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Don Kerstetter
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Dear Don,

As you requested, I am summarizing here my remarks made at Mitchum's Restaurant on water quality in the Choptank Basin.

Water quality in the Choptank in general is considered "fair" to "poor". There is little SAV, except in dry years, but fish and crabs remain somewhat plentiful. Oysters are overfished and held back by diseases. The real problem is that there are worsening trends in several water quality parameters, and it is important for people to understand that conditions are going to get worse unless we make important changes on land, which is where water quality problems start. The worsening trends in water quality problems are as follows:

- N and P have increased at the Greensboro USGS gauging station since measurements began in the 1960s
- At 15 agriculturally dominated watersheds within the Choptank, there has been no significant decreases in N or P over the last 20 years
- In one of those agricultural watersheds, a new confined animal operation has increased N and P concentrations by almost a factor of 2 since the 1980s
- Although many wastewater plants in the Choptank have applied BNR and ENR to reduce N and P concentrations, continued growth of small towns has increased the volume of discharges, which partially or completely offsets the reductions in concentrations
- Chlorophyll a (a measure of algal biomass) has been increasing in estuarine tidal waters at the Rt. 50 bridge since the 1980s
- Dissolved oxygen in bottom waters at the Rt 50 bridge in summer (June-August) has been decreasing since the 1980s and is now approaching critically low levels for bottom organisms such as fish, crabs, and oysters.

Projection of the water quality trends at the Rt. 50 bridge suggests that estuarine waters of the Choptank will experience algal blooms and dissolved oxygen low enough to kill bottom fish and crabs, particularly in wet years when water column stratification is enhanced by fresh water inflows. The last two trends are the classic descriptions of "eutrophication" or the enrichment of lakes or estuaries with N and P by human activities which results in "dead water," as in the mainstem Chesapeake Bay, the N Coast of the Gulf of Mexico, and other areas in the world.

What is responsible for these trends? In the Choptank, with few significant industrial discharges, there are two main causes: increases in the production of food (crops, animals) and increases in disposal of human waste (sewage and septic systems). Agriculture is the dominant source of N (~80%), whereas P is nearly evenly produced by agriculture and sewage. Although agricultural acreage has remained the same or even declined in some areas, the intensity of

agriculture (yield or number of crops) has increased (fertilizer applications, overapplication of chicken manure or sewage sludge, double-crop soybeans, winter commodity crops, addition of poultry operations, etc.). Likewise, continued growth of small towns and waterfront properties in the region has resulted in increasing human populations, with attendant increases in septic systems and sewage production.

What can be done about this situation? How do we reverse the trends that are described above? The following is a list of policy changes that, in my opinion of the scientific literature, should help to reverse the eutrophication in the Choptank:

- All idle croplands should have winter cover crops. These cold season grasses stabilize soil and P, and capture excess N not used during the previous summer. Cover crops reduce P losses in runoff and decrease enrichment of groundwater with nitrate.
- All non-tidal streams and tidal regions should have at least a 50 foot wide buffer of forest. No agriculture, septic systems, fertilized lawns, or houses should be allowed in this area, to augment the capture of terrestrial N and P in overland flow and groundwater.
- Farmers should be asked to reduce fertilizer applications and to accept lower yields of crops, in exchange for assistance from USDA. This will reduce excess N in winter fields following very dry summers when crop use of fertilizer is limited by water availability.
- Increases in confined animal feeding operations should cease until waste streams are processed appropriately for fertilizer or energy production.
- Lawn fertilizers should be banned. USDA fertilizer recommendations for lawns are approximately the same as those applied to corn (100-150 lbs per acre per year). Many homeowners and lawn care companies probably apply excess, and collectively the fertilized lawns within a drainage basin are a significant source of N for the Choptank.
- All septic systems should be upgraded to denitrifying units. Septic systems are a diffuse source of N to groundwater, and nitrate concentrations in groundwater under medium to high housing density can be equivalent to those underlying croplands. Talbot County is currently offering attractive options for homeowners to make this upgrade.
- All sewage systems should be upgraded to ENR to release the lowest possible N and P to surface waters. All plants should consider alternative disposal options such as composting and selling sludge for sale as soil amendments, using effluent to grow energy crops such as switchgrass for conversion to methane or ethanol, and use of wastewater for appropriate levels of crop irrigation in place of commercial fertilizers. Wastewater is a valuable resource that should be used, not disposed of.
- Growth in human populations in towns or rural areas should be controlled by regulation of building permits or water connections until most of the above have been implemented.
- Harvesting of oysters and clams in the Choptank should be stopped to allow recovery of these populations which help filter estuarine waters and remove terrestrial N.

These policy changes need to be accompanied by water quality monitoring to ensure adaptive management. Many policy changes implemented in the US are not monitored for effectiveness, and careful monitoring can show which policy changes are most effective in reducing N and P. Combined with social and economic considerations, monitoring data can help adapt initial management actions to achieve the most results at the lowest social or economic cost.

It is important to realize that these recommendations are based on my interpretation of the scientific literature. Details or scientific citations are available to those who are interested.

Thomas R. Fisher
Professor