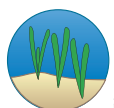


CHESAPEAKE BAY 2007

A SUMMER OF POOR WATER CLARITY, ALGAL BLOOMS, AND FISH KILLS

Produced by the Chesapeake Bay Program's Monitoring and Analysis Subcommittee

This year's drought led to lower than normal nutrient and sediment discharge into the Bay during the summer. With fewer sediments and nutrients entering the Bay, the health of the Bay may have been expected to improve, however, this was not the case for water clarity, harmful algal blooms, and fish kills (Figure 1). While dissolved oxygen in the mainstem was still poor this summer, the volume of oxygen depleted water was relatively small compared to the past 22 years. This newsletter summarizes summer conditions, offers some explanations as to why they may have occurred, and compares observations to the forecast made this past spring.



AQUATIC GRASSES

Preliminary survey results indicate that aquatic grass cover and density increased in the north of the Bay, while other areas, such as the lower Potomac River, may have experienced a decline.



DISSOLVED OXYGEN

Compared to the past 22 years, the volume of low dissolved oxygen water in the Bay's mainstem this year was relatively small. The small volume was likely due to a combination of average winter-spring nutrient loads and mixing of the water column by wind in July.



HARMFUL ALGAL BLOOMS

Harmful algal blooms, such as mahogany tides, occurred in many regions of the Bay this summer. Reduced dissolved oxygen levels and algal toxins associated with many of the blooms were the likely cause of fish kills.

The *Microcystis* bloom in the Potomac River did not occur to the extent predicted, most likely because the drought led to higher than normal salinity levels.



FISH KILLS

Fish kills occurred along many of the Bay's creeks and beaches this year. The largest fish kill occurred on the Potomac River in July, with the death of approximately 300,000 fish. Oxygen depletion following algal blooms is thought to be the main cause of the fish kills, although algal toxins may also have had an effect.



WATER CLARITY

Water clarity was below the long-term average in most regions of the Bay. Poor water clarity occurred even though sediment loads into the Bay this summer were less than the long-term (1981–2007) median.



SEA NETTLES

Sea nettles normally proliferate in the Bay from late spring to fall, affecting recreational activities such as swimming. This year the number of sea nettles in the Bay declined earlier than normal. While the decline has been associated with the drought, the direct cause has yet to be established.

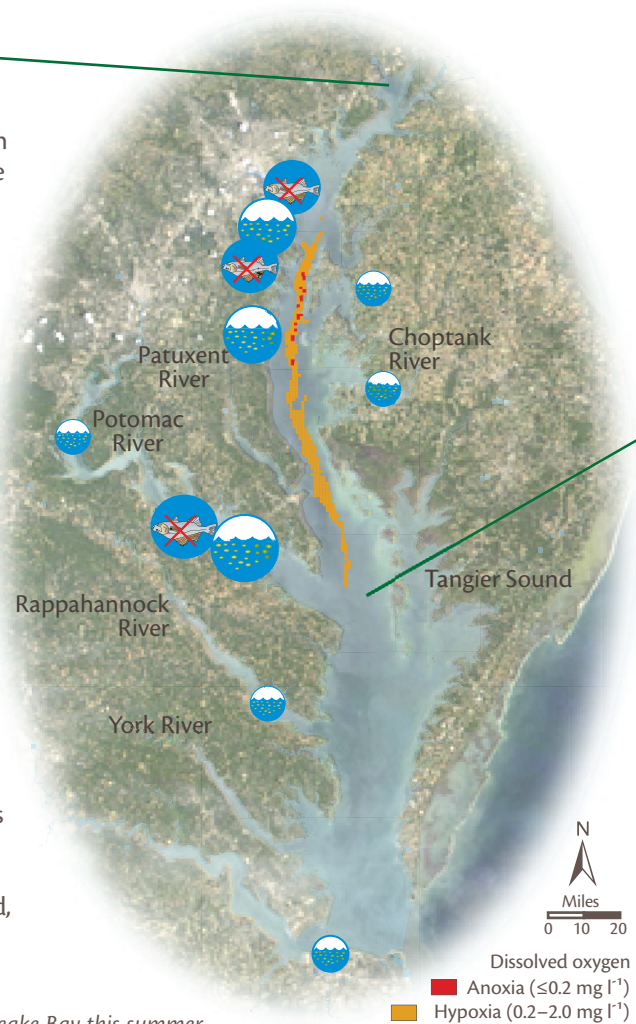


Figure 1: Summary of the conditions in Chesapeake Bay this summer.

SUMMER DROUGHT, HOWEVER, ANNUAL RIVER FLOW CLOSE TO NORMAL

Record low rainfall in many regions of the Chesapeake Bay watershed this summer led to below normal river discharge rates (Figure 2) and therefore below normal nutrient and sediment loads. Normal flow is between the 1937–2007 25th to 75th percentile. While summer discharge rates were below normal, the 2007 water year discharge rate (October 2006 to September 2007) was within the normal range due to more typical winter and spring flow.

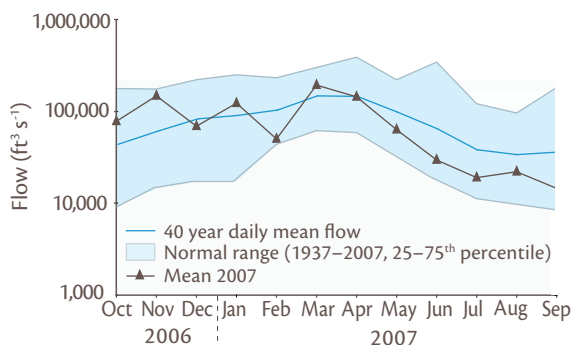


Figure 2: Mean monthly river flow from nine tributaries into Chesapeake Bay during the 2007 water year (October 2006 through September 2007). Data: USGS (provisional and subject to revision)

POOR WATER CLARITY EVEN IN A DROUGHT

This summer's drought led to lower than normal (i.e., less than the 1981–2007 25th percentile, note that load data is for the Susquehanna River only) levels of sediment and nitrogen flowing into the Bay through the Susquehanna River mouth (Figure 3).

It could be expected that because there were less nutrient and sediment loads, water clarity would improve. However, below average and record low water clarity (measured by lowering a black and white Secchi disc into the water) was observed for at least Maryland's portion of the Chesapeake Bay. Monthly averages of Secchi depths at the mainstem stations from the Chesapeake Bay Bridge to the Maryland/Virginia state line illustrate this trend compared to the average of the previous 21 years (Figure 4).



A Secchi disc is lowered into water to measure water clarity.

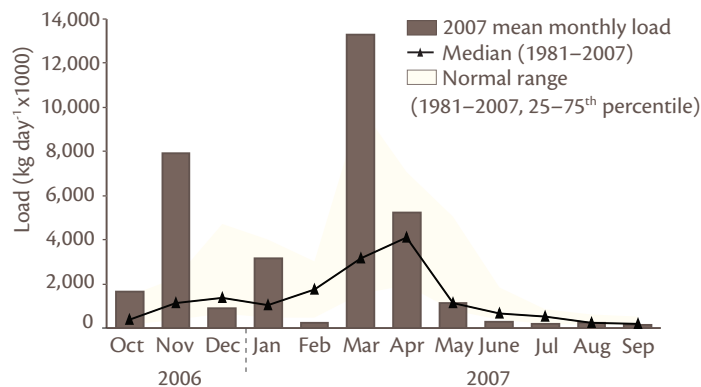


Figure 3: Sediment loads into Chesapeake Bay from the Susquehanna River during the 2007 water year (October through September). Note: This data does not account for other sediment sources, such as tributaries or shoreline erosion.

Data: USGS (provisional and subject to revision)

While the exact reasons for the poor water clarity have yet to be determined, there are a couple of factors that may be at play. First, a large amount of sediment entered the Bay in March, much of which may have remained in suspension over the summer months. Secondly, numerous algal blooms such as mahogany tides (see opposite page) were recorded throughout the Bay. These blooms can cause major discoloration of the water (often making the water look coffee colored). Finally, as

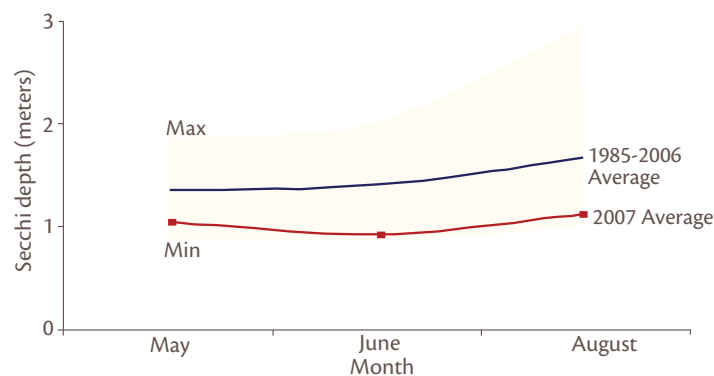


Figure 4: Average, May to July 2007, mainstem Secchi depth illustrates that water clarity was well below the long-term average conditions, and close to the poorest on record in some cases. (Data for stations between the Chesapeake Bay Bridge and the MD/VA border. Source: MD DNR).

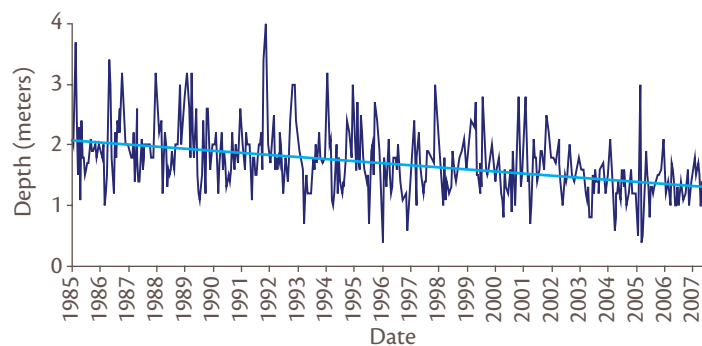


Figure 5: Long-term monthly Secchi depth for a monitoring station (CB4.2c) located in the mainstem. Data show the long-term decline in water clarity observed in some regions of the Bay. (Source: MD DNR).

the next section discusses, there has been a long-term decline in water clarity throughout many regions of the Bay, setting the stage for a summer of poor water clarity.

In addition to this year's poor water clarity, there has been a declining trend in water clarity in many regions of the Bay (Figure 5). The most noticeable feature of this trend is the absence of higher values of Secchi depths (clearer water) in the last seven years. While the exact cause of the decline is still being investigated, a few factors may be involved. First, a decrease in filtering organisms may lead to more particles remaining in suspension. This includes the loss of filter-feeding shellfish, decrease in plankton-filtering fish, and the decline in buffering submerged aquatic vegetation beds and wetlands. Some research indicates that sediments and particulates in the Bay are becoming finer and more organic, allowing them to remain in suspension longer.

RESTORATION TO REDUCE SEDIMENT INPUT

Farmers are employing dozens of conservation practices to reduce the amount of sediment reaching the Bay such as cover crops, buffer zones, and conservation-tillage. In 2006, 43% of the agriculture sediment reduction goal had been achieved. In urban/suburban regions, sediment reduction relies on treating stormwater in facilities such as bio-retention ponds. To date, the urban/suburban sediment reduction goal is not keeping pace with population growth, leading to a negative progress in relation to the goal. To see what you can do to reduce sediment loads to the Bay, visit the Chesapeake Bay Program website: www.chesapeakebay.net/involved.htm.



B. Longstaff, EcoCheck

Streamside vegetation and buffer zone along a creek on the Eastern Shore reduces sediment and nutrients entering the Bay.

HARMFUL ALGAL BLOOMS LEAD TO FISH KILLS

Numerous harmful algal blooms (HABs) were recorded around the Bay this year, many of which may have led to fish kills (Figure 6). Blooms of the dinoflagellates *Prorocentrum*

minimum (mahogany tides) and *Karlodinium veneficum*, occurred in western tributaries, from the Patapsco to the Rappahannock River. *Prorocentrum* blooms were also

recorded along the Eastern Shore and Elizabeth River. In late summer, another dinoflagellate, *Cochlodinium polykrikoides*, developed into a bloom in the tidewater region of the lower Bay. In contrast to the dinoflagellate blooms, the cyanobacteria *Microcystis aeruginosa* was found in lower than average concentrations and for a shorter duration than is typical of recent years. The proliferation of this alga species takes place in the tidal fresh portions of specific Bay tributaries, most commonly the Sassafras, Potomac, and James Rivers. The short duration of blooms this year may be attributed to higher salinity levels caused by the drought.

Why numerous large algal blooms occurred this year when summer nutrient loads were below normal (Figure 7) may be related to a number of factors, including: (1) close to normal spring nutrients — spring nutrient loads are known to play a significant role in bloom formation; (2) high residual nutrient levels and input from local sources; and (3) periods of optimal wind conditions and water temperatures.

Harmful algal blooms can lead to fish kills when dissolved oxygen levels are depleted by decaying algae. Fish kills can

also be caused, or made worse, by toxins released by certain species of algae. Most fish kills recorded this year were located in the northwestern portion of the Bay and the Potomac River, corresponding to the region where most algal blooms were observed (Figure 6). The largest fish kill occurred in the Potomac River in early July when approximately 300,000 fish, including juvenile menhaden and white perch, died. This fish kill was attributed to oxygen depletion occurring after a *Karlodinium* bloom and algal toxins.

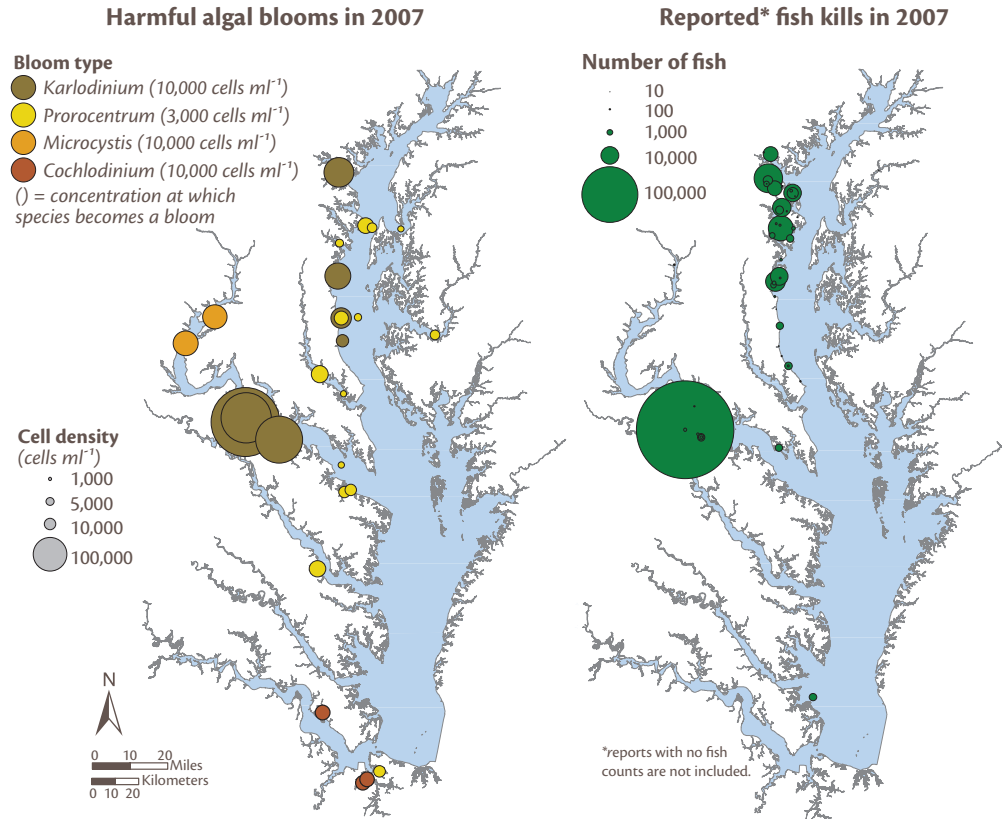


Figure 6: Major harmful algal blooms and reported fish kills in Chesapeake Bay during the spring and summer of 2007. Note: only blooms recorded by ODU and MSU monitoring are included. Source of fish kill data: MDE and VA DEQ.

RESTORATION TO REDUCE NUTRIENT LOADS

Decreases in the amount of nutrients discharged from wastewater treatment plants (WWTPs) account for a large portion of the estimated nutrient reductions in the watershed to date. A new permitting approach that requires hundreds of WWTPs to install a new generation of nutrient reduction technology equipment is being implemented. Upgrades of WWTPs were 72% and 87% toward the goals for nitrogen and phosphorus reduction in 2006. To reduce nutrients from urban/suburban areas, stormwater improvement systems such as bio-retention ponds are being constructed. To see what you can do to reduce nutrient loads to the Bay, visit the Chesapeake Bay Program website: www.chesapeakebay.net/involved.htm.



J. Thomas, UMCEs

A stormwater bio-retention area in Annapolis. Bio-retention areas improve stormwater quality before it reaches the Bay.

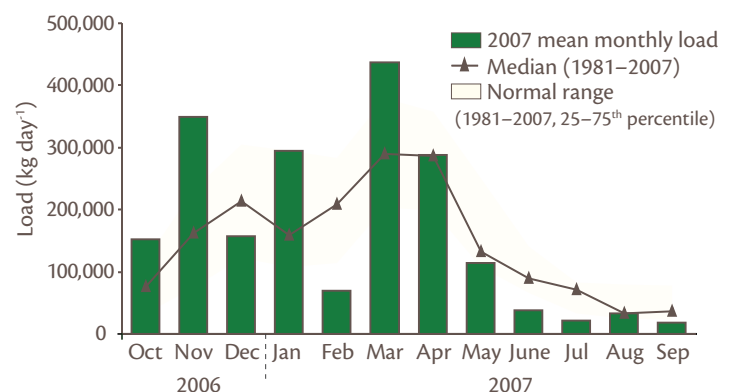


Figure 7: Nitrogen loads into Chesapeake Bay from the Susquehanna River during the 2007 water year (October through September). Note: This data does not account for other sediment sources, such as tributaries or shoreline erosion. Data: USGS (provisional and subject to revision)

COMPARING FORECAST TO OBSERVED CONDITIONS

Summer forecasts of three important Bay health indicators were released in spring of this year. The three indicators were dissolved oxygen (volume of anoxia and hypoxia in the Bay's mainstem), extent and duration of harmful algal blooms (*Microcystis aeruginosa*) in the Potomac River, and area of aquatic grasses in three regions of the Bay. The forecasts are developed to aid management, build awareness, and provide guidance to restoration efforts. Winter and spring river flow and nutrient loads led to the development of a forecast for typically poor conditions during the summer. However, summer weather led to conditions that were different from what was predicted (Figure 8). The volume of low dissolved oxygen waters in the Bay's mainstem was significantly smaller than the forecast, likely due to a wind event in July that mixed oxygenated surface waters with oxygen depleted deep waters. The summer drought may have led to unfavorable salinity levels (too salty) for *Microcystis* blooms in the Potomac River, with only small blooms observed. While the aquatic grass distribution is still being determined,

preliminary observations indicate reduced area in some regions of the Bay and increased density in other areas. Additionally, preliminary observations indicate that abundance in the Bay has exhibited a variety of patterns that appear to be both watershed and species specific. Some areas continue to increase in both abundance and density, while others continue to decline. Areas of eelgrass that were severely affected by the 2005 heat appear to be recovering, with patchy beds becoming denser.



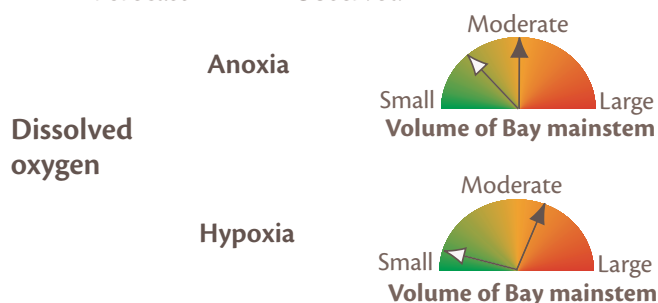
Susquehanna River near entrance to Chesapeake Bay. Nutrient loads from the Susquehanna River are used to help forecast dissolved oxygen.

B. Longstaff, EcoCheck

FORECAST AND OBSERVATION

EXPLANATION

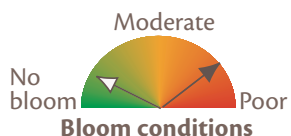
—► Forecast —▷ Observed



The volume of hypoxic and anoxic water in the Bay's mainstem was significantly less than what was forecast. This is probably due to a strong wind event in July that mixed bottom and surface waters.

	Volume of mainstem (km ³)	
	Forecast	Observed
Anoxia (summer average)	1.39	0.73
Hypoxia (July)	9.3	3.85

Potomac River *Microcystis* blooms



The moderately sized bloom predicted for this summer did not occur. This was most likely due to higher salinity levels resulting from the summer drought conditions.

Aquatic grasses



Preliminary results indicate that the lower Potomac River aquatic grasses experienced a decrease in area, while an increase was predicted. Northern Bay aquatic grasses may have experienced an increase in density, while the forecast predicted no change in area. Tangier populations appear to have increased slightly due to the eelgrass recovery noted for 2007.

Figure 8: A comparison of the summer 2007 forecast with the observed conditions. This year's forecast proved to be largely incorrect for all the indicators predicted. This was due to the drought conditions, but also due to other unpredictable weather events such as strong winds.

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For further information, please see the following websites:
www.eco-check.org
www.chesapeakebay.net
www.eyesonthebay.net



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