher, and the amount of algae and chemical contaminants in its waters must be reduced. Water Quality goals in this section are based on published water quality criteria designed to protect aquatic life in the Bay. Rain in the winter and spring washes pollutant loads into the Bay, largely determining summer water quality conditions. Summer weather plays a role as summer storm intensity leads to greater erosion and nutrient load. The health of the Bay in the critical summer season will improve as actions are taken year-round to reduce the level of pollutants in the watershed.

DISSOLVED OXYGEN

Like terrestrial animals, the Bay's fish and shellfish need oxygen to survive. During summer months, some of the Bay's waters still do not hold enough oxygen to support aquatic life. Throughout summer 2006, scientists estimate about 37 percent of the Bay met dissolved oxygen restoration goals designed to protect resident aquatic life.

Over time, large-scale reductions in the amount of nutrients flowing into the Bay will help improve low oxygen conditions.

MID-CHANNEL WATER CLARITY

Good water clarity is important for the growth of underwater bay grasses. Because bay grasses provide vital habitat for a number of living resources in the Bay, it is essential to maintain good water clarity and restore bay grasses to historical levels.

In 2006, scientists estimate that only 7 percent of the Bay's waters had acceptable water clarity. Measurements for this indicator are from fixed stations located in open water areas of the Bay and do not necessarily reflect water clarity in shallow water areas where bay grasses are most abundant.

Clarity will always fluctuate annually, as it is greatly impacted by weather events; however, reduced nutrient and sediment loads, abundant bay grasses and healthy Bay life will help improve annual conditions.

DISSOLVED OXYGEN:

The amount of oxygen dissolved in a stream, river, lake or bay is an indication of the degree of health of the water and its ability to support a balanced aquatic ecosystem.
Source: EPA

CHLORPHYLL *a*

Scientists measure the amount of chlorophyll *a* in the Bay's waters to assess the amount of algae present. The Bay needs the right amount of algae to maintain a balanced food web. Excess algae can cause large-scale algal blooms that block sunlight from reaching bay grasses, reducing available habitat for Bay life. Lower algal levels promote better water quality, more available habitat and fewer harmful bloom effects.

Every year harmful algal blooms cover a portion of the Bay and its tributaries. In 2006, scientists estimate that about 26 percent of the Bay's waters had acceptable chlorophyll *a* concentrations.

CHEMICAL CONTAMINANTS

Portions of Chesapeake Bay tidal tributaries are contaminated with chemical pollutants that can be found in fish tissue. The states and the District of Columbia use this information to develop risk assessments and fish consumption advisories to protect the health of recreational fishermen and their families. Listings for all toxic contaminants in fish tissue were considered. Ultimately this indicator is comprised of impairments due to PCB tissue concentrations in Maryland and Virginia and mercury tissue concentrations in Virginia, as these are currently the only contaminants responsible for listings fitting criteria for inclusion in this indicator.

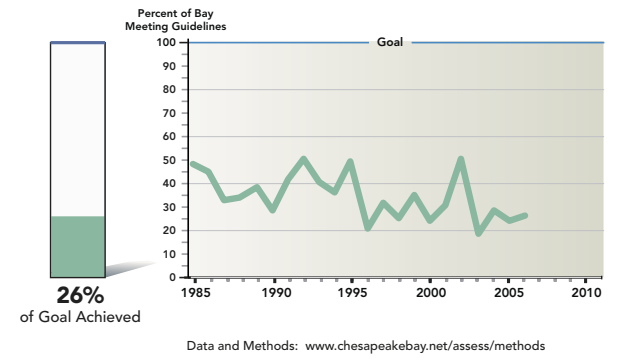
Surveys indicate that in 47 percent of monitored tidal rivers of the Bay, levels of bio-accumulative contaminants in fish tissue are low enough for unlimited fish consumption. The remaining 53 percent of the monitored tidal rivers contain elevated contaminant levels that warrant advisories limiting the consumption of fish from those waters.

The data used in this indicator was also used by the states of Virginia and Maryland to determine fish tissue impairments for the 2006 impairment listing. Some of the 2006 listings were first determined during the 2002 listing cycle, which used data beginning in 1996. Therefore, an eight year period is reflected in the data. Prior to the 2006 listing year, there were insufficient spatial data to allow the indicator to be developed, resulting in the single point on the graph.

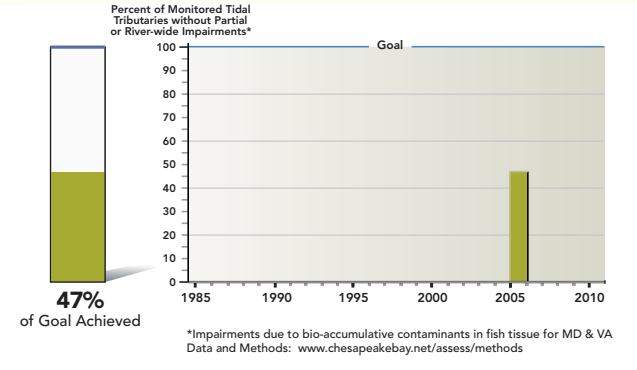
CHEMICAL CONTAMINANTS:

Substances, elements, or compounds that may harm humans or other forms of life if released into the environment. Refers to concentrations that are above acceptable levels and/or are in a location where they should not be found.
Source: www.answers.com

CHLOROPHYLL *a*



CHEMICAL CONTAMINANTS



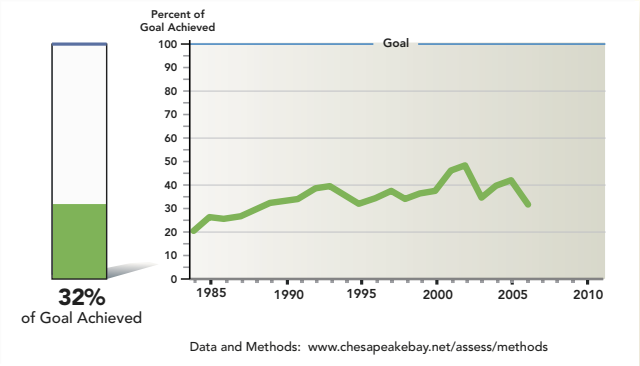
CHLOROPHYLL *a*:

The pigment that makes plants and algae green. Measurement of chlorophyll a is an indicator of the quantity of algae in the water.
Source: EPA

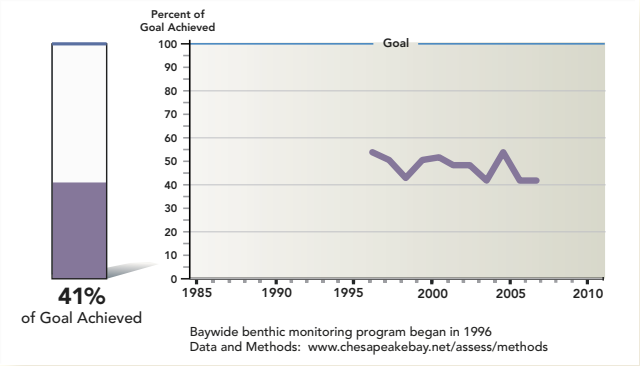
BOTTOM HABITAT:

The bottom of the Bay is home to bacteria, clams, worms and other creatures that serve as a key food source for higher levels of aquatic life, such as white perch, spot, croaker and crabs.
Source: Chesapeake Bay Program

BAY GRASS ABUNDANCE



BOTTOM HABITAT (Benthic Index of Biotic Integrity)



HABITATS AND LOWER FOOD WEB

Life in the Bay needs high-quality food and habitat to thrive. From the clams and worms that live within the Bay's bottom sediments, to the rockfish that prowl its open waters, to the juvenile fish and crabs darting among underwater grasses and wetlands, healthy and abundant habitat is critical for supporting the Bay's aquatic life. When healthy habitat is supported by a balanced food web, healthy aquatic communities can flourish. As both of these key environmental elements improve, the ecosystem's potential to support larger and more diverse populations of aquatic life expands as well.

BAY GRASSES

Aside from the water itself, underwater bay grasses are one of the most important habitats in the Chesapeake Bay. As their health is closely related to the quality of local waters, grasses serve as an excellent barometer for the overall health of the estuary. Bay grass abundance has a profound effect on the Bay and its aquatic life, as it provides critical habitat to key species such as striped bass and blue crabs while improving the clarity of local waters.

The most recent baywide data from 2006 show bay grasses covering 59,090 acres – or about 32 percent of the 185,000-acre restoration goal.

The total Bay grass abundance goal has also been broken down by 3 zones. Bay grasses in the Upper Bay in 2006 covered 15,510 acres or 66% of the 23,630-acre goal. Middle Bay grasses covered 30,659 acres or 27% of the 115,229-acre goal, while grasses in the Lower Bay covered 12,922 acres or 28% of the 46,030-acre goal.

As water clarity improves from nutrient and sediment pollution reductions, bay grass acreage should expand.

BOTTOM HABITAT

The health of the Bay's bottom dwelling – or benthic – communities is greatly reduced when pollution levels increase and oxygen levels drop. Benthic habitats serve as a good indicator of long-term environmental conditions, as the inhabiting worms and clams are long-lived, have limited mobility and their responses to stress are well documented.

In 2006, about 41 percent of the Bay's benthic habitat was considered healthy as measured by the composite Benthic Index of Biotic Integrity. Scientists attribute the decline from 2004 to persistent low dissolved oxygen levels during the summer. Reduced amounts of nutrients, sediment and chemical contaminants flowing into the Bay will help these bottom dwelling communities improve.

PHYTOPLANKTON

Phytoplankton are an excellent indicator of the health of the Bay's surface waters, as they are especially sensitive to changes in nutrient pollution, water clarity, day length, temperature, salinity and grazer communities. Phytoplankton are primary producers capable of converting sunlight and nutrients into food for the base of the food web.

While increased populations provide more food to organisms further up the food web, too much or the wrong type of algae can harm the overall health of the Bay. In some cases, harmful algal blooms can impact human health.

Scientists assess microscopic algal community health with a Phytoplankton Index of Biotic Integrity. Data from Spring 2006 show that about 31 percent of the Bay's phytoplankton communities were considered healthy.

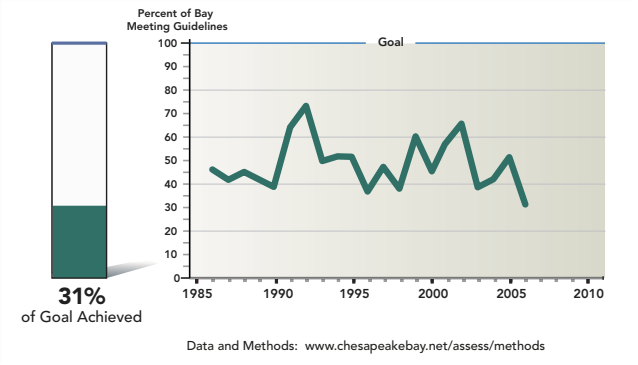
TIDAL WETLANDS

Wetlands link land to the water. In both tidal and non-tidal parts of the Bay, they serve as critical habitat to terrestrial and aquatic life, and act as natural filters and sponges by absorbing runoff and removing pollutants from water before they can reach local streams and the Bay.

Many researchers believe Chesapeake Bay tidal wetlands are threatened by sea level rise, storms, shoreline development and invasive species. As of 1993, there were approximately 282,000 acres of tidal wetlands in the Bay. Assessments of acreage in 2001 and 2005 are pending data analysis.

For more information about wetland improvement efforts, see page 7 of *Part Two: Restoration Efforts*.

PHYTOPLANKTON (Index of Biotic Integrity)



PHYTOPLANKTON:

Microscopic plants such as algae are capable of making food via photosynthesis. They float and cannot move independent of water currents.
Source: EPA

TIDAL WETLANDS:

Wetlands that are tidally flooded by salt or brackish water and are found chiefly along the shores of Chesapeake Bay and its tidal rivers.
Source: Chesapeake Bay Program

STRIPED BASS:

A North American food and game fish (Morone saxatilis) *chiefly of coastal waters, having dark longitudinal stripes along its sides. Striped bass, which swim up the Chesapeake Bay to spawn, are occasionally found in landlocked bodies of water. Also called rockfish, striper.*

Source: Chesapeake Bay Program

FISH AND SHELLFISH

The long-term health and sustainability of the Bay's fish and shellfish is critical to restoring ecosystem health. Ample aquatic habitat, clean water and well-managed fisheries are key components to restoring abundant fish and shellfish populations to the Bay.

Scientists and natural resource managers are working to develop ecosystem-based fisheries management strategies which take into account numerous factors when setting harvest targets, including the species' role in the food web and other water quality, habitat and climatic considerations. As these strategies are further developed and ecosystem goals are defined, the Bay Program will compare annual data to population targets for a balanced Bay system.

BLUE CRAB

It is estimated that more than one-third of the nation's blue crab catch comes from the Chesapeake Bay. Commercial harvest from the Bay between 1968 and 2005 averaged around 73 million pounds. The most recent harvests have been approximately 60 million pounds, or below the time series average. The low harvest corresponds to low exploitable stock abundance and also reflects restrictive management measures in place since 2001 and 2002.

In 2006, the abundance of adult crabs in the Chesapeake Bay remained well below the restoration goal. Scientists estimate that the population of blue crabs in the Chesapeake Bay in 2006 is about 57 percent of the 232 million crab interim goal. Blue crab abundance has been below the target for the past ten years.

These numbers are estimated through winter dredge and summer trawl surveys. The blue crab fishery is vulnerable to exploitation; therefore, harvest restrictions will continue to remain in place. Proper management of the crab harvest, improved water quality and habitat restoration efforts will help restore the Bay's blue crab populations.

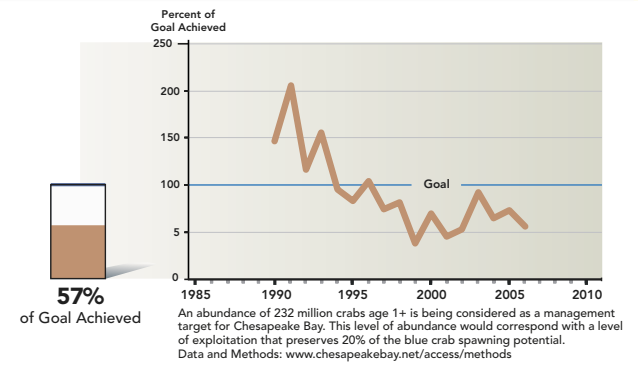
STRIPED BASS

The striped bass population has dramatically increased over the past decade in the Chesapeake Bay. Scientists attribute this increase to a late 1980s fishing moratorium and responsible fisheries management since the lifting of the fishing ban. Striped bass are one of the top predators in the Chesapeake Bay food web and prey availability is an important factor affecting abundance and growth. In 1995, populations had increased to the point where the species was considered restored. While biomass remains high, scientists are particularly concerned with the high prevalence of disease (mycobacteriosis) and the ability of the prey base to adequately support the population.

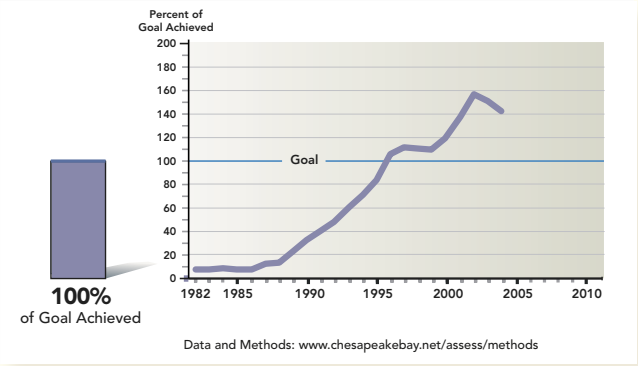
Research is underway to better understand the disease's impact on the Bay's striped bass population. The current status of Bay striped bass – high abundance but uncertain health – illustrates the need for an ecosystem-based fisheries management approach in Chesapeake Bay. The next assessment of striped bass will take place during 2007.

For more information, see page 8 of *Part Two: Restoration Efforts.*

BLUE CRAB ABUNDANCE (Age 1 and Older)



STRIPED BASS ABUNDANCE (Spawning Female Biomass)



BLUE CRAB:

An edible, bluish swimming crab (Callinectes sapidus) *that has a wide distribution in the Chesapeake Bay, and along the Atlantic and Gulf coasts of North America.*
Source: Chesapeake Bay Program

OYSTERS:

An edible bivalve mollusk of the family Ostreidae, *species* Crassostrea virginica, *which lives in a wide range of depths and salinities of the Chesapeake Bay.*
Source: Chesapeake Bay Program

OYSTERS

For more than a century, oysters constituted one of the Bay's most valuable commercial fisheries. Over-harvesting, pollution and the diseases Dermo and MSX have caused a severe decline in their numbers throughout the Chesapeake Bay. Scientists estimate that the population of native oysters in the Chesapeake Bay in 2005 was about 9 percent of current restoration goals.

SHAD

The introduction of hatchery raised fish, a moratorium on shad fishing, the removal of dams, and installation of fish passages on key Bay tributaries have helped to increase the number of shad in the Bay.

One of the ways scientists currently estimate spawning shad populations is by counting the number of fish annually lifted over Conowingo Dam near the mouth of the Susquehanna River, via the fish passageway installed in 1991. Annual estimates have increased from several hundred per year in the early 1980s to 56,899 in 2006. In spite of the increasing abundance, the Susquehanna River population is far below the long-term restoration goal of two million fish per year.

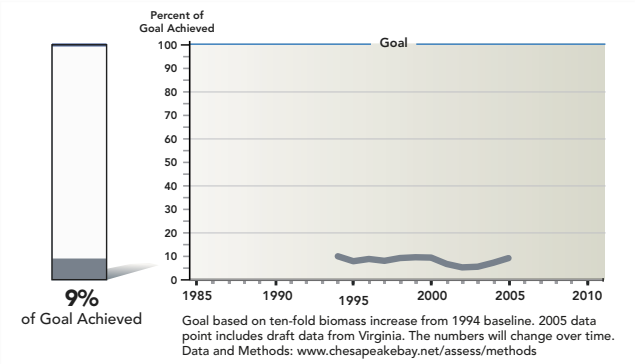
Assessing annual baywide spawning populations is difficult as each river stock is unique. To provide better baywide estimates, scientists are developing new monitoring methods to estimate populations in other key Bay tributaries including the James and Potomac rivers. An updated assessment is expected in 2007.

ATLANTIC MENHADEN

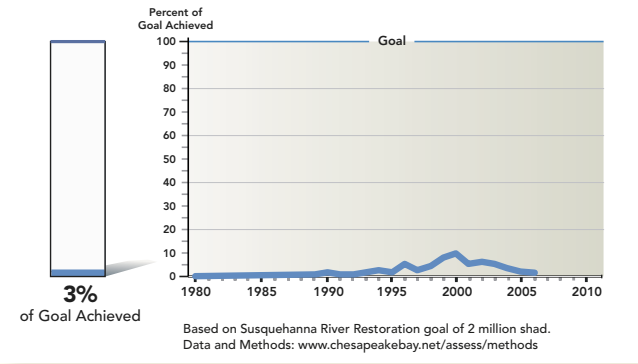
Scientists currently do not produce Chesapeake Bay-specific population estimates of menhaden. Estimates are made on an Atlantic Coast-wide basis. Populations along the Atlantic Coast appear to be healthy, but scientists are concerned about low regional abundances in Chesapeake Bay. The number of juvenile menhaden in Chesapeake Bay has been declining in recent years, with current recruitment levels being about 50% lower than the mid-1980s.

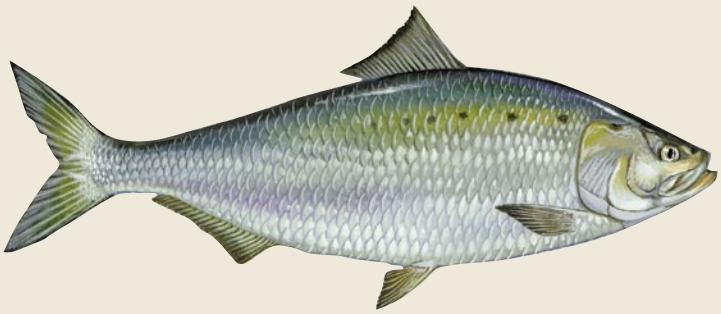
In 2006, Virginia placed a cap on the amount of menhaden that can be harvested annually from the Chesapeake Bay by the commercial fishing industry. Maryland currently prohibits the commercial industry from harvesting menhaden from Maryland waters. Since menhaden are an important forage species in the Bay food web, a number of studies are underway to assess their status in the Bay.

NATIVE OYSTER ABUNDANCE (Biomass)



SHAD RETURNING TO THE SUSQUEHANNA RIVER





AMERICAN SHAD:

The American shad, Alosa sapidissima, *occurs along the Atlantic coast from southern Labrador to northern Florida. American shad undergo extensive seasonal migrations, moving into rivers for spawning beginning in January in southern rivers, and continuing until July in the northernmost portion of their range. After spawning, shad migrate north along the coast to Canada where they feed during the summer. A southward migration occurs later along the continental shelf where the fish overwinter prior to spring spawning migrations to their natal rivers.*
Source: NOAA

RIVER FLOW AND THE POLLUTANT LOADS REACHING THE BAY

The Bay's watershed covers an enormous 64,000-square-mile area that includes parts of six states – Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia – and all of the District of Columbia. Billions of gallons of water flow each day through thousands of streams and rivers that eventually empty into the Bay. The Bay must process runoff from a large amount of land with a relatively small body of water.

Annual Bay water quality conditions are largely determined by a combination of the amount of pollution deposited on the land and the amount of water flowing into the Bay. As the river flow increases, its potential to carry additional amounts of pollutants multiplies as well.

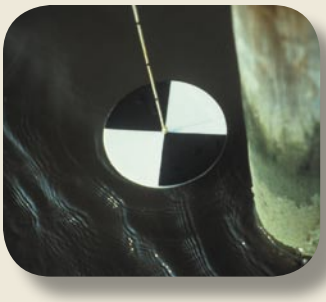
Precipitation doesn't just increase river flows by washing directly off the land. Some water seeps into the soil, carrying nutrients into groundwater. It can take years for these waters and their associated pollutants to slowly travel through underground systems until they reach the streams that drain into the Bay. Each year, pollution that may be decades old reaches the Bay.

Scientists calculate annual pollutant loads to the Bay through a combination of monitored water samples and modeled information. Whenever practical, scientists measure pollution levels in water samples from the rivers and wastewater pipes that flow into the Bay. Model generated estimates are used where monitoring is not practical, when no data are available, or data do not meet specific requirements and/or are outdated. By capturing water samples at the point where large rivers meet the Bay, scientists can calculate pollution loads from 78 percent of the watershed land area. For the remaining area, loads from wastewater and model-generated estimates are used. This combination of monitoring and modeling data allows scientists to provide the most complete accounting of the amount of pollution reaching the Bay.

Spring 2006 weather conditions were considered extreme, with lower than average rainfall from mid-February to mid-May. The region was then deluged at the end of June with rainfall exceeding the 100-year-flood mark in some areas. The remainder of the summer weather was fairly average until August, when the remnants of Hurricane Ernesto soaked the area.

RIVER FLOW:

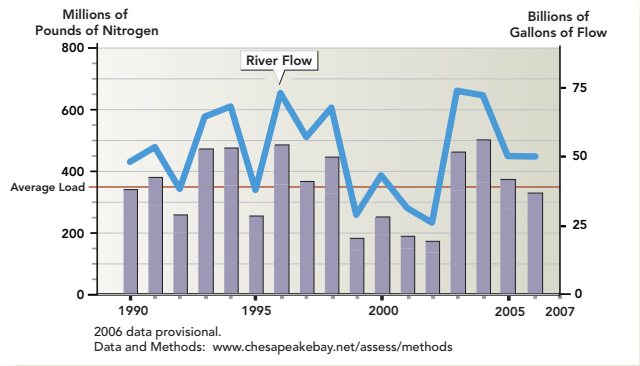
Volume of water flowing into the Bay.
Source: Chesapeake Bay Program



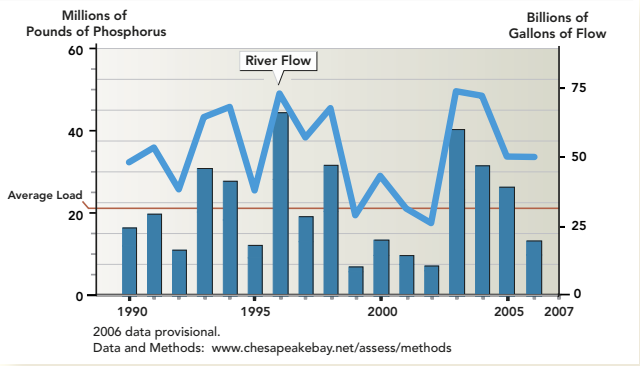
ATLANTIC MENHADEN:

Brevoortia tyrannus *are small schooling fish related to herring, shad, and sardines. Menhaden consume large quantities of phytoplankton and zooplankton, and are themselves a favorite food of striped bass, bluefish, sea trout, tunas, sharks, and sea birds. Menhaden spawn in the ocean, in shelf waters off Chesapeake Bay from March to May, and again in September and October.*
Source: VIMS

RIVER FLOW AND NITROGEN LOADS REACHING CHESAPEAKE BAY



RIVER FLOW AND PHOSPHORUS LOADS REACHING CHESAPEAKE BAY



Total river flow to the Bay during the 2006 water year (October 2005-September 2006) was very close to the long-term average. Provisional estimates indicate that approximately 331 million pounds of nitrogen reached the Bay during the 2006 water year, which is similar to the average load for 1990-2005 and slightly lower than 2005. This amount is almost double the restoration target of 175 million pounds of nitrogen.

Additionally, provisional estimates indicate that approximately 13.4 million pounds of phosphorus reached the Bay during the 2006 water year, which is well below the 1990-2005 average and almost half of 2005. This amount is above the target level of 12.8 million pounds of phosphorus to reach the Bay.

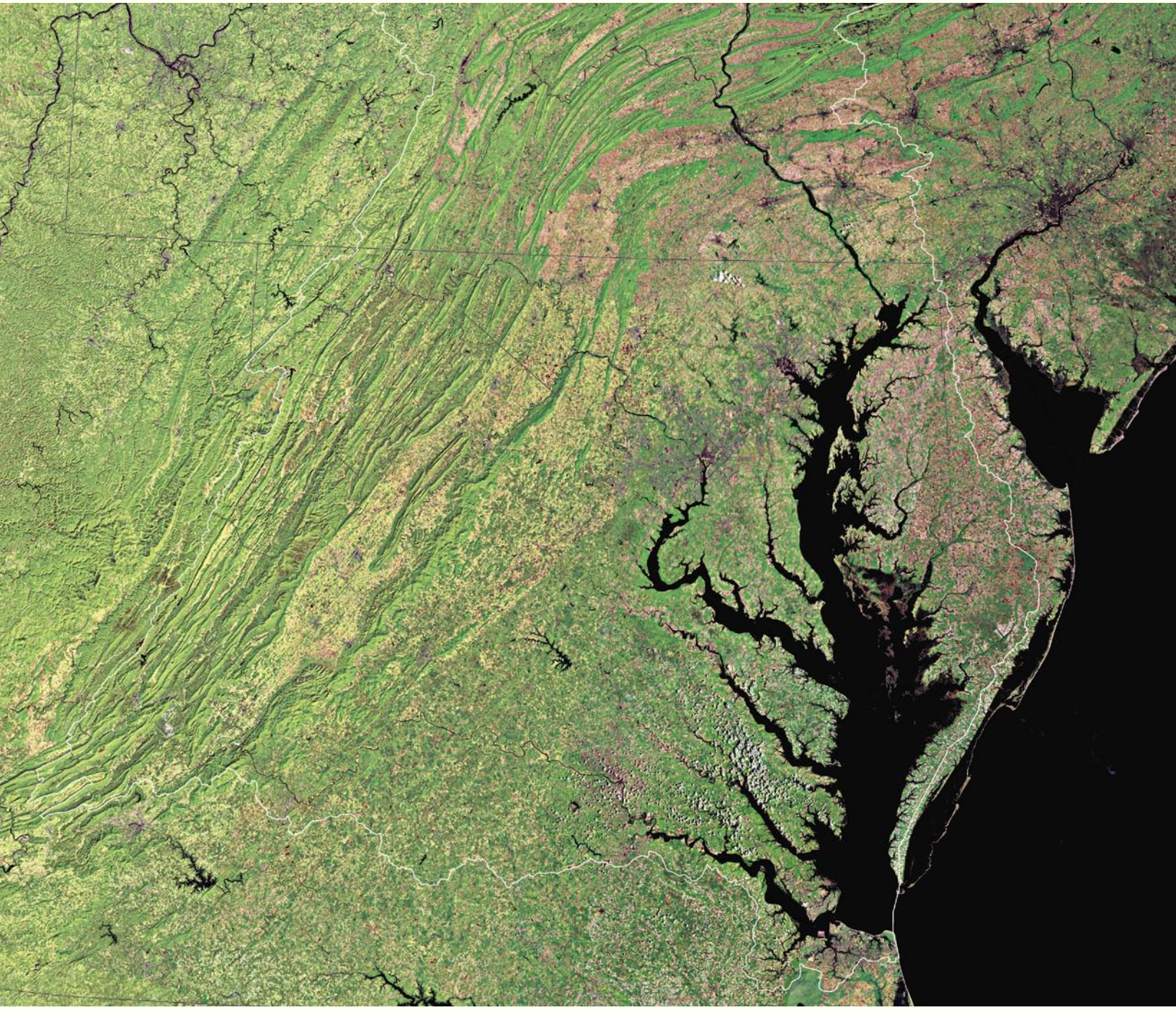
While less nitrogen and phosphorus reached the Bay during the 2006 water year, additional pollution-fighting measures are being put in place throughout the watershed to reduce total pollution loads in the future.

Based on water samples collected at the point where large rivers meet the Bay, in 2006 2.5 million tons of sediment were delivered to the Bay. This is well below the average load for 1990-2005. The sediment load estimates do not account for sediment from the coastal plain areas of the watershed. Scientists are currently developing methods to quantify the total loads of sediment to the Bay.

POLLUTANT LOAD:

The amount of stress placed upon an ecosystem by pollution, physical or chemical, released into it by man-made or natural means.

Source: General Environmental Multilingual Thesaurus (GEMET 2000)



THE
CHESAPEAKE BAY
WATERSHED

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