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Pollution Studies on the Big Black River in Mississippi, USA

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Abstract

Water quality can be closely linked to the surrounding environment and land use and is affected by community uses such as agriculture, urban and industrial use, and recreation. The Big Black River Basin is one of Mississippi's largest watersheds, with the Big Black River being its major water source. The basin has several possible sources of pollution in its surroundings. Oil and gas production are major industries in this area and cattle ranching and farming are present and may cause agricultural runoffs. The purpose of this study was to observe and analyze changes in the concentration of pollutants at various ranges and in two seasons, fall and winter, in order to effectively evaluate the water quality of the Big Black River and compare it with Mississippi Water Quality Criteria and Environmental Protection Agency (MSWQC/EPA standard). Three sample sites, at 50-meter intervals were established. Samples were collected three times during each season and analyzed for pollutants using the LaMotte pollution Test Kits. Atmospheric temperature, surface temperature, dissolved oxygen, and turbidity were observed and recorded on site. The results show that the water quality of the Big Black River met the MSWQC/EPA standard with the exception of alkalinity, chlorine, phosphate and total hardness in the fall and alkalinity, iron, and phosphate in the winter. So the river is not seriously polluted chemically. Further study of this river is recommended to include and record the biological profile.

Keywords: Pollution, Seasonal distribution, Big Black River, Mississippi.

1.0 Introduction

Water, one of our most valuable resources, is vital in order to sustain human life and maintain a healthy environment. It encompasses a broad spectrum which includes but not limited to streams, rivers, lakes and groundwater. Maintaining unpolluted or good quality of these waters is imperative. Few bodies of water remain free of human contamination. Contaminants or pollutants have drastically altered the ecology of many lakes and streams (Brower *et al*., 1998) Sustaining the quality of water not only protects public health, but provides ecosystem habitats and plays major roles in farming, fishing, mining, recreation and tourism. The environment alone does not suffer from poor water quality, commercial and recreational aspects also dwindle (Sullivan *et al*., 2000). Water quality can be closely, linked to the surrounding environment and land use and is affected by community uses such as agriculture, urban and industrial use, and recreation. The Big Black River Basin is one of Mississippi's largest watersheds, with the Big Black River being its only major water source (Brown, 2002). This basin has numerous possible sources of pollution in its surroundings. Oil and gas production are major industries in this area and cattle ranching and farming are present (loc.cit.).

The Big Black River is a lotic body of water that is classified as fish and Wildlife water body. This classification includes: fishing, propagation of fish, aquatic life and wildlife, and secondary contact recreation. The river and its tributaries are in relatively natural conditions and only a small percent of the basin's surface waters have been monitored. It has several operations that influence the water quality conditions. These operations include: livestock, mining and hazardous waste operations, wastewater dischargers, and solid waste management. This river appeared to have abundant amounts of fish, and plant life around it when investigated.

Pollution enters the environment from point source and non-point source. Point source of pollution has known origin. The sources may include: municipal

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landfills, livestock wastes, leaky sewer lines, underground injection wells, and leaks or spills of industrial chemicals at manufacturing facilities. Non-point sources of pollution have unidentifiable origins. Pollutants can come from fertilizers on agricultural land, pesticides on agricultural land and forests, forestry practices, construction and mining, and contaminants in rain, snow, and dry atmospheric fallout. In order for water to be considered healthy, it must contain a balanced amount of nutrients and normal fluctuations in salinity and temperature. Plenty of oxygen and little sediment are also a must. Oxygen ensures that underwater living resources can breathe and grow. There are numerous factors that must be taken into consideration when determining water quality. According to EPA these factors include biological, chemical, physical, aesthetic factors and radioactivity .Several water quality or pollution studies have been done on freshwater bodies in Mississippi (Acholonu *et al.*, 2000; Acholonu *et al.* 2002; Acholonu and Harris, 2011). These in the main, met the MSWQC/EPA standard. Only a few parameters exceeded the threshold of MSWQC/ EPA Standard. It was considered needful to find out the situation with the Big Black River; to verify if the river, like the others, met the MSWQC/EPA standard and is acceptable for human use. So, the purpose of this study was to observe and analyze the changes in concentration of pollutants during the fall and winter seasons and between the years 2003 and 2004 and to determine if it met the water quality criteria established by the Mississippi Department of Environmental Quality and EPA standard.

2.0 Materials and Methods

2.1 Study Area

The Big Black River is a tributary of the Mississippi River. Its origin is in the Webster County near the town of Europa. From there, it flows 330 miles (530 km) southwest and empties into the Mississippi River 25 miles (40 km) south of Vicksburg, MS. It is the major contributor to the Big Black River Basin (Figures 1a and b). It forms the northern boundary of Claiborne County (https://en.wikipedia.org/wiki/Big_Black_River_(Mississippi) and part of the southern border of Warren County. Water samples were collected under and near the long Big Black River Bridge on Highway 61 South, in Claiborne County, MS approximately 5 miles north of Port Gibson, MS and 25 miles north of Alcorn State University (Figure 2).

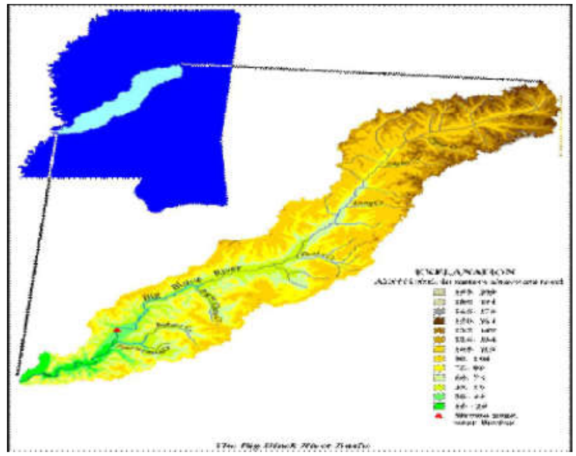

Figure 1a: Big Black River Basin
(source: https://en.wikipedia.org/wiki/Big_Black_River_(Mississippi))

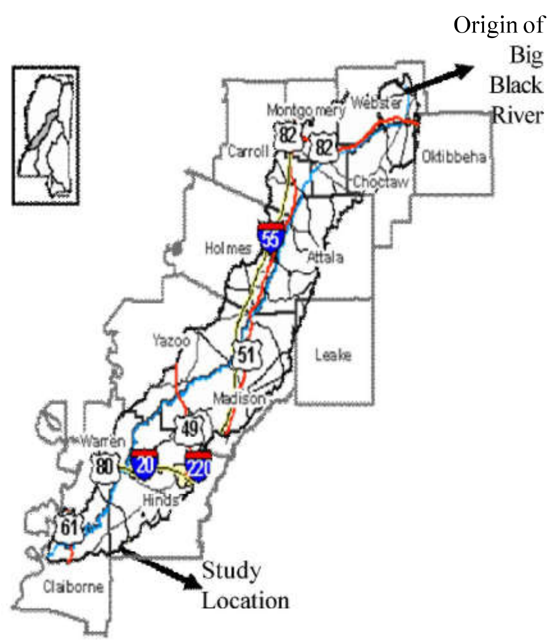

Figure 1b: Big Black River Basin Showing Webster County (origin/source of the Big Black River) and mouth (Mississippi River) in the vicinity of Claiborne and Warren Counties.
(source: http://deq.state.ms.us/MDEQ.nsf/page/WMB_Big_Black_River_Basin?OpenDocument).

2.2 Sampling Procedures

This study was conducted essentially following the methods of Acholonu and Harris (2011). Water samples were collected from the river at one week intervals. Three samples were collected at each

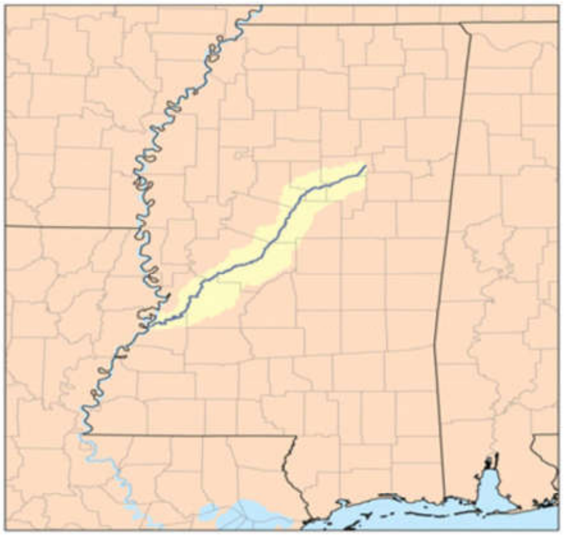

Figure 2: Map Showing Mississippi and Big Black River
(source: https://en.wikipedia.org/wiki/Big_Black_River_(Mississippi)).

interval from three sites, about 50 meters apart. The collections were made at depths of 2-5 meters. Physical parameters were tested at the river (in situ).These parameters include: conductivity, salinity, and pH and temperature which were taken using the YSI mode163 Hand held pH, Conductivity, Salinity, and Temperature Meter. Plastic containers (water bottles) were used to collect the water samples and they were transported to the Alcorn State University laboratory. Dissolved Oxygen was taken using the YSI model 95 handheld Dissolved Oxygen and Temperature Meter. In the laboratory, LaMotte pollution Test Kits ordered from the Carolina Biological Supply Co. were used to perform various chemical tests (Table 1).

3.0 Results

3.1 Fall

The average readings for the parameters tested are indicated in Table 1 and Figure 3. Of all theses, only alkalinity (53.7/3.08), Hardness (57.0/50), phosphate (0.2/0.1) and chlorine (0.6/0.5) exceeded the MSWQC/EPA standard.

3.2 Winter

The average readings for the parameters tested are indicated in Table 1 and Figure 3. Only alkalinity (24.4/3.08), Iron (1.2/0.3), and phosphate (0.3/0.1) exceeded the (MSWQC)/EPA standard.

Table 1: Average Seasonal Chemical Profile (All Concentrations are ppm (parts per million) except pH and temperature).

	Fall	Winter	MDEQ
Alkalinity	53.7*	24.4*	3.08
Ammonia-Nitrogen	2.0	1.300	10.00
Calcium	14.0	6.000	200.00
Carbon Dioxide	4.3	2.000	10.00
Chloride	9.2	5.000	250.00
Chlorine	0.6*	<0.500	0.50
Chromate	0.0	0.000	0.10
Conductivity	178.0	73.000	5000.00
Copper	0.05	0.134	8.85/6.29
Cyanide	0.0	0.000	NA
Dissolved Oxygen	13.1	10.000	5.00
Fluorides	0.6	0.400	2.00
Iron	0.1	1.200*	0.30
Magnesium	6.0	2.100	150.00
Manganese	0.2	0.010	0.05
Nitrate-N	2.0	2.30	10.00
pH	7.0	7.00	6.0-9.0
Phosphate	0.2*	0.300*	0.10
Silica	6.0	8.000	75.00
Sulfate	2.5	2.200	250.00
Sulfide	0.2	0.100	NA
Total Hardness	57.0*	22.300	50.00
Temperature	11.2	9.600	<32.20
Zinc	0.1	0.100	10.00

4.0 Discussion and Conclusion

The Big Black River was noted not be very turbid except after it rained. When it rains, the currents increase causing the suspended particles to be more disturbed. In most natural waters the pH ranges from 5.0 to 8.5. The acidic, freshly fallen rain water may have a pH value of 5.5 to 6.0 (Renn, 1970). The average pH reading for the Big Black River was 6.94. During the fall and winter months there was very little rainfall. So the pH was not significantly lowered.

Alkalinity for the Big Black River exceeded the limit set by the MSWGC/EPA both in the fall and the winter. It also exceeded that of the Lower Mississippi River in the fall (0) and winter (0) but less than that of the Lower Pascagoula River sampled in the spring (June) of 2014 (70.0 ppm). Historically, alkalinity referred to the buffering capacity of the carbonate system in water. Currently alkalinity is used interchangeably with acid neutralizing

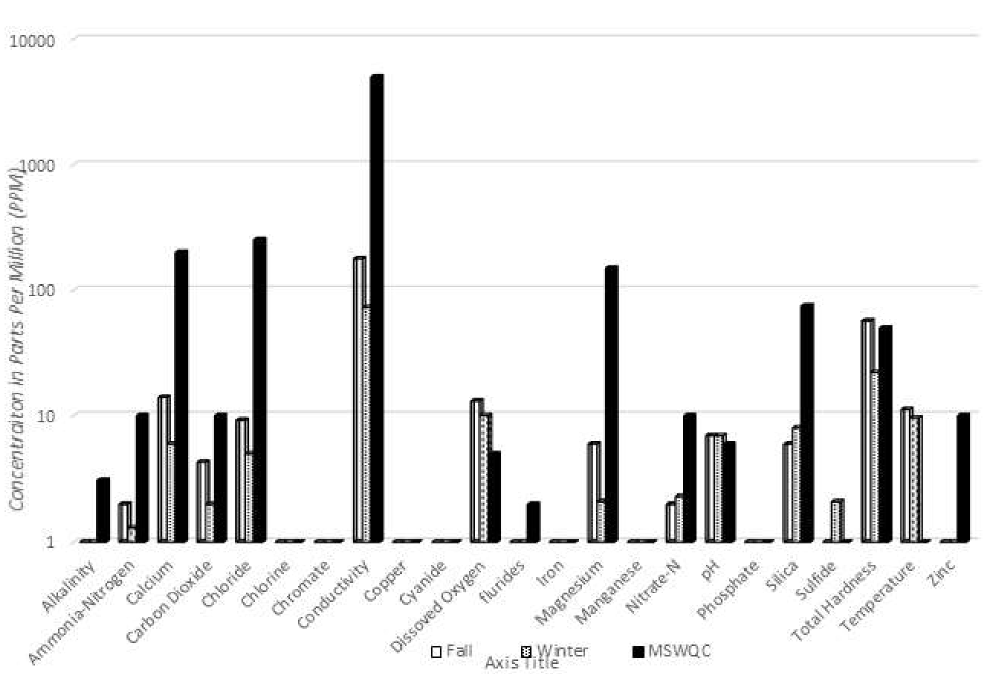

Figure 3: Average Seasonal Chemical Profile

capacity (ANC), which refers to the capacity to neutralize strong acids such as hydrochloric acid and nitric acid. Alkalinity in water is due to any dissolved species (usually weak acid anions) that can accept and neutralize protons. (Watzel *et al*., 2000). The recommended limit is 3.08 ppm. Alkaline along with ammonia-nitrogen and carbon dioxide are naturally found in water Ammonia-nitrogen is normally present in surface and ground water (Renn, 1970). The average concentration levels of manganese, nitrate, and phosphate found in the Big Black River were 0.2 ppm in the fall and 0.3 ppm in the winter, slightly above the MSWQC/EPA standard. The river had neither a foul odor nor overgrowth of plants. These pollutant sources may come from fertilizer runoff, sewage and erosion of natural deposits (Renn, 1970). The small amounts may be due to natural deposits rather than human made.

Hardness exceeded the MSWQC in the fall (57/50 but below the threshold in the winter (22.3/50) Hardness is measured as Calcium Carbonate (CaCo3). Total hardness of water is a combination of calcium and magnesium. The average total hardness observed was 57.0 ppm in the fall and 22.3 ppm in winter and the average measurements of calcium and magnesium were 14.0 (Fall) and 6.0 ppm (winter) respectively. The threshold for calcium is 200 ppm and for magnesium 150 ppm, so neither limit was exceeded. Water is known as soft if it is in the range of 0-60 ppm, medium-soft if it is in the range of 60-120 ppm, hard if it is in the range of 120-180 ppm, and very hard if observed to exceed 180 ppm. The Big Black River had an average total hardness of 57.0ppm (fall) and less hardness in the winter (22.3 ppm). So the Big Black River can be classified as soft water. Since this river receives industrial and agricultural runoffs, it is necessary to test for pollutants.

Rain and wind are components of nature that cleanse or contaminant the environment. Rain dilutes the pollutants, while wind carries pollutants from one place to another, which may dilute them or they may be mixed in soil. Some plants take up certain pollutants and remove them from the soil. The Big Black River exhibited low readings indicating that the river was not polluted. It therefore in general, met the criteria set by the Mississippi Department of Environmental Quality for safe water. This study precluded the biological profile of the river. As observed previously, the Big Black River has several operations in close proximity to it and its basin that influence water quality conditions. The seasonal contaminant variations may be attributed to the fact that the river is a lotic (running) body of water with the contaminant concentrations changing from time to time. As such, it is recommended that periodic pollution studies of this nature be conducted and that the biological profile be included.

Acknowledgments

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