Chesapeake Bay and its Tributaries: Results of Monitoring Programs and Status of Resources

2004 Biennial Report of
The Secretary of Natural Resources to
The Virginia General Assembly
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COMMONWEALTH of VIRGINIA

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Honorable Members of the General Assembly:

You will find attached the report as required by §2.1-51.8:2 of the Code of Virginia.

This report summarizes monitoring programs related to water quality and living resources. Our natural resource agencies have cooperated with local, regional and federal agencies to compile this report. As you can see, while we have made progress in many areas, but much remains to be done in order to restore the Chesapeake Bay and its Tributaries and its living resources.

I look forward to the implementation of our nutrient and sediment reduction strategies that are critical to removal the bay and its tidal tributaries from the federal list of "impaired waters." I also know that with sufficient support, our fisheries and wildlife agencies will be able to continue the sound wildlife, fisheries and habitat management programs under their control.

As always, I look forward to working closely with you in the protection and restoration of Virginia's natural resources.

Sincerely,

W. Tayloe Murphy, Jr.

Table of Contents

LIST OF TABLES ..... **II**

LIST OF FIGURES ..... **II**

PROGRAMS MONITORING BAY RESOURCES **1**

STATUS OF WATER QUALITY CONDITIONS **3**

TOXICS 4
Recent Chemical Contaminant Monitoring in Areas of Insufficient Data *6*

STATUS OF LIVING RESOURCES **8**

STRIPED BASS 8
BLUE CRAB 9
OYSTERS 12
WATERFOWL 13
MIGRATORY FISH 16
SEAGRASSES 18
PHYTOPLANKTON COMMUNITIES 20
BENTHIC COMMUNITIES 22

List of Tables

TABLE 1) 1999 CHEMICAL CONTAMINANT CHARACTERIZATION RESULTS..... 6

List of Figures

FIGURE 1) STATUS OF CHEMICAL CONTAMINANT EFFECTS ON LIVING RESOURCES IN THE CHESAPEAKE BAY'S TIDAL RIVERS..... 5
FIGURE 2) STRIPED BASS SPAWNING STOCK..... 8
FIGURE 3) BLUE CRAB LANDINGS (ESTIMATED)..... 9
FIGURE 4) BLUE CRAB FISHING MORTALITY RATE..... 10
FIGURE 5) BLUE CRAB SPAWNING STOCK ABUNDANCE..... 11
FIGURE 6) OYSTER HARVEST..... 12
FIGURE 7) 2003 STATUS AND TRENDS OF BAY WATERFOWL DOING WELL..... 14
FIGURE 8) 2003 STATUS OF BAY WATERFOWL IN NEED OF MANAGEMENT ACTION 15
FIGURE 9) STREAM MILES OPENED TO MIGRATORY FISH..... 17
FIGURE 10) BAY-WIDE ACREAGE OF SUBMERGED AQUATIC VEGETATION..... 19
FIGURE 11) 2003 PHYTOPLANKTON COMMUNITY TRENDS..... 21
FIGURE 12) BENTHIC COMMUNITY STATUS 23

APPENDICES

A. LEGISLATIVE CITATION

PROGRAMS MONITORING BAY RESOURCES

Several agencies in the Natural Resources Secretariat conduct monitoring of the Chesapeake Bay and its tributaries. A summary of these programs follows:

- The Department of Environmental Quality (DEQ) participates in the Federal-Interstate Chesapeake Bay Monitoring Program, a nationally recognized example of coordinated environmental monitoring of a multi-state body of water. This monitoring program is an important component of the scientific basis to demonstrate that the millions of dollars being spent on Bay restoration efforts are having a positive impact.

  One component of this monitoring focuses on water quality. This component monitors key qualities of the water such as nutrient concentrations, water clarity, salinity levels, dissolved oxygen concentrations and pH. The DEQ monitors these parameters monthly at 65 locations throughout the Bay mainstem and tidal tributaries (i.e., tidal portions of the James, Rappahannock, York, and Elizabeth Rivers).

  A second component of the DEQ Bay monitoring program focuses on important non-commercial biological communities. The DEQ monitors these communities at a sub-set of the water quality stations so that analysts can study and understand the linkages between water quality and biological communities. Benthic communities (i.e., bottom dwelling invertebrate organisms) are monitored semi-annually at 21 fixed locations and once each summer at 100 randomly allocated stations. Planktonic communities (i.e., small plants and animals in the water) are monitored monthly at 14 stations and more intensively in fish spawning areas.

  The third component of the DEQ Bay monitoring is the "River Input" component. This component measures the amounts of nutrients and sediment entering the tidal Bay tributaries from most of its watershed. Intensive water quality sampling for this program is done at one site each in the James, Rappahannock, Mattaponi, Pamunkey, and Appomattox Rivers. This monitoring component is of major importance in determining the Commonwealth's progress toward meeting defined numeric goals for the reduction of nutrient inputs.

- The Virginia Marine Resources Commission (VMRC) conducts two programs involved in the collection of fisheries information in the Bay. The Commercial Fisheries Mandatory Harvest Reporting program assembles data on commercially valuable species harvested from Virginia waters and nearby oceanic waters, on a per fisherman basis. Harvest or landings of over 50 species taken by dozens of fishing methods are analyzed on a monthly basis. These data are used to develop conservation and management strategies and to determine the benefits and impacts of proposed and implemented measures.

  VMRC's Stock Assessment Program collects information concerning the biological attributes (e.g., age and size) of 13 various fish stocks. For key species (e.g., striped bass, summer flounder, weakfish), these data are used in Atlantic coast-wide population models to assess the levels of population abundance and exploitation and the impacts of various proposed

management measures such as possession limits, size limits or allowable harvest. In addition to monitoring fish stocks, annual stock assessments of hard clams and oysters are conducted. A Bay-wide, quantitative survey of hard clams is underway to determine the current distribution and stock condition of this economically important species. Oysters are surveyed qualitatively by dredge every fall to determine spatset, overall condition, and mortality. Oyster stocks are also surveyed quantitatively each fall by a combination of patent tong and diver collections.

Effective fisheries management is currently dependent upon reliable and timely measures of the levels of harvest and effort and the ability to detect significant changes in the fish stocks. VMRC's Harvest Reporting Program and Stock Assessment Program provide these management tools. The Mandatory Harvest Reporting Program, which replaced a voluntary, buyer-based program, has served as a model for the development of similar programs in other Atlantic coastal states, during the Atlantic coast-wide transition to a standardized program (Atlantic Coastal Cooperative Statistics Program) for the collection of fisheries harvest data on a per trip basis. Information from the program is used as a basis for fishery management decisions at the state, interstate, and federal levels. The quality of the data ensures that decisions affecting Virginia's fishermen will be based upon the best available science.

- The Department of Game and Inland Fisheries (DGIF) performs in-depth game and nongame wildlife surveys and management activities throughout the Bay watershed. These wildlife management and research programs are conducted on both public and private lands and waters. Warmwater and coldwater stream management projects are conducted within the basin. The Warmwater Streams Project is an effort to survey existing aquatic resources, enhance game fish populations, improve recreational access and opportunities, and protect critical habitat. Department biologists conduct surveys of the Bay's tidal and freshwater resources and assist in drafting fisheries management and species restoration documents. The Coldwater Streams Project will continue to manage Virginia's coldwater stream habitats, many of which are in the Chesapeake Bay watershed, through research, habitat development and surveys, and recreational fisheries management.

STATUS OF WATER QUALITY CONDITIONS

Water is the medium in which all aquatic living resources of the Bay live, and their ability to survive and flourish is directly dependent on it. The following summarize several key water quality issues, including excessive levels of nutrients and their impact on living resources and impacts from toxic chemicals in regions with existing or potential problems.

A detailed analysis of status and trends for nutrients has been recently published in the report titled "2003 Annual Report On The Environmental Conditions Of Virginia's Chesapeake Bay And Tributaries", available from the Virginia Department of Environmental Quality. The following is a summarization of the findings from this report.

- Nutrient loadings from watershed input monitoring stations have been are affected by the reduced point and non-point inputs but are highly dependant on river flow patterns as well. There have been decreased loadings of nitrogen, phosphorus, and sediments found at the James, Appomattox, and Mattaponi stations. Much of these decreased loadings are due to decreased riverflow but there have also been decreased loadings due to management actions.

- Phosphorus levels in water entering from the Bay watershed are reflecting both point and nonpoint source nutrient source reductions by showing improving concentration trends in some rivers. Within the tidal waters themselves, there is some improving areas observed but also some degrading areas. Overall, there were eight areas showing improving trends and five areas showing degrading trends for phosphorus.

- For nitrogen, the Potomac and James show improving trends in water entering from the watershed. Nitrogen levels also showed improving trends in much of the tidal Potomac, James, and Elizabeth Rivers. Improving trends have also been found for the first time in the mainstem Virginia Chesapeake Bay. Degrading trends are a concern in the upper Pamunkey and Rappahannock rivers. Overall, there were nineteen areas showing improving trends and only four areas showing degrading trends for nitrogen.

- Chlorophyll concentrations (an indicator of algae levels) are moderately high throughout much of the tidal waters. Degrading trends were found particularly in the tidal fresh portions of the rivers. Improving trends are being found only in the Potomac and Elizabeth Rivers. Overall, eight areas showed degrading trends in chlorophyll while two areas showed an improving trend. These results indicate nutrient concentrations are still too high despite relatively widespread improving trends in nitrogen.

- Levels of dissolved oxygen are improving in geographically widespread areas of the tidal rivers. However, an assessment of oxygen conditions in relation to recently developed criteria shows many areas of impairment. Overall, there were eleven areas showing improving trends and zero areas showing degrading trends for dissolved oxygen conditions. A preliminary assessment of new regulatory criteria for dissolved oxygen indicates fairly widespread non-attainment.

- Water clarity, a very important environmental parameter, was generally poor and degrading trends were detected in many areas. This degradation is probably related to scattered areas of increasing levels of suspended solids. These degrading conditions are a major impediment to restoration of submerged aquatic vegetation (SAV). Overall, there were six areas showing improving trends and ten areas showing degrading trends in water clarity. A preliminary assessment of new regulatory criteria for water clarity indicates fairly widespread non-attainment.

- The Elizabeth River is showing improving trends in all major water quality parameters.

- Water quality in creeks and inlets of the Virginia Eastern Shore indicate high groundwater nutrient levels due to agricultural activities.

- In summary, there are generally improving conditions for nitrogen and dissolved oxygen. Conversely, phosphorus, chlorophyll, suspended solids, and water clarity are generally declining. These patterns are a combined result of both management controls of nutrient inputs and the natural effects of rainfall (e.g. the drought which ended in 2003).

Toxics

In 1999, the Chesapeake Bay Program's Toxics Subcommittee completed a toxics characterization (see Figure 1 and Table 1) of the tidal tributaries of the Chesapeake Bay, which includes all of Virginia's tidal tributaries. The results of the characterization can be found in "U.S. EPA, 1999. Targeting Toxics: A Characterization Report. A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers. Chesapeake Bay Program, U.S. EPA 903-R-99-010, 1999, 49 pp. and appendices". The characterization served a dual purpose for the Chesapeake Bay Program and its partners: 1) it served as a guide in the development of the Toxics 2000 Strategy, and 2) it continues to provide the basis to direct management actions, such as toxics monitoring. The characterization process directed the placement of each pre-defined regional area into one of four categories based on chemical contaminant exposure and biological affects. Two contrasting areas include *Regions of Concern* which are highly impacted areas (e.g., Elizabeth River) and A*reas of Low Probability for Adverse Effects* which are regional areas where studies have been performed but there is no evidence to suggest living resources are impacted or threatened by chemical contaminants. The third grouping, *Areas of Emphasis,* are areas where data points to the potential for serious chemical contaminant-related impacts to living resources. Lastly, *Areas of Insufficient or Inconclusive Data* are those areas where the evidence from a particular segment is insufficient to place it into one of the three categories above.

Figure 1) Status of Chemical Contaminant Effects on Living Resources in the Chesapeake Bay's Tidal Rivers

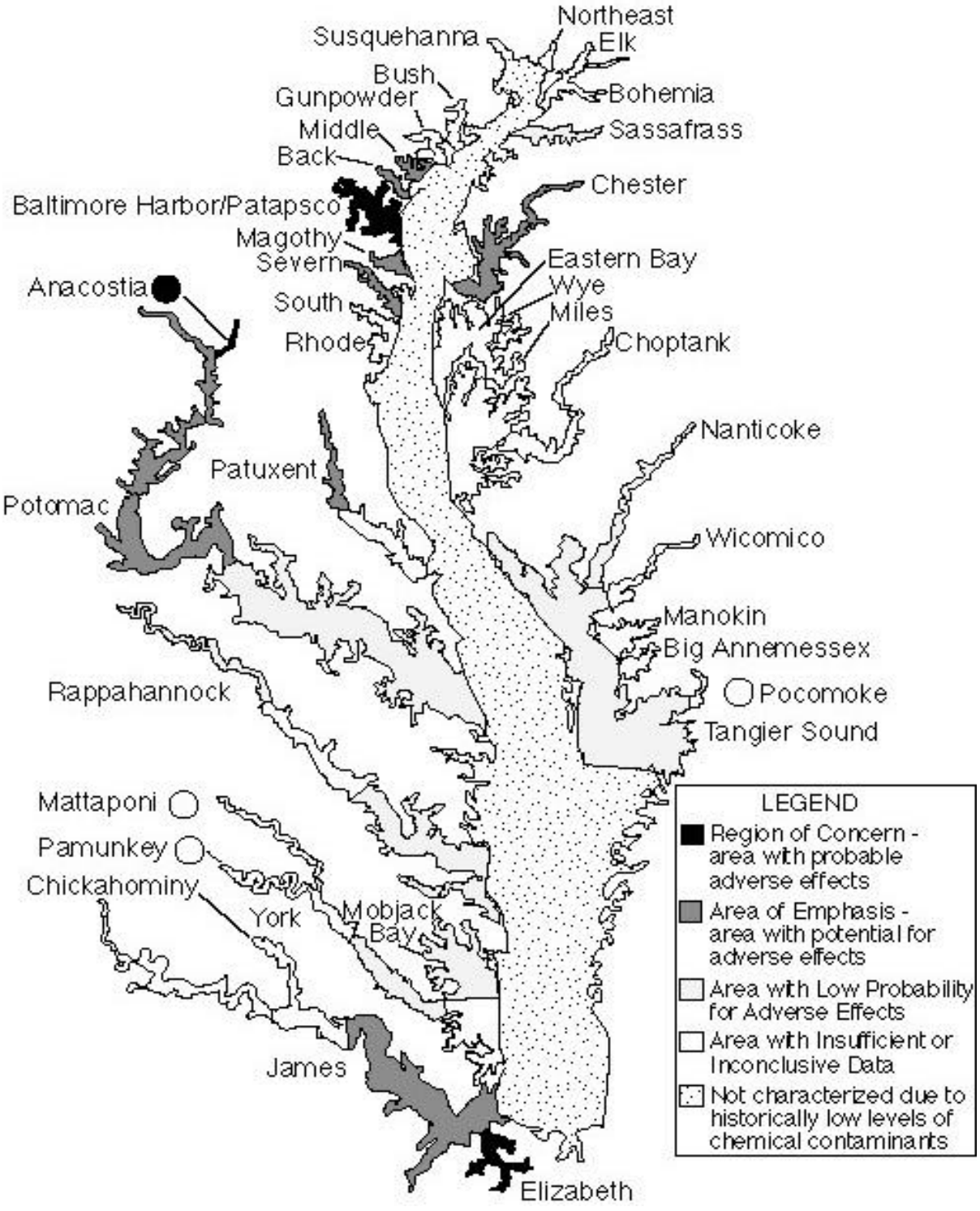


Table 1) 1999 Chemical Contaminant Characterization Results

VIRGINIA TIDAL TRIBUTARIES	TOXICS CHARACTERIZATION RESULTS
James River	Tidal Upper Segment: Area of Insufficient Data Tidal Middle Segment: Area of Insufficient Data Tidal Lower segment: Area of Emphasis
York River	Tidal Pamunkey: Area of Insufficient Data Tidal Mattaponi: Area of Insufficient Data Upper Middle York: Area of Insufficient Data Lower Middle York: Area of Low Probability for Adverse Effects Upper Mobjack Bay: Area of Low Probability for Adverse Effects Lower Mobjack Bay: Area of Insufficient Data
Rappahannock River	Tidal Upper: Area of Low Probability for Adverse Effects Tidal Middle: Area of Insufficient Data Tidal Lower: Area of Low Probability for Adverse Effects
Potomac River (*western shore)*	Tidal Upper: Area of Emphasis Tidal Middle: Area of Emphasis Tidal Lower: of Low Probability for Adverse Effects

Source: EPA 903-R-99-010, CBP/TRS 222/106, June 1999

Recent Chemical Contaminant Monitoring in Areas of Insufficient Data

- Upper and Middle Tidal James River – Ambient Toxicity monitoring was completed during early fall in 2000 and 2001 in the tidal freshwater James River. In the first study year, twenty (20) stations were randomly located from Jamestown Island to the Benjamin Harrison Bridge near Hopewell. Full chemical contaminant analyses of the water column and sediment along with ambient toxicity tests, in-situ assays and benthic community assessments were performed. To enhance spatial coverage, a sediment quality triad approach (chemical contaminants, toxicity tests and benthic analysis) was performed on the James River between Hopewell and Richmond during the fall of 2001. A total of nine (9) stations were included with the placement of eight (8) in the James River and one (1) in the Appomattox River.

  The 2000 water column results plus data from 2 years of sediment study suggest there may be a low incidence of chemical contaminants causing deleterious biological impacts in this stretch of the James River. The observance of low chemical contaminant levels and the lack of toxicological impacts at almost 30 random stations support this conclusion. Benthic community impacts were noted but for reasons other than chemical contaminants. While this effort was designed to make statements about the entire segment, conclusions from this study cannot rule out the possibility of locally impacted areas. Furthermore, this study was not designed to measure the bioaccumlative impacts of PCBs to fish and other biota although PCBs were on the targeted analyte list.

- Lower Mobjack Bay, including the Tidal Back and Poquoson Rivers – This area was sampled during fall 2002. Following a similar station selection design to earlier years, three (3) strata were identified with the selection of four (4) random stations within each stratum. The strata were defined as the Back River, Poquoson River, and the Mouth of the York River/Chesapeake Bay. As described above, the sediment quality triad approach was again used, as this has become the preferred tool for performing these characterizations.

The triad results show that degraded benthic communities were found in the Back and Poquoson Rivers, but the impact was described as being related to a eutrophic condition (i.e., nutrient enrichment). This was supported by low level chemical contaminants detected in sediments well below threshold levels predictive of a biological response. Additionally, lack of toxicological responses within the toxicity tests provides further evidence chemical contaminants are not the likely cause of the benthic stress.

- Tidal Mattaponi and Pamunkey Rivers - In continuing the ambient toxicity-monitoring program, DEQ performed the field portion of a sediment quality study during the fall of 2003. Seven (7) randomly selected stations were targeted in both water bodies, ranging from their respective mouths to the upstream head of tide. The completion of this study should provide adequate information to the Chesapeake Bay Program such that full characterization can be made within this Bay segment. The full results and conclusions will be available by summer 2004.

Elizabeth River

An important component of the Elizabeth River restoration process is monitoring for toxic pollutants deemed as problematic to the river's ecology. Historically, a wide array of chemical contaminants and biological tests were targeted in the sediment and the water column. The occurrence of toxic pollutants has been well documented in the Elizabeth River, particularly in the Southern Branch. More recently, since the availability of state funding has diminished and because management actions require implementation to reduce the inflow of contaminants, toxics monitoring efforts have been re-directed. One program that has continued is Tributyltin (TBT) monitoring performed by the Virginia Institute of Marine Science. Result have shown that all Elizabeth River stations had average TBT concentrations that exceeded the Virginia Water Quality Criterion (1 ng/l). The data also show that TBT concentrations increases steadily at the upstream stations, with the highest levels observed at the confluence of the Eastern and Southern Branches. The trend from three (3) years of data collection illustrates that TBT concentrations are not on the decline, and at some stations have substantially increased when compared to the initial monitoring year.

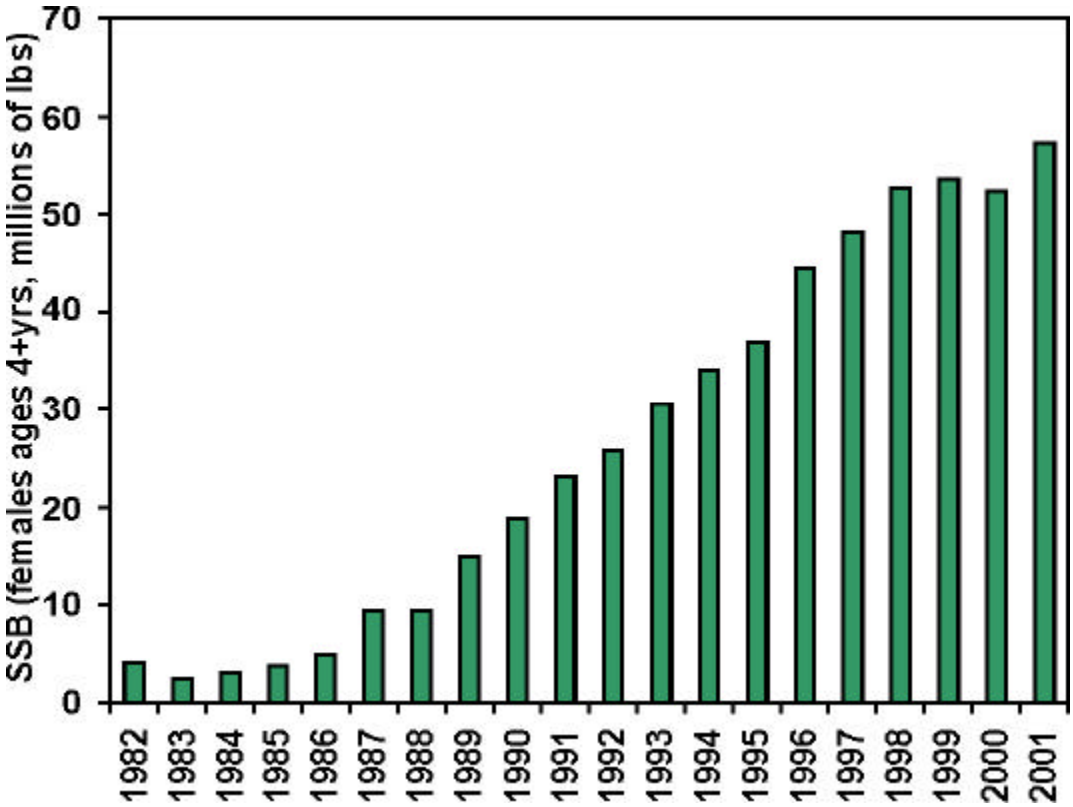
STATUS OF LIVING RESOURCES

The Chesapeake Bay Agreement states that the productivity, diversity and abundance of living resources are the best ultimate measures of the Chesapeake Bay's condition. The following sections summarize the most recent information on the status of Virginia shellfish, finfish, and other living resources.

Striped Bass

Striped bass have formed the basis of one of the most important fisheries (commercial and recreational) on the Atlantic coast. Striped bass are anadromous fish, spending most of their life in the ocean and returning to the Chesapeake's tributaries to spawn. They continue their remarkable recovery beyond historically high levels and now support healthy commercial and recreational fisheries. Figure 2 shows that spawning stock has recovered to recent historic high levels and this fishery was declared "fully recovered" in 1995. The female spawning stock biomass is a relative measure of mature female biomass in metric tons for ages 4-15 years old. Index values are derived by a simulation model that incorporates the population dynamics of striped bass plus the historical nature of the coastwide fisheries. A major factor in the striped bass decline was overharvesting, which disrupted the balance of the spawning stock. Other factors included contaminants in spawning grounds and loss of habitat.

Figure 2) Striped Bass Spawning Stock



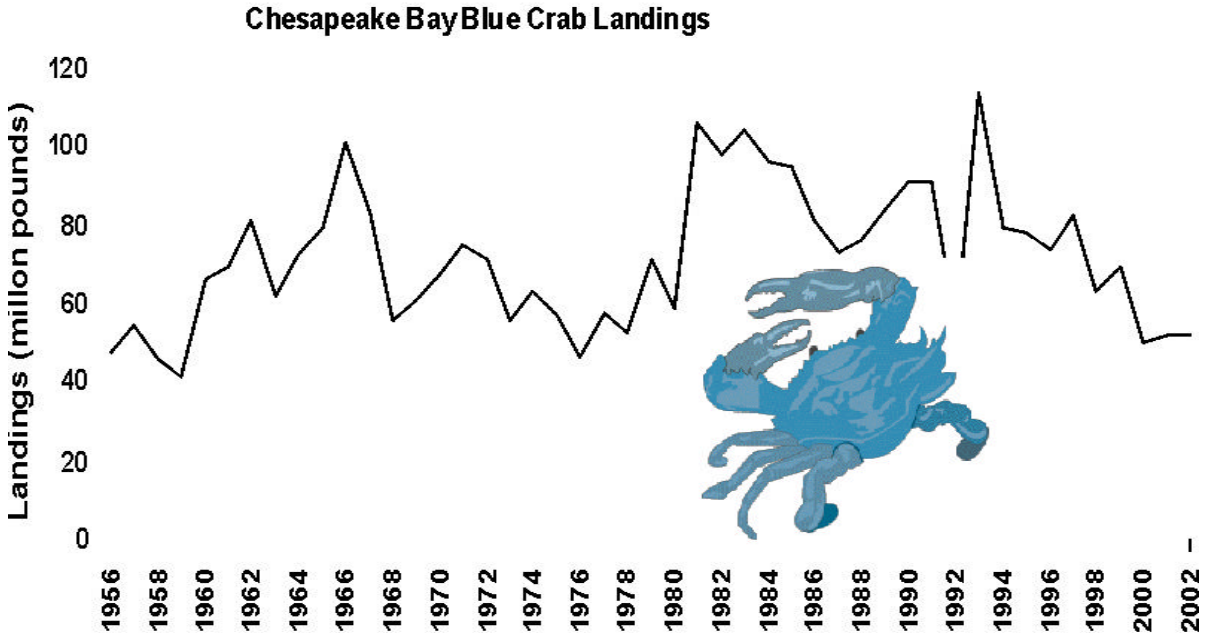
The 1979 Emergency Striped Bass Research Study resulted in the Atlantic States Marine Fisheries Commission (ASMFC) preparing a coast wide management plan severely restricting harvests. Since 1993 the health of the striped bass stock within the Chesapeake Bay is assessed through a mark-recapture program, used to determine the Bay-wide fishing mortality rate, and those fishing mortality rates have usually been below or at the ASMFC required target.

Blue Crab

Blue crabs serve as both predator and prey in the food webs of the Chesapeake Bay. Smaller life stages serve as food for eel, drum, spot, Atlantic croaker, striped bass, sea trout, catfish and even larger crabs. Some sharks and cownose rays feed on juveniles and larger crabs. Adult blue crabs are omnivorous, feeding on bivalves, crustaceans, fish, marine worms, plants, detritus, and nearly any food item they can find (including dead fish and plants). The favorite food of blue crabs appears to be thin-shelled bivalves. Blue crabs mature at approximately 12 to18 months of age. Under current levels of fishing pressure, most crabs live from one to two years beyond maturity and the typical lifespan of a crab is up to three years. The maximum age may be as long as five to eight years where there are very low levels or an absence of a commercial fishery.

The 2002 Chesapeake Bay blue crab harvest of about 52 million pounds (Figure 3) is well below the time series (1968 - 2002) average of about 73 million pounds. The low harvest in 2002 was principally a result of low exploitable stock abundance. However, the harvest was also constrained by management measures implemented in Maryland, Virginia and the Potomac River Fisheries Commission, prior to and during the 2001 and 2002 seasons

Figure 3) Blue Crab Landings (estimated)

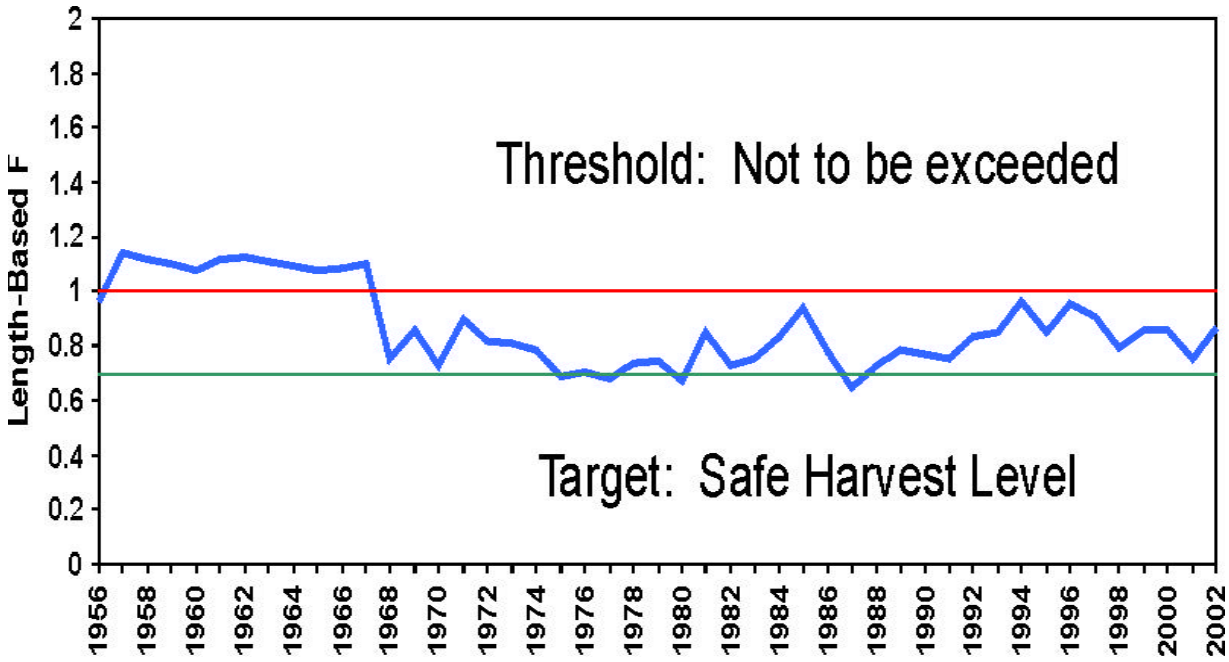


In October 2000, the Bi-State Blue Crab Advisory Committee reported that changes were needed in the management of the fishery. They endorsed a fishing threshold that protects at least 10% of

the crab stock's spawning potential, and a stock threshold equal to the lowest stock biomass on record, which occurred in 1968.

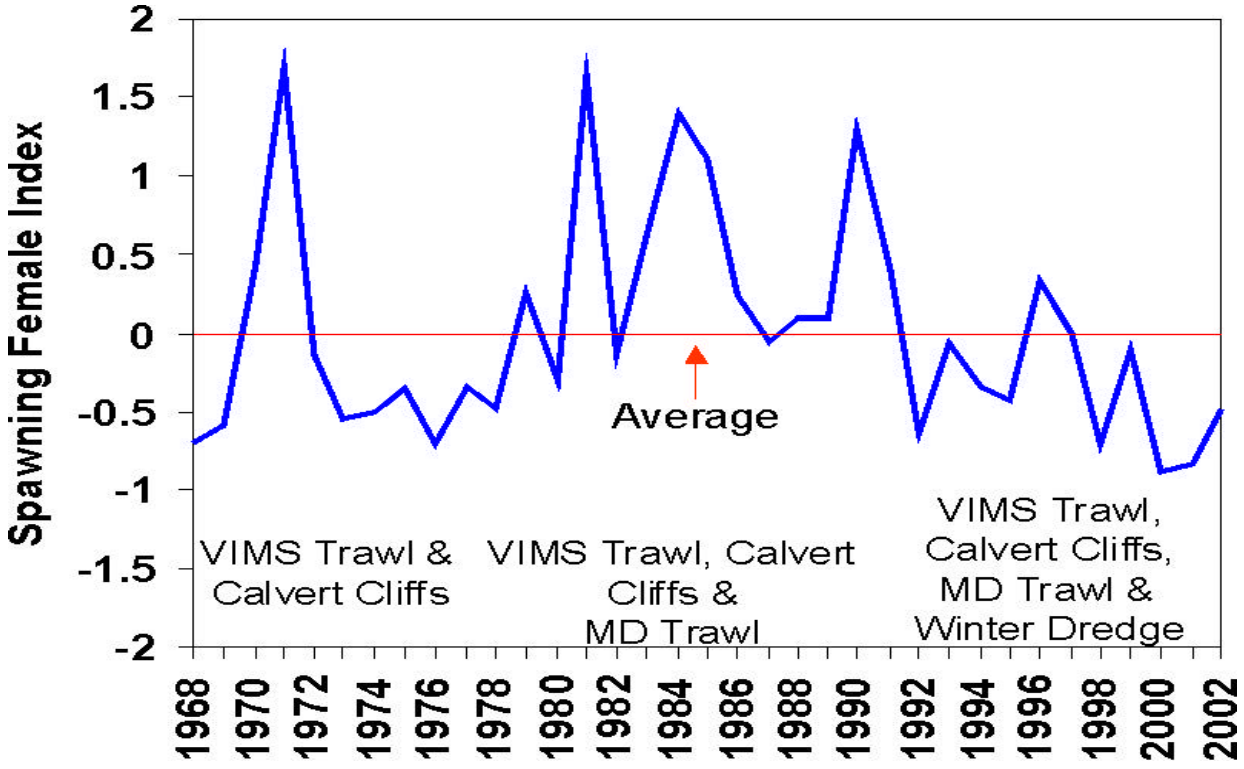
Harvest pressure on blue crabs is indicated in Figure 4. Stated simply, the threshold, F = 1, means that 54% of the stock would be removed by fishing, alone, on an annual basis. The year 2002, F = 0.9 means that 51 % of the Bay-wide stock of blue crabs is being removed by fishing, and the target F = 0.7 means that Bay-wide managers recommend that, by 2003, the harvest or fishery removal rate should be 43%, in order to promote additional biological stability to this valuable resource. Should the target F = 0.7 result, then at least 20% of the spawning stock would be protected. The current annual mortality rate (fishing and natural mortality, combined) is 72%. Whereas, when the target F is achieved the annual mortality will be 66%. For each of these annual mortality rates, natural mortality compromises roughly 1/3 of the total annual mortality.

Figure 4) Blue Crab Fishing Mortality Rate



Mature female blue crab abundance in 2000 was well below the long term average and has declined since the early 1990s (Figure 5). The abundance is currently slightly above the previous historical lows set in 2000 and 2001. The Chesapeake 2000 Agreement commits the Bay states to "establish harvest targets for the blue crab fishery by 2001." In 2001, Bay jurisdictions met this commitment by adopting a Baywide threshold for the blue crab stock. They agreed to double the spawning stock which equated to a 15 percent reduction in harvest levels (based on 1997-1999 average) over three years.

Figure 5) Blue Crab Spawning Stock Abundance

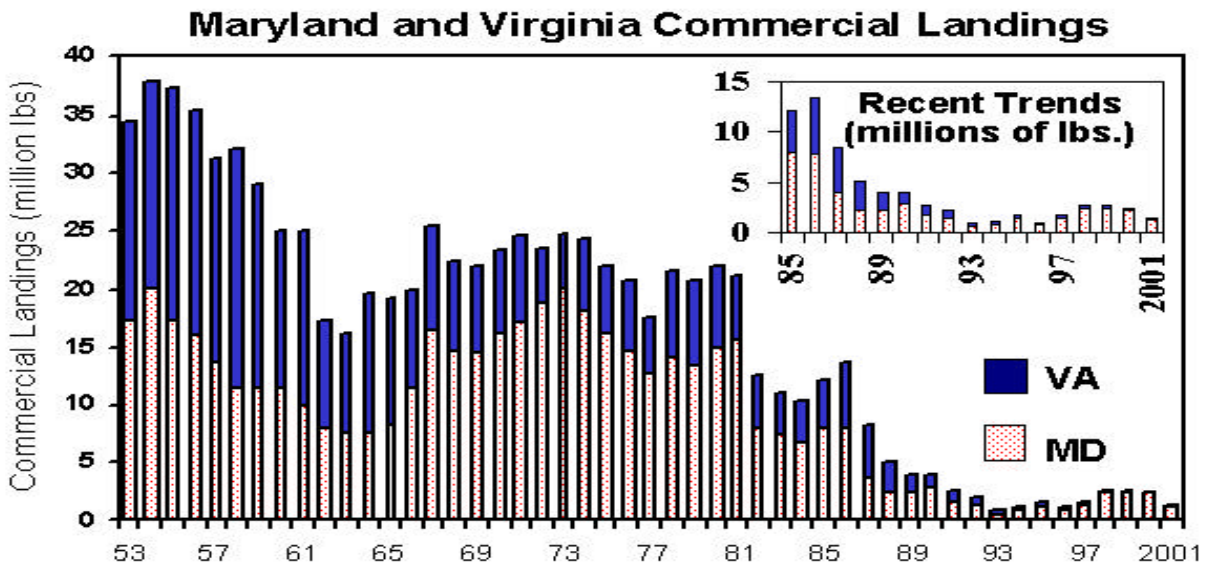


NOAA, one of the Bay Program federal agency partners, has sponsored research, through the Chesapeake Bay Stock Assessment Committee (CBSAC), to assess the status of the blue crab stock. An Advisory Report is issued every May. The 2003 report, based on several surveys through 2002, concluded that baywide abundance has stabilized near historically low levels over the last four years. This continued low abundance puts the stock at increased risk for recruitment failure. The current status of the stock was compared to thresholds and targets endorsed by regional management agencies in January 2001. Stock abundance was above the overfished threshold. The absolute magnitude of fishing mortality is uncertain but some measures of exploitation indicate an increasing trend over the past decade. There is an indication from the winter dredge survey that fishing mortality has decreased from 2001 to 2002. Although stock abundance improved slightly in 2002, it was still below the BBCAC abundance action threshold. The low abundance combined with a high exploitation rate indicates a stock condition that warrants concern for the sixth consecutive year.

Oysters

In recent years, the scientific community has convincingly demonstrated the significant role a flourishing oyster resource once played in maintaining water quality in the Chesapeake Bay. These great populations of oysters, in addition to supporting large fisheries, were capable of filtering the waters of the Bay in a few days. Their value to the Chesapeake Bay and Virginia simply cannot be overstated. Current populations of oysters, which provide great economic and ecological benefits to the Bay region, are very low as reflected in very low commercial harvests (Figure 6). Reasons for the decline have been related to historic overfishing, habitat degradation, poor water quality, and most recently, oyster diseases.

Figure 6) Oyster Harvest



With recent drought conditions prior to 2003, disease impacts have been especially severe, resulting in significant oyster mortalities throughout the Bay in natural oyster beds as well as new reef restoration project beds.

The dismal condition of oyster populations in the bay has led to several restoration approaches attempted. The creation of new oyster reefs through the placing of natural or artificial substrate in the waters has met with limited success. Though there are fair amounts of baby native oyster (spat) naturally settling or being placed on the reefs, their growth and survival has been disappointing. A second approach of developing disease resistant strains of the native Chesapeake Bay oyster has also had little success in restoring oyster populations or harvests. The third approach has been to use non-native oyster species that would be disease resistant. This approach has recently seen great interest with 60,000 oysters tested in 2003 and permits received to allow the Virginia seafood council to test 1,000,000 oysters in the future.

Waterfowl

The Chesapeake Bay is located along the Atlantic flyway, which every year channels the annual seasonal flights of millions of migratory birds. Waterfowl were once so abundant that they seemed to blanket areas of the Bay and to "blacken the sky." Today their numbers are greatly reduced. The deterioration of their shallow water habitats, coupled with human activities, loss of wetlands in the US and Canada have reduced the area's capacity to support huge populations of these migratory birds.

State biologists and the US Fish and Wildlife Service routinely count at least 20 species or species groups of waterfowl each winter in the Bay watershed. The goal for each species is based on the mean number of waterfowl counted on surveys from 1973-1977 or the 1986-1990 count, whichever was greater. Figure 7 shows species or species groups that have met their goals and are showing improving trends. Nine valuable waterfowl species have not met their goals (Figure 8). Most show declining trends, although redheads, pintails and shovelers have increased since 1986-1990.

For some species, increasing populations may be bad for the Bay. Mallards, Canada geese and mute swans have growing resident populations (introduced or non-native) that may harm the Bay ecosystem through consuming food resources such as Bay grasses needed by wintering populations, and by competing for breeding areas and food with native black ducks. Additionally, expanding populations result in increased conflicts with humans at beaches and ponds, and elevated bacterial levels in swimming areas. These resident populations also make it hard to determine trends of native waterfowl, as they are difficult to differentiate during the winter survey.

Snow geese populations are increasing dramatically and are destroying their tundra breeding areas by eating all of the vegetation. Because they often move in flocks of thousands and eat roots in the mud, they can destroy large areas of marsh and crops in a short time, thereby increasing erosion. The problem is not as severe in the Chesapeake Bay as in many other areas, but may become so if the population continues to grow.

Figure 7) 2003 Status and Trends of Bay Waterfowl Doing Well

	Goal Achieved	Trend Since Plan Adopted (1986-1990)
Mallard (migratory)	Y	▲
Gadwall	Y	▲
American Wigeon	Y	▲
Northern Shoveler	Y	▲
Northern Pintail	Y	▲
Green-winged Teal	Y	▲
Canvasback	Y	▲
Scaup	Y	▲
Ring-necked Duck	Y	▲
Bufflehead	Y	▲
Ruddy Duck	Y	▲
Mergansers	Y	▲

▲ Increasing - Good
▼ Decreasing - Bad

Figure 8) 2003 Status of Bay Waterfowl in Need of Management Action

	Goal Achieved	Trend Since Plan Adopted (1986-1990)
Black Duck	N	▼
Redhead	N	△
Common Goldeneye	N	▼
Scoters	N	△
Long-tailed Duck	N	▼
Brant	N	▼
Canada Goose (m)	N	△
Tundra Swan	N	▼

Problem Species with Increasing Trends		
Snow Goose	Y	▲
Mute Swan	N/A	▲
Canada Goose (r)	N/A	▲
Mallard (r)	N/A	▲

△	Increasing - Good
▼	Decreasing - Bad
▲	Increasing – Bad
m	Migratory
r	Resident

Migratory Fish

Anadromous fish, such as shad and river herring, live in the Bay and ocean as adults and migrate to spawn in freshwater. Blockage of these freshwater streams, habitat degradation, and heavy fishing pressure has resulted in dramatic declines of these fish. More than a thousand miles of fish spawning habitat on Chesapeake Bay tributaries are currently blocked by dams, culverts and other obstructions.

Early removals of blockages, along with harvest restrictions, have resulted in some increased numbers of migratory fish in the Bay and its tributaries. However, spring runs of American shad, hickory shad, blueback herring, and alewife in the Bay are still currently depressed. Fish passages are man-made modifications that help these fish swim upstream, past dams and other blockages, to reach their freshwater spawning habitat.

Restoring and protecting the Bay's vital fishery resources are key parts of the 1987 Chesapeake Bay Agreement and the more recent agreement, Chesapeake 2000. A major component of restoring migratory fish populations includes providing passageways that will allow fish to reach their historic spawning grounds. Working toward this restoration goal, the Chesapeake Bay Program partners have committed to removing blockages and reopening 1,357 miles of the Bay's tributaries for migratory fish by the year 2003.

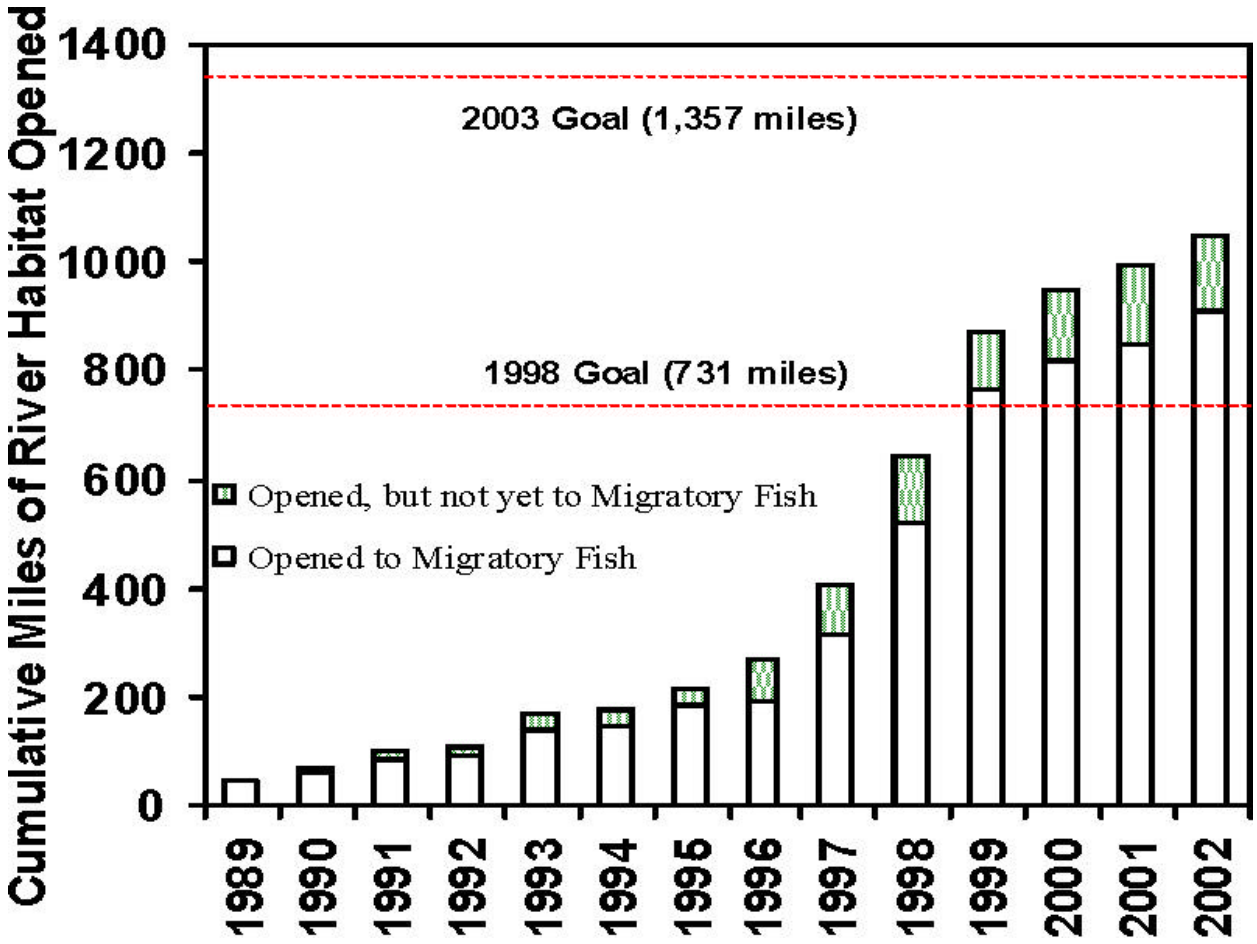
The Department of Game and Inland Fisheries Fish Passage Program identifies blockages to fish migration and facilitates the design and construction of these fishways. Working toward this restoration goal, the Chesapeake Bay Program partners have committed "to provide for fish passage at dams, and to remove stream blockages wherever necessary" to restore passage for migratory fish.

The removal (and/or natural destruction) of stream blockages and the construction of fish passages in 2002 reopened 65.3 miles of historic spawning habitat to migratory fish (figure 11).

Between 1988 and 2002 a cumulative total of 913.8 miles became available to migratory fish, and an additional 138 miles to resident fish.

The 138 miles currently open only to resident fish will eventually be open to migratory fish as well.

Figure 9) Stream Miles Opened to Migratory Fish



Seagrasses

Bay grasses are also known as submerged aquatic vegetation, or SAV. These grasses are important because they produce oxygen, are food for a variety of animals (especially waterfowl), provide shelter and nursery areas for a variety of fish and shellfish, protect against shoreline erosion by reducing wave action, absorb nutrients such as phosphorus and nitrogen, and trap sediments. Grasses are a good progress measure because they aren't under harvest pressure like most other living resources and they directly respond to improvements in water quality, which primarily occur through reductions in sediment, phosphorus and nitrogen.

Submerged aquatic vegetation (SAV) refers to underwater vascular plants such as eel grass and widgeon grass. These aquatic plants perform a number of valuable ecological roles in Chesapeake Bay. They are food for waterfowl and also provide habitat for a variety of fish, shellfish and many smaller organisms. The beds of SAV are also a nursery area for juvenile stages of many valued commercial and recreational fishes. Historically, SAV has generally been abundant throughout Chesapeake Bay; however, current populations are only a remnant of the once thick beds that provided shelter to the Bay's thriving fisheries. The drastic decline of SAV, first noted in the 1970's, sparked the interests of Bay scientists and managers to determine the cause for this significant loss and seek methods to restore this dwindling resource.

Increasing quantities of nutrients, such as phosphorus and nitrogen, as well sediment in the water – some still due to significant runoff from Tropical Storm Agnes in 1972 – have choked or eliminated the growth of SAV in many areas, and contributed to declines in SAV acreage throughout the Bay. By 1984, aerial surveys of bay grasses documented only about 38,000 acres in the Bay and its tributaries.

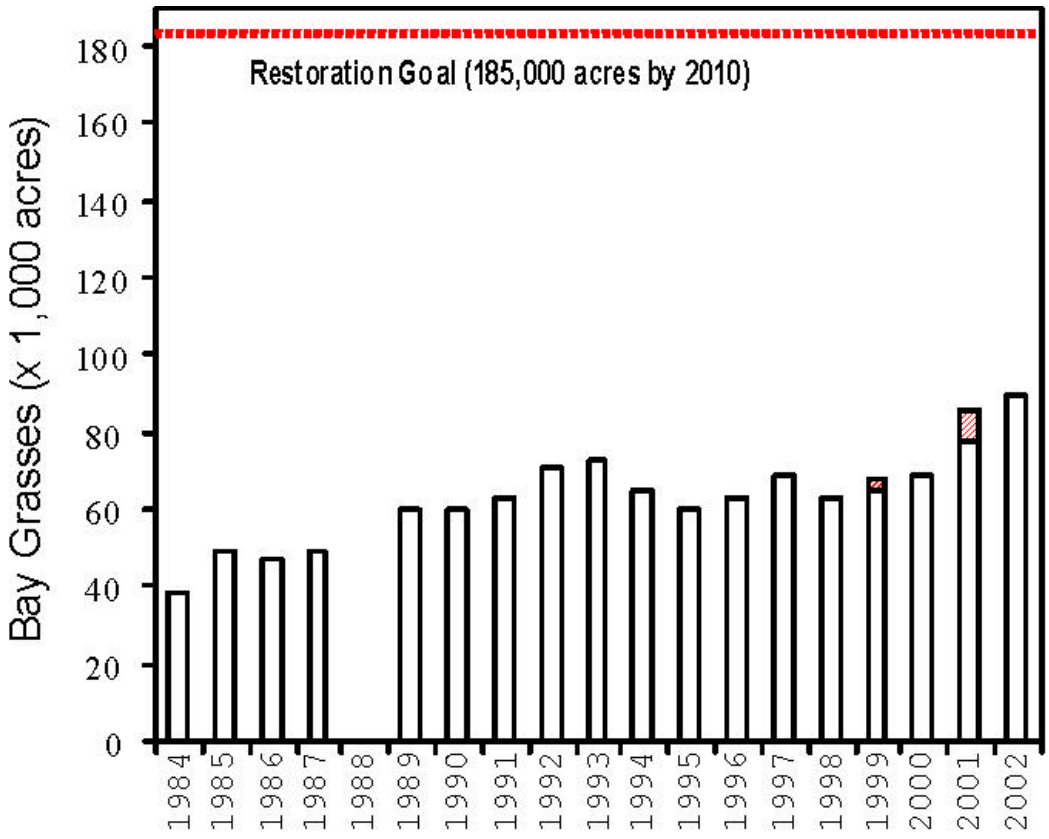
In 1993 the Bay Program agreed to work to restore SAV to its historical levels. They set an interim restoration goal of 114,000 acres - the total area vegetated at one time or another since the early 1970s. Based on recovery rates at that time, it was expected that this acreage would be achieved by 2005.

In 2003, the CBP adopted the Strategy to Accelerate the Protection and Restoration of Submerged Aquatic Vegetation in the Chesapeake Bay including a new Baywide restoration goal of 185,000 acres by 2010. This acreage represents approximate historic abundance from the 1930s to present. Scientists believe increasing bay grass coverage beyond today’s acreage will result in dramatic improvements throughout the entire Bay ecosystem.

Populations of SAV have been intensively monitored since 1978 (Figure 12). In 2002, 89,658 acres of bay grasses (also known as submerged aquatic vegetation or SAV) were mapped in the Bay and its tributaries. Significant changes in SAV distribution were measured between 2000 and 2002 (changes are calculated between 2000 and 2002 since flight restrictions prevented a complete survey in 2001). Between 2000 and 2002 SAV has:

- Increased 30% Baywide (the estimated Baywide increase between 2001 and 2002 is 8%);
- Decreased 11% in the upper Bay, stretching from the Chester and Magothy rivers north;
- Increased 58% in the middle Bay, stretching from the Chester-Magothy area, south to the Pocomoke and Rappahannock rivers; and
- Increased 13% in the lower Bay, stretching from the Pocomoke-Rappahannock area south to the mouth of the Bay at Hampton Roads.

Figure 10) Bay-wide Acreage of Submerged Aquatic Vegetation



*Note Hatched area of bar includes estimated additional acreage. No survey in 1988.
Source: Chesapeake Bay Program.

Phytoplankton Communities

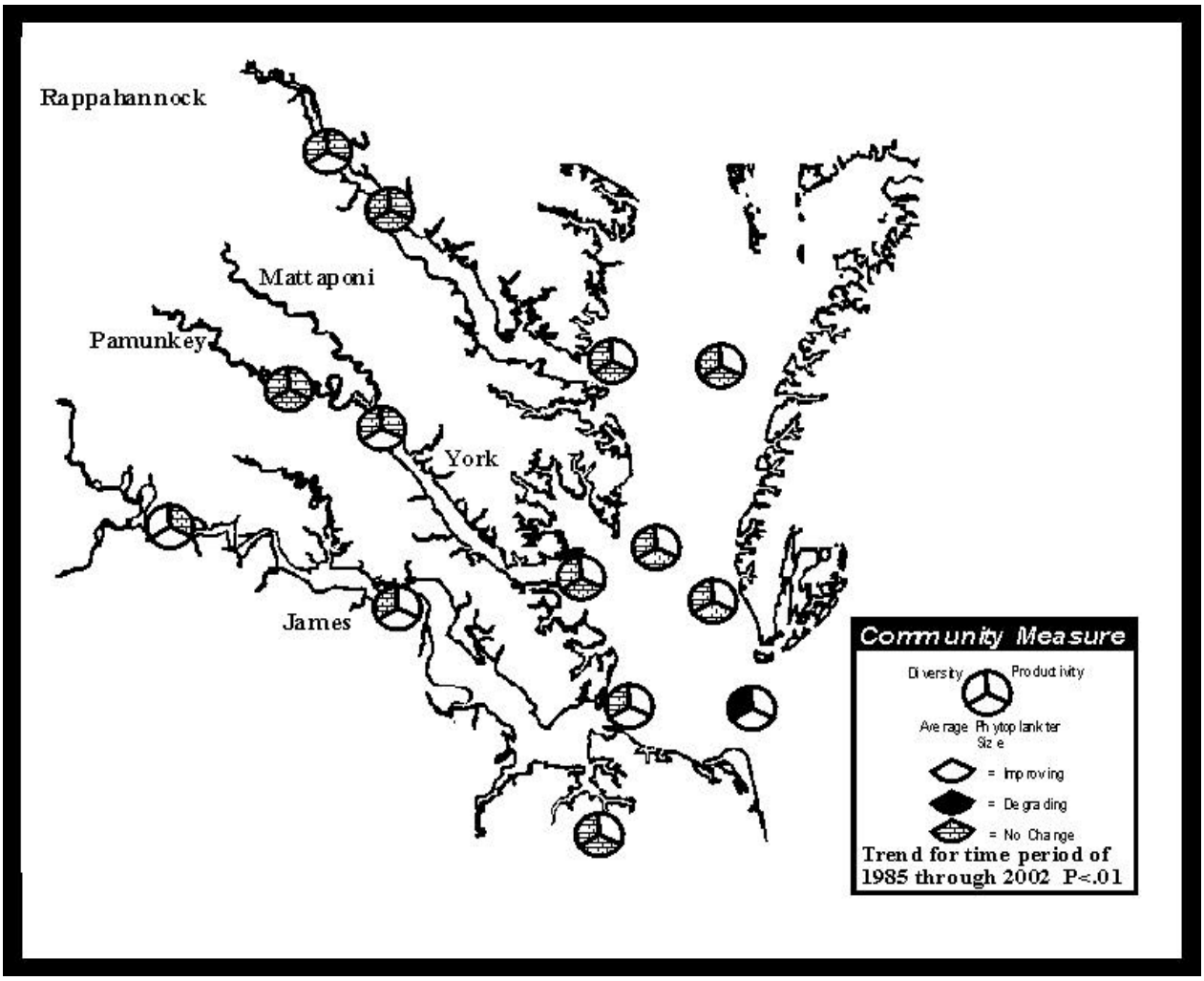
Phytoplankton are small plants (often composed of only a single cell) which utilize sunlight and nutrients to grow and reproduce. The phytoplankton community represents an important ecological component in the Chesapeake Bay ecosystem because all other ecologically and economically important species rely on this component for the oxygen they produce, and as the primary contributor of food at the base of their food webs. Changes in the composition and balance of certain phytoplankton components can result in the reduction, or elimination, of species within the higher levels of the food chain. Knowledge of phytoplankton populations provides an early warning of environmental changes that are having an impact on commercial species populations, and which could result in widespread ramifications. Phytoplankton populations are also very sensitive and responsive to changes in nutrient conditions.

Figure 11 shows the trends during the last 17 years of three important phytoplankton community measures (diversity, productivity, and individual phytoplankter size). Diversity is a measure of the number of different types of plankton. The present phytoplankton diversity of the Virginia Chesapeake Bay and tributaries is generally good and contains many of the more favorable algae (e.g., diatoms) that function as active food and oxygen producers within these waters. There has been no significant change in phytoplankton community diversity except for a degrading trend at the Bay mouth and an improving trend in the upper Rappahannock River. The trend at the Bay mouth may be a response to the decreasing trend in salinity that has been observed throughout the lower Bay.

There are some less favorable algal populations becoming more abundant at several locations. Increased concentrations of undesirable cyanobacteria have occurred in recent years though it is not known if this will become an established trend or is the result of natural fluctuations within their normal range of abundance. Also, there appears to be increasing presence and areal coverage of dinoflagellate blooms occurring in the tributaries. These smaller phytoplankton types tend to be less desirable for other organisms and also tend to produce more algal “blooms”.

There are some improving trends occurring as indicated by relatively widespread decreases in productivity. High productivity by plankton, driven by high nutrient concentrations, is one of the main causes of low dissolved oxygen. These improving productivity trends may be due more to the declining light levels than nutrient reductions since nutrient levels still remain quite high. Also of note is that average phytoplankter size is improving (i.e., increasing) in several areas. This indicates an increased proportion of larger, more desirable, species (e.g., diatoms) in these regions.

Figure 11) 2003 Phytoplankton Community Trends



Benthic Communities

Benthic communities (Benthos) are bottom dwelling organisms living in the sediments at the bottom of the Bay. They are a food source for many fish and waterfowl species. Their immobility and longevity makes them a sensitive integrative indicator of the Bay's health. Both toxic contaminants and low dissolved oxygen levels can affect their populations. The following discussion relates only to the general condition of benthic communities in soft sediments (i.e., muds and sands) that are not subject to commercial harvest.

The benthic community health and habitat condition is assessed through an Index of Biological Integrity (IBI). This benthic IBI is determined by examining benthic biodiversity measures, measures of assemblage abundance and biomass, life history strategy measures, activity beneath the sediment surface, and feeding methods.

Figure 12 shows the current (1996-2002 period) areal amounts of degraded benthic habitat in the Chesapeake Bay system and various sub-areas. In general, the three primary tributaries - the **James**, **York** and **Rappahannock** rivers- have higher percentages of area with stressed benthic communities compared to the **Virginia Chesapeake Bay** Mainstem.

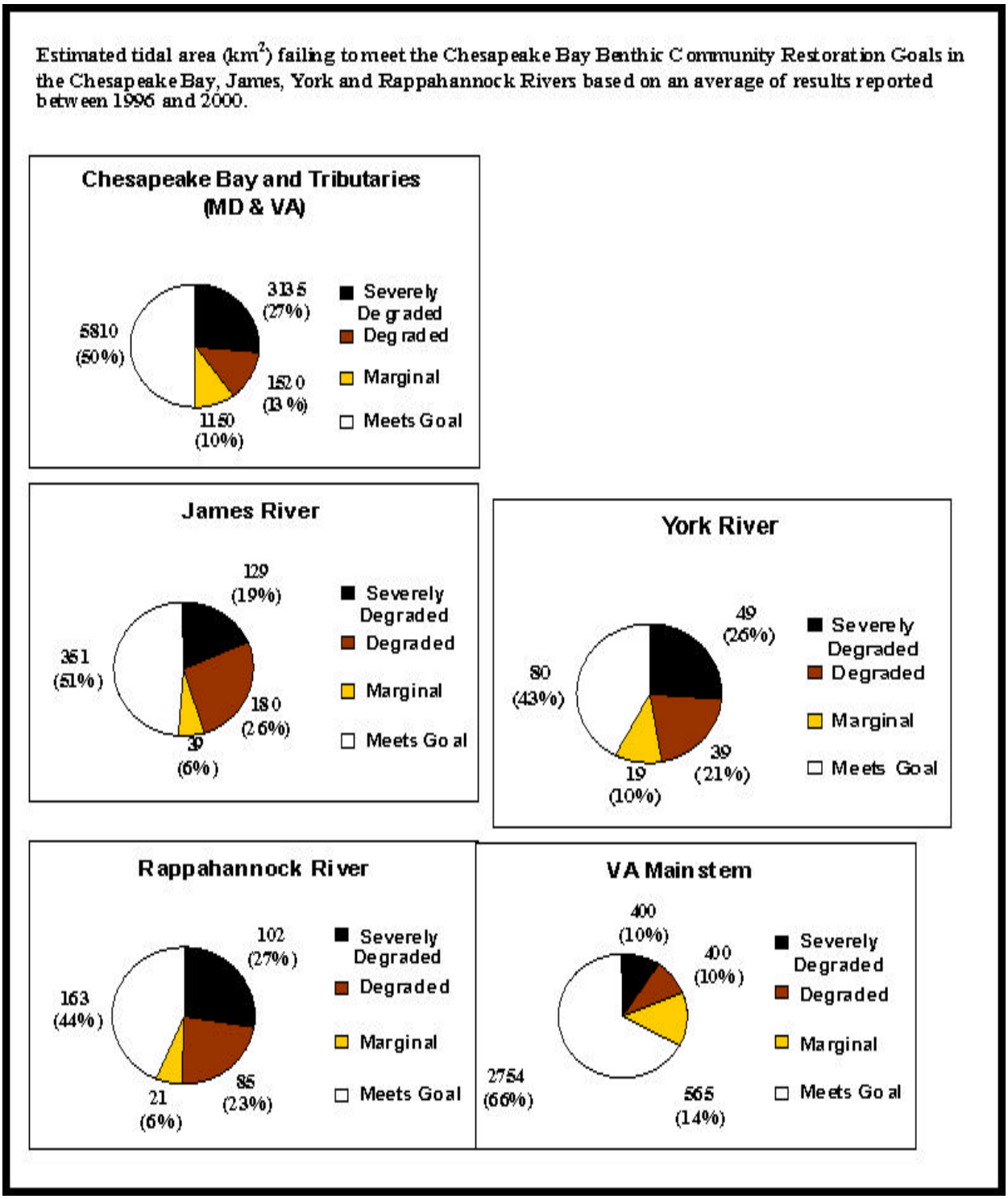
Benthic communities in the **James** are currently considered amongst the healthiest of the major tributaries in the Chesapeake Bay system. Benthic community condition has been improving at stations in the Upper and Middle **James** River since 1986. The **Elizabeth** has degraded benthos most likely related to the levels of contaminants in the sediments more than water quality conditions. Encouragingly, there has been a significant improving trend in the benthos at the station in the Southern Branch of the **Elizabeth** River since 1986. On an aerial basis, 51% of the overall **James** meets restoration goals established by the Chesapeake Bay program (Figure 12).

The **York** River has marginal benthic communities in much of its length. Low bottom dissolved oxygen does not seem to be a contributing factor in explaining the poor status of the **York** River benthos and it may be more related to physical factors such as tidal currents or sediment type. Trend analysis of the benthic IBI indicates degradation in the middle segment of the **York** and improving conditions at the mouth of the river. On an areal basis, 43% of the **York** meets restoration goals established by the Chesapeake Bay program (Figure 12).

The **Rappahannock** River has a fair benthos in up-river segment but poor benthos in the segments near its mouth. Benthic communities are deteriorating in a portion of the middle of the river since 1986 but stable elsewhere. Stations in the lower river region are degraded primarily due to annual low dissolved oxygen events during summer. On an areal basis, 44% of the **Rappahannock** meets restoration goals established by the Chesapeake Bay program (Figure 12).

The Lower **Virginia Chesapeake Bay** mainstem is the healthiest region of the entire Chesapeake Bay and there have been no significant trends in the benthic IBI since 1986. On an areal basis, 66% of the area meets the restoration goals established by the Chesapeake Bay program (Figure 12).

Figure 12) Benthic Community Status



Appendix A

§2.1-51.8:2. Duty to monitor and report on water and resources of Chesapeake Bay and its tributaries.-- The Secretary of Natural Resources shall cooperate with appropriate state and federal agencies in the development and implementation of a comprehensive program to monitor the quality of the waters and the living resources of the Chesapeake Bay and its tributaries. The Secretary shall report biennially in even-numbered years to the General Assembly on the results of this monitoring program and the status of the resources of the Chesapeake Bay and its tributaries. (1984, c. 183; 1986, c. 492)