Cyanobacteria, Algae and Microbes Used as Bioindicators in Water Quality Analysis of Pocotaligo Watershed in Sumter, SC

Rachel Byrd[1], Alexander Sims[1], Christopher Brandon[2], Erika Balogh[2], Pearl Fernandes[1] and Kajal Ghoshroy [1]

[1.] Division of Science, Mathematics and Engineering, University of South Carolina at Sumter, Sumter, SC 29150 USA
[2.] Electron Microscopy Center, University of South Carolina, Columbia, SC 29208 USA

The Pocotaligo River is a freshwater wetland that originates in Sumter, South Carolina, and joins the Black River at the Clarendon-Williamsburg County line. The swamp encompasses over 30,000 acres of wetlands. This watershed has endured severe anthropogenic and natural alterations to its ecology over the last eight or nine decades, including fertilizer run-off from agricultural areas, livestock breeding, lawns, construction and maintenance of roads and storm water drainage. The main point source of nutrient pollution here is from a wastewater treatment plant that discharges an average of over 1 billion liters/month effluent into the swamp [1].

The objectives of the present study was to determine the possible effects of the point and non-point sources of pollution on water quality by using physiochemical measurements and biological indicators such as fecal coliform bacteria and algal species. These indicator organisms are affected by concentrations of nutrients such as nitrogen and phosphorus, total dissolved oxygen, and total suspended solids.

Samples were taken from five sites at the Pocotaligo watershed. The waste water treatment plant effluent site was considered to be the Point Source (PS) for pollutants. Two upstream control sites were chosen at 3.08 (Turkey Creek) and 0.3 km (Briar Branch) above this effluent site. Two downstream sites were at 0.3 km and 5.6 km (12-Bridges) from the effluent site. Sampling was conducted multiple times in the year. Physical parameters such as pH, temperature, dissolved oxygen, and total dissolved solids were measured. For fecal coliforms, scans were conducted using the Coliscan method (Micrology laboratories). Water samples were examined under the light microscope (Zeiss) and Scanning Electron Microscopy (SEM) using standard methods [3]. Elemental analyses were performed using Energy-dispersive X-ray spectroscopy (EDS) technique.

Elemental analysis by EDS showed that K, Ca, and Cl were present at all five sites. However, metals like aluminum were found at a much higher concentrations, especially at Turkey Creek, Briar Branch, and 12-Bridges. Manganese and sulfur were found only at Turkey Creek and Briar Branch. Iron content was the highest at Turkey Creek. This site also had fluorine, and molybdenum in the water, as well as the highest dissolved solids (at 104 mg/l) indicating possible contamination occurring at or above Turkey Creek. Diatoms, flagellated unicellular and filamentous green algae were found in all waters, although were abundant at Turkey Creek. Euglenoids were also mostly seen at Turkey creek.

Dissolved oxygen was seen to rise in the water between June and January, with highest at Turkey Creek and lowest at Briar Branch. At Briar Branch, temperature was always lower (mean being stable at 20.9 °C) when compared to the rest at around 28 °C. The total dissolved solids at Briar Branch were also substantially lower (at 31.8 mg/l) when compared to the rest, probably because it did not support biotic growth.

Abundant organic matter was observed at PS, as expected, from the waste water treatment plant. Sodium content of water was the highest here. Bacteria were abundant at PS (mostly bacilli and cocci, and a few spirillum). Cyanobacteria were restricted to the PS site and 12-Bridges. It is thus likely that bacteria are being introduced at the waste water effluent site along with minerals. The resulting eutrophication might be causing cyanobacteria to flourish at this site and below it.

References:

[1] Morris JT, Gross J, Mcaninch S. 1994. The Pocotaligo swamp reclamation study, Columbia, SC, p. 51.
[2] American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater. 18th ed. Washington, D.C.
[3] Bellinger EG, David, SC. 2010. Freshwater Algae: Identification and Use as Bioindicators. Wiley Publishers; 1st Ed.
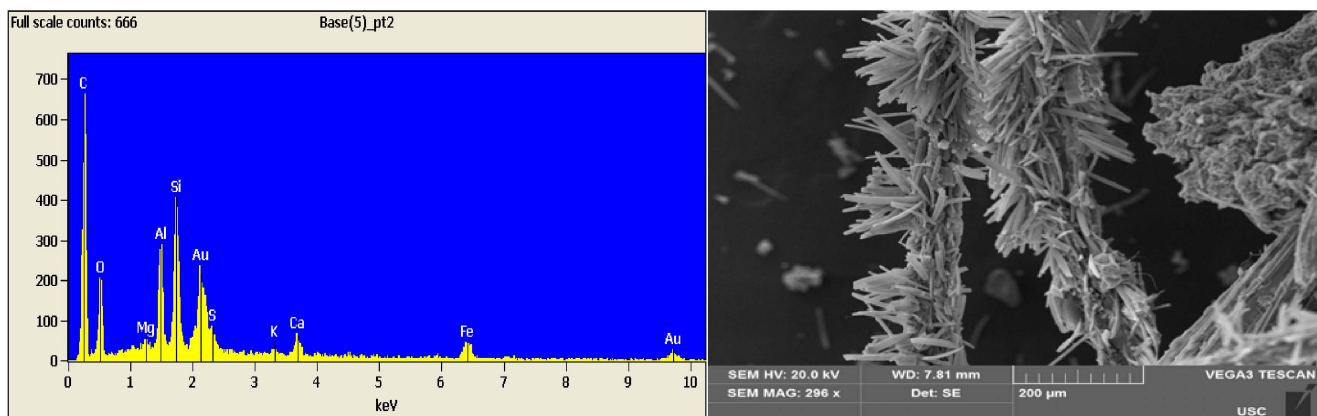
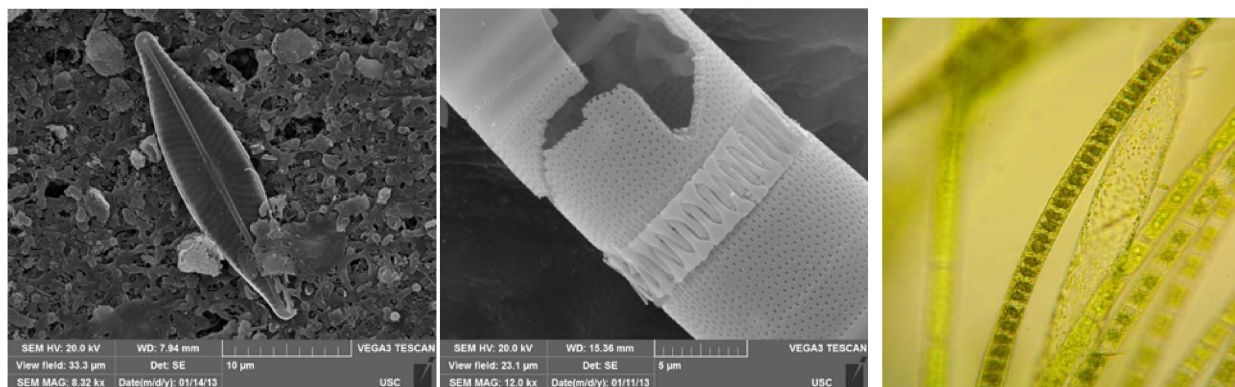Fig 1. EDS scan of sample (left) and diatoms under SEM (right) from Turkey Creek

Fig 2. *Gomphonema* (left), diatom silicate wall (center), *Zygnema & Oedogonium* (right), Turkey Creek

Fig 3. *Oedogonium* and *Anabaena* (left & center) 12-Bridges; Algae and bacteria, Point Source (right)