

Dead Zones in Creeks

The water in estuaries and near-shore environments is normally saturated with oxygen gas and contains about 7 ml/l (milliliters per liter) dissolved oxygen at typical summer temperatures. The oxygen is derived from the atmosphere and from plants that produce oxygen as the result of photosynthesis. But more and more estuaries and near-shore marine environments are suffering from hypoxia (dissolved oxygen concentrations low enough to restrict animal life – typically less than about 5 ml/l) or anoxia (insufficient dissolved oxygen to support animal life – about 2 ml/l) commonly called “Dead Zones”.

Chesapeake Bay has always had a “Dead Zone” during mid-summer in the very deep water at the center of the Bay, but the “Dead Zone” has expanded tremendously so that now nearly one-third of the water in the Bay is hypoxic in summer. One-third the volume of the Bay cannot support a normal ecosystem in mid summer. The secret to understanding this phenomenon is to recognize that water bodies can become stratified (layered) according to the density of the water. Less dense (warm and/or low salinity) water “floats” on top of denser (colder and/or saltier) water. In Chesapeake Bay it is normal to find saline (salty and dense) water near the bottom, derived from the Atlantic Ocean, and less saline, less dense water near the surface derived from rivers and groundwater discharge. In summer the surface water warms and the density contrast increases until the wind can no longer mix the entire water column, and stratification (called a pycnocline) develops. Once stratification develops, the deep zone no longer has access to oxygen because it is out-of-contact with the atmosphere and the water is too turbid for enough light to penetrate to allow plants to photosynthesize. Animals remove (respire) dissolved oxygen and the organic-matter-rich bottom sediments consume great quantities of oxygen as microbes respire the particulate organic material deposited along with the mud. Dissolved oxygen levels sink lower and lower until animal life suffers. As the water becomes inhospitable to fish and crabs they can swim away, but bottom-dwelling (benthic) organisms, some normally food for fish and crabs, cannot escape and suffocate. Clams and oysters are killed, and all the dead organisms “rot” on the bottom as microbes decompose their tissues, consuming whatever dissolved oxygen remains. Not pretty.

Many people do not recognize that some of our local creeks and rivers undergo the same phenomenon in late July and/or early August. The surface water may appear normal, but the water on the bottom is another matter. Out of sight is out of mind. For the last two years I have measured bottom water oxygen concentrations in the Little Wicomico River opposite marker “G21” at a depth of seven feet. There is no deep “hole” at this location. The water has been hypoxic or anoxic, below 3.2 mg/l or the “instantaneous minimum” that violates the Clean Water Act, for several weeks both years. Few people have the ability to trap a sample of water from below the surface, bring it up and analyze it for dissolved oxygen, but there are a couple clues to anoxia that everyone can observe. The first clue is the distribution of crab pot floats. When anoxia develops, crab pots disappear from the center of the rivers and are moved into shallow water along the shoreline. It was this clue in 2003, and the dead crabs in my pots, that prodded me to actually make the measurements in subsequent years. The boundary between the deep “dead” water and shallow water can sometimes be seen with a fish-

finder because the density contrast reflects sound energy. The boundary appears as a flat reflection between the bottom and the surface. Commonly there will be lots of little reflections from fish above the boundary whereas the water between the horizontal boundary and the bottom contains no reflections because there are no fish in the anoxic water column to reflect the sound energy. The boundary of the main “Dead Zone” in Chesapeake Bay is usually quite evident on a depth-sounder at this time of year. Don’t waste time bottom-fishing or trolling below it.

What can be done to eliminate the bottom hypoxia from our local water bodies? The local problem demands a local solution. The hypoxia exists because too much organic material enters the water, mostly from the “carcasses” of tiny algae that grow in profusion because too much nitrate and phosphate (fertilizer) enter the water. Obviously no organic material such as crab debris, filleted rockfish carcasses (charter captains please take note), baskets of grass clippings, etc. should ever be disposed in the water. The waterways are not sewers and it is illegal to dispose of anything in the water. We should all try to minimize the amount of organic material and fertilizer (nitrate and phosphate) that enter the water. Farmers should employ Best Management Practices and avoid the use of animal waste like poultry litter and sewage sludge because they are extremely inefficient and cause massive pollution. Maintaining septic systems is also important. Minimize the water that is “flushed” and have the tank pumped every five years. See the NAPS web site www.napsva.org for Stewardship Tips on septic system maintenance and on animal waste as fertilizer. Summer anoxia in our local waterways is a violation of the Clean Water Act because the water is not “fishable.” It remains to be seen what, if any, action the State or EPA will eventually take to rectify this long-standing violation of an old law.