CHESAPEAKE BAY 2006

SUMMER ECOLOGICAL FORECAST

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

This newsletter describes the methods used and the predictions for the 2006 summer ecological conditions in Chesapeake Bay. The forecast focuses on three important elements of the Bay's health – dissolved oxygen (DO), harmful algal blooms (HABs) and changes in aquatic grass distribution. This summer it is predicted that the amount of mainstem anoxia (low dissolved oxygen) will be moderate compared to previous years, that there is a moderate to high likelihood of harmful algal blooms in the Potomac River and that a small expansion in aquatic grasses is expected in the northern Bay and lower Potomac River.

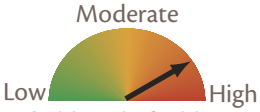
TYPICAL SUMMER CONDITIONS EXPECTED

Dissolved oxygen

Anoxic volume

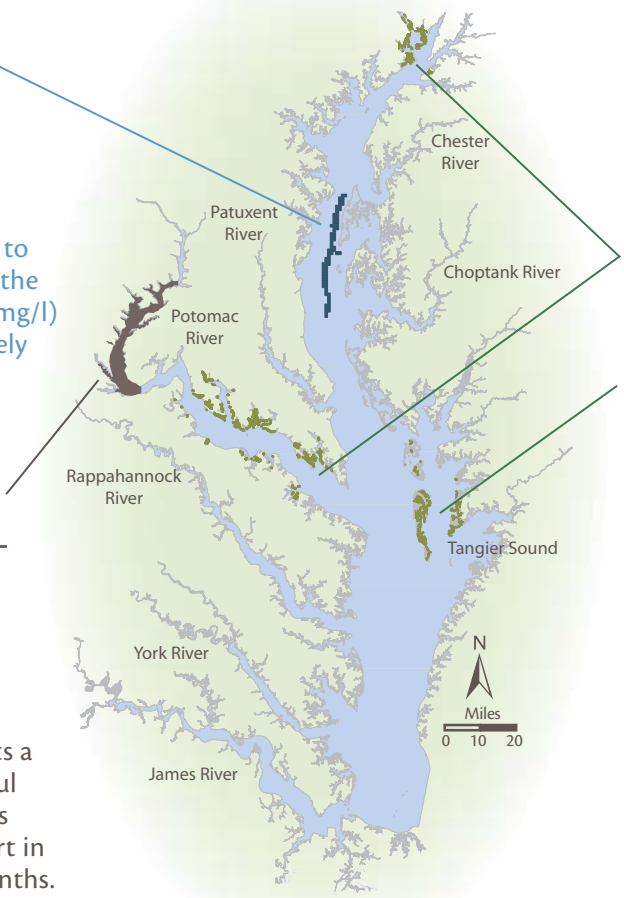
Based on the nutrient loads delivered to northern Chesapeake Bay this spring, the mean anoxic (dissolved oxygen ≤ 0.2 mg/l) volume in the Bay will be approximately 1.17 km^3 (± 0.78). Relative to previous summers, this volume of anoxia is considered 'moderate'.

Harmful algal blooms



Likelihood of a bloom

The Chesapeake Bay Program forecasts a moderate to high likelihood of harmful algal blooms in the Potomac River this summer. Blooms are predicted to start in early summer and last one to two months.



Aquatic grass

Change in aquatic grass area

A small increase in aquatic grass area is predicted to occur in northern Chesapeake Bay and on the lower Potomac River this growing season.

An eelgrass loss occurred in Tangier Sound during late summer 2005. Some population recovery via new seedlings and surviving adult plants is predicted to occur this growing season.

MD DNR

Maryland DNR staff investigating aquatic grasses in northern Chesapeake Bay last summer.

Wet winter followed by dry spring sets the stage

Nutrient loads are strongly linked to river discharge and have an over-riding influence on many aspects of the Bay's health. Thus, most of the forecasts are based on nutrient loads and flow. Susquehanna River flow was above average during January and early February and below average for most days from mid–February to mid–May (Figure 1), due to the wet winter and dry spring in 2006.

The forecasts do not account for unseasonable summer conditions such as high temperatures and unexpected river flow. Routine water quality monitoring will be used to track and report conditions during the summer. Updates will be provided on the Chesapeake Bay Program website as more data are available (*www.chesapeakebay.net/bayforecast.htm*).

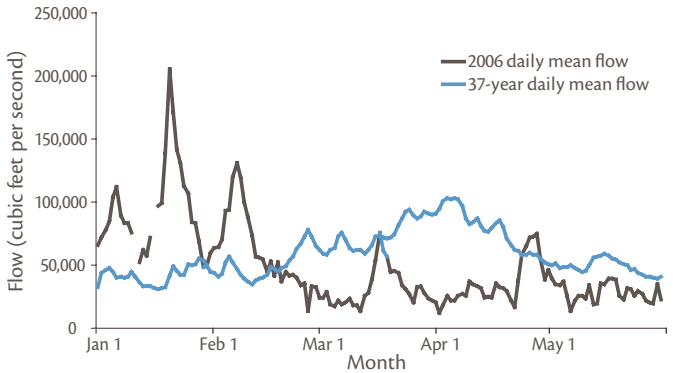


Figure 1: Susquehanna River daily mean flow rates from January to May.

MODERATELY SIZED ANOXIC ZONE PREDICTED

Dissolved oxygen (DO) is critical for the survival of aquatic organisms, including key species such as rockfish, blue crabs, and shad. Reduced DO levels can lead to physiological stress or death of an organism if it is unable to migrate to regions of sufficient DO availability. In this section we explain what factors influence the amount of DO in the water column and how the forecast of summer anoxic conditions (DO ≤ 0.2 mg/l) was calculated.

The dissolved oxygen (DO) forecast is based on the relationship between spring nutrient inputs to northern Chesapeake Bay and summertime anoxia, expressed as the mean June to September water volume with ≤ 0.2 mg/l of dissolved oxygen (Figure 2). Relationships for other concentrations of DO have been investigated (1, 3, and 5 mg/l), however the strength of these relationships was considered too weak for use in forecasting.

Nutrient loads are the combined total nitrogen (TN) and total phosphorus (TP) loads from the Susquehanna River from January to April plus point sources on the upper Western shore, upper Eastern shore, and the Potomac River from the same time period.

Nutrient Index	=	Spring Susquehanna River nutrient loads	+	Spring point source nutrient loads

Flow-related nutrients from the Susquehanna River can account for 75% – 95% of the nutrients and point source load can account for 5% – 25% of the remaining load.

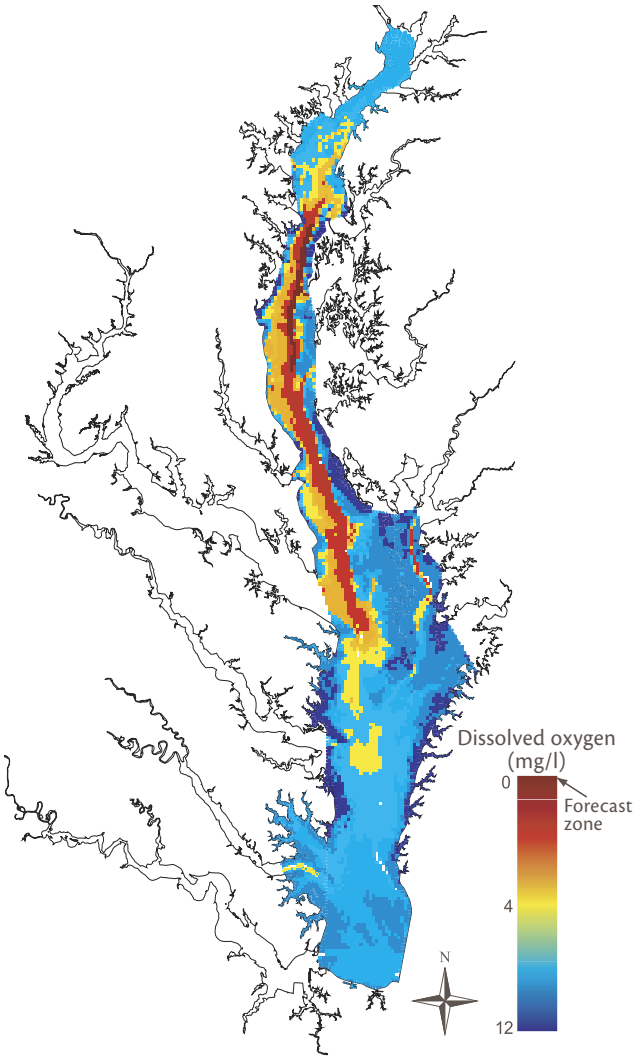


Figure 3: If the forecast holds true, the spatial extent of the 2006 anoxic area will be similar to the anoxic area of 2001.

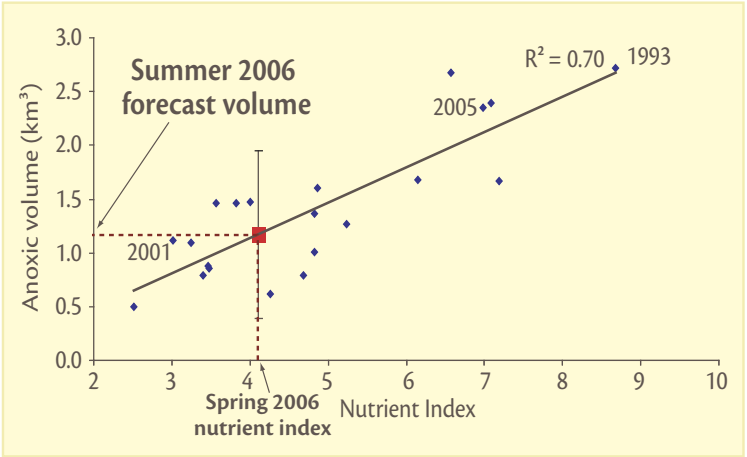


Figure 2: A strong relationship exists between nutrient loads and the volume of anoxic water in the Bay's mainstem.

The Chesapeake Bay Program forecasts a moderate amount of anoxic waters, with a mean volume of 1.17 cubic kilometers (0.28 cubic miles), which is similar to the anoxic area of 2001 (Figure 3). Compared to the previous 20 summers, 2006 could have the 10th lowest anoxic volume if this prediction holds true (Figure 4). However, the amount of anoxic waters forecasted for this summer will exceed state water quality standards that aim to protect the Bay's living resources.

The forecast is a reasonable assessment of the anoxic volume we expect to see this summer. However, there are certain factors such as wind characteristics and water temperature that may occur this summer that can affect this potential anoxic volume. The Chesapeake Bay Program will continue to monitor some of the factors affecting the development of anoxia in the Bay through the summer and update the conditions accordingly.


MD DNR

MD DNR staff preparing to monitor water quality.

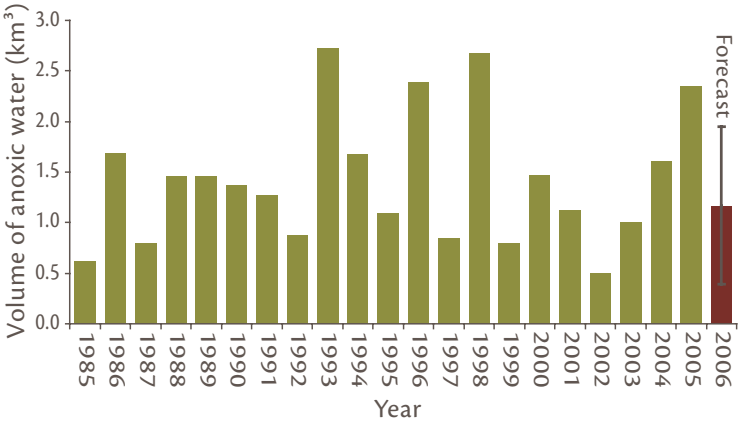


Figure 4: Mean volume of anoxic water predicted to occur in Chesapeake Bay mainstem this summer compared to historical volumes.

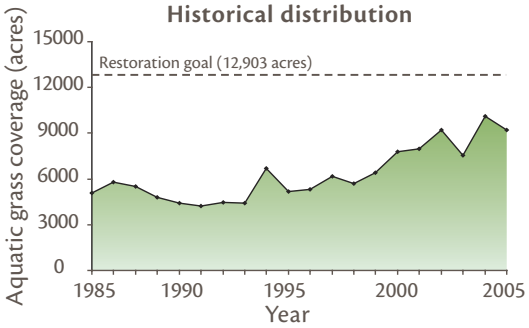
SMALL INCREASE IN AQUATIC GRASS PREDICTED

Aquatic grass distribution in Chesapeake Bay is influenced by multiple interacting factors. Relationships between aquatic grass cover at select locations and a range of environmental factors were investigated in the development of aquatic grass forecast models. Depending on the location, factors such as nitrogen load, wind speed, and water clarity were found to correlate significantly with aquatic grass cover. Since these forecast models are still under development, this year's forecast is based on a combination of expert assessment, recent field observations, and in some cases, the observed relationships discussed above. Forecasts for three distinct locations of the Bay are provided – northern Bay, lower Potomac River, and Tangier Sound (Figure 5).

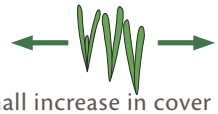
Peter Bergstrom

Observations were used to help determine aquatic grass growth this spring.

Northern Bay



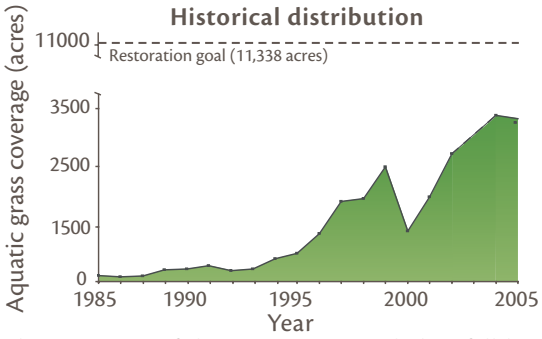
Summer 2006 Forecast



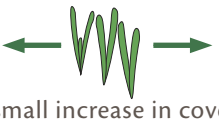
- small increase in cover
- increased density of some beds

While strong winds have been found to have a negative correlation with aquatic grass cover in the northern Bay, the relatively mild winter and low flow this spring is likely to have an over-riding effect on aquatic grass this year. Recent field observations indicate a large number of over-wintering plants, pointing to a good season for aquatic grass in the northern Bay.

Lower Potomac River



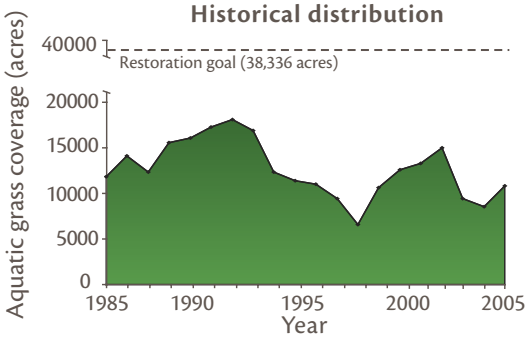
Summer 2006 forecast



- small increase in cover

In the lower region of the Potomac River, below fall-line nitrogen loads were negatively correlated with aquatic grass cover. This does not necessarily mean that the amount of nitrogen causes a certain amount of aquatic grass to grow, rather that both parameters change in a predictable way. Based on this relationship, a small expansion in aquatic grass area is predicted for the 2006 growing season. Similarly, recent field observations indicate an expansion is likely in the mid to upper regions of the river (Piscataway Creek to Potomac Creek).

Tangier Sound



Summer 2006 Forecast

- some recovery from loss in late 2005
- recovery via seedlings and adult plants

Like many southern Bay areas, loss and thinning of eelgrass beds occurred in Tangier Sound in late 2005. The loss may be due to a period of warmer than normal water temperatures. As the loss occurred after the survey period, it is not reflected in the 2005 aquatic grass survey results. Recent field observations in Tangier Sound indicate that some recovery from seedlings and surviving adult plants will occur this summer.

Figure 5: Maps of spatial extent in 2005, graphs of historical coverage (1985–2005), and summer 2006 forecast of aquatic grasses for three regions of Chesapeake Bay. Aquatic grass spatial extent maps only show aquatic grass for the forecast region.

POTOMAC RIVER HARMFUL ALGAL BLOOMS LIKELY

Harmful algal blooms (HABs) occur in many regions of Chesapeake Bay. In this forecast we focus on the Potomac River, where blooms of predominantly Microcystis aeruginosa *(a cyanobacterium) have been occurring for most summers since the 1960s. These blooms have had numerous ecological, economic, and human health implications for the region and have been the impetus for major nutrient reduction programs.*

(a) Model

Previous year annual flow	Bloom onset (levels first detected)	Bloom duration	Bloom extent (dependent upon spring flow conditions)	
			Spring flow	Bloom extent
DRY	Early–mid summer or no bloom	Short (1.25 months)	DRY	Small (< 10 miles)
			MODERATE	Small (< 10 miles)
			WET	Medium (10–20 miles)
MODERATE	Early summer or no bloom	Moderate (2 months)	DRY	Small (< 10 miles)
			MODERATE	Medium (10–20 miles)
			WET	Large (>20 miles)
WET	Late spring to early summer	Long (>2 months)	DRY	Medium (10–20 miles)
			MODERATE	Medium (10–20 miles)
			WET	Large (> 20 miles)

(b) Forecast

Bloom condition	2006 Forecast
Bloom onset	Early summer
Bloom duration	Moderate (1 to 2 months)
Bloom extent	Small to medium (<20 miles)

Figure 6: (a) The model used to forecast harmful algal blooms in the Potomac River for summer 2006; (b) 2006 Potomac River HAB forecast.

The main factors that determine HAB occurrence and characteristics in the Potomac River are nutrient availability, salinity, water temperature, and light availability. An over-riding influence on bloom occurrences is river flow rates, most likely due to its effect on nutrient availability. Therefore, the forecast is based on a model that relates spring and previous year Potomac River flow rates to the likelihood, onset period, duration, and extent of a bloom (Figure 6).

The Chesapeake Bay Program forecasts a moderate to high likelihood that a *Microcystis* bloom will occur in the Potomac River this summer (Figure 7). Given that Potomac River flow rates were categorized as 'moderate' in 2005, the blooms are predicted to start in early summer (late June to early July) and last for one to two months. While this spring was considered dry, recent weather patterns have increased precipitation, and as a result, river flow. Because spring flow rates could ultimately be classified as either dry or moderate, there is less certainty in the prediction of bloom extent. Based on the current spring flow rates we predict a very localized to medium sized bloom (1–20 miles).

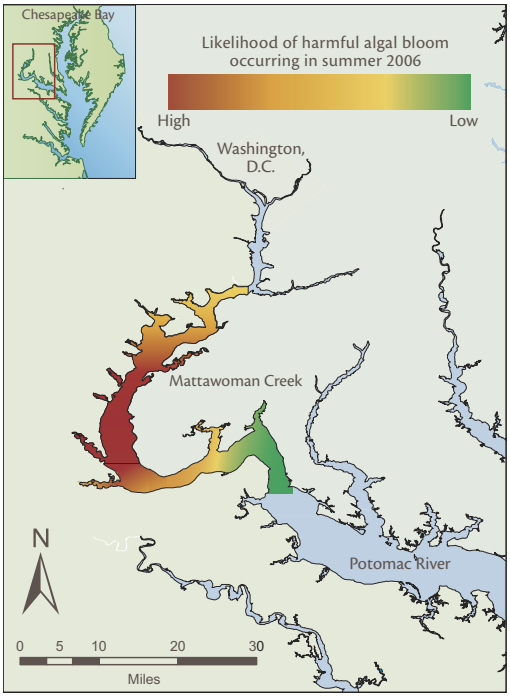


Figure 7: The likelihood of harmful algal blooms occurring in the Potomac River in summer 2006.

Newsletter produced by the Chesapeake Bay Program's Monitoring and Analysis Subcommittee (MASC). Dissolved oxygen forecast conducted by David Jasinski. Harmful algal bloom forecast conducted by Dr. Peter Tango. Aquatic grass forecast analysis conducted by Dr. Michael Williams, with field observations provided by Mike Naylor, Dr. Nancy Rybicki, and Dr. Robert Orth. Nutrient load data used in forecasts provided by the USGS with specific help provided by Jeff Raffensperger.

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Further information located at:
www.chesapeakebay.net/bayforecast.htm
www.eyesonthebay.net
www.eco-check.org

Chesapeake Bay Program
A Watershed Partnership