Chemical Monitoring of Streams in the East Cobb Area

Caroline Hugh

Wheeler High School

Marietta, Georgia

Abstract

Stream health in the Chattahoochee River watershed is very important. This study aimed to measure the chemical health of 28 streams around the East Cobb area. pH, dissolved oxygen, total dissolved solids, and conductivity were measured. These results were compared to water quality index (WQI) scores from a 2017 study of the same streams. The hypothesis was that the streams with higher WQIs would have more ideal chemical readings. This was not supported. The results showed no correlation between WQI and chemical measurements. The data gathered did match up with volunteer data of Cobb County's averages, however, which lends credibility to the experiment. This could be because the streams' health changed over the course of two years, or this could show that macroinvertebrates are more resilient to poor stream health in this area. This study is significant because of the area's importance to the Chattahoochee watershed. Also, streams are a great way to get citizens interested in environmental science, since many streams are in backyards or equally accessible places.

Chemical Monitoring of Streams in the East Cobb Area

INTRODUCTION: Water health is of paramount importance, now more than ever. Chemically, water is vital to all life, and it is the main component in the human body (Sargen, 2019). Freshwater is especially essential, as humans, and many plants and animals, can only process freshwater (Skofronick-Jackson, n.d.). However, this crucial resource is being threatened by pollution, overuse, and other dangers. In order to know exactly what is happening to freshwater sources, information needs to be gathered from the sources themselves, which is what this study aimed to accomplish.

The Chattahoochee River watershed, which is where this study was conducted, is one of the most important watersheds in the United States. It is the main water source in Georgia, and it is the smallest watershed to support a metropolitan area in the country (“Chattahoochee River,” n.d.). Due to the watershed’s significance, it is important that streams within it are monitored. In this study, chemical monitoring was performed according to the recommendations by Georgia’s Adopt-A-Stream program. Georgia’s Adopt-A-Stream program is a “gratifyingly comprehensive” program that aims to monitor chemical, biological, and bacterial components in the state’s streams (Norris, 2008). It offers recommendations on what chemical factors to measure in order to fully monitor a stream’s health. The basic factors include pH, dissolved oxygen, and TDS/conductivity (“Georgia Adopt-A-Stream,” n.d.). These factors offer a well-rounded view on stream health.

pH monitors the basicity/acidity of the water. Freshwater pH fluctuates more than saltwater, so its inhabitants are more resilient to changes, but any levels below 4.5 or above 10 are lethal to aquatic organisms (Norris, 2008). Georgia’s standards set pH levels between 6 and 8.5, with 6.5 to 8.2 being ideal (“Georgia Adopt-A-Stream,” n.d.). The next parameter is dissolved oxygen. Dissolved oxygen, or DO, is a very important measurement because all aquatic organisms rely on it. Low DO levels usually equate to less macroinvertebrates living in the stream and low stream health all around. Georgia's standards are between 4.0 mg/L and 5.0 mg/L. The next measurements -- TDS and conductivity -- are connected. TDS stands for Total Dissolved Solids, and includes any solid nutrients that have been dissolved into the stream, the most common being nitrates, nitrites, phosphates, and potassium (Norris, 2008). Normal levels are between 0 and 250 ppm, though both too few nutrients and too many nutrients are detrimental (Georgia Environmental Protection Division, 2004). High levels of nutrients can cause eutrophication (rapid algae growth) which chokes the streams. Conductivity is connected to TDS because conduction through water relies on dissolved matter, since pure water is a nonconductor. Georgia streams tend to have conductivity levels between 50 and 500 µs/cm ("Georgia Adopt-A-Stream," n.d.).

A study I performed two years ago monitored stream health via macroinvertebrates (Hugh, 2017). No significant link was found between water temperature (a rough measure of DO) and the water quality index score (WQI) using macroinvertebrates. This current study aims to find a link between stream health (using the data from two years ago) and the new chemical measurements. The hypothesis is: the streams with the higher WQI will have pH levels between 6.5 and 8.2, DO around 5.0 mg/L, TDS between 0 and 250 ppm, and conductivity between 50 and 500 µs/cm.

METHODS: This experiment involved the same 28 streams as the 2017 study (the Leita Thompson locations 21 and 22 were excluded for time purposes), and the following procedure is repeated at each stream. First, the surveying site used in 2017 was located. DO was measured first using the Sera Oxygen-Test Kit. A small tube was rinsed and then filled with water from the stream, and six drops of reagent 1 were added, followed by six drops of reagent 2. The tube was left to settle. Next, the pH was measured using the JulyPanny Digital PH Meter. The digital meter was held in the water until the pH reading remained steady, then that number was recorded. Next, the TDS/conductivity was taken using the TDS Water Quality Tester. The meter was held in the water until the reading registered. One reading was enough to capture the TDS and conductivity, and both were recorded. At this point, the DO testing tube had precipitated, and the color of the precipitate was matched with a color chart that determined the level of DO. This was recorded. The whole process, per stream, took between 20 and 30 minutes.

RESULTS:

Table 1

WQI and Chemical Data

STREAM #	**WQI**	**pH**	**TDS (ppm)**	**Con. (µs/cm)**	**DO (mg/L)**
Stream 1	10	6.43	35	74	4
Stream 2	8	6.36	40	85	6
Stream 3	8	6.1	11	23	5
Stream 4	2	6.04	17	36	4.5
Stream 5	10	6.16	28	59	5
Stream 6	6	6.17	27	57	5
Stream 7	6	7.22	56	119	6.5
Stream 8	5	6.52	13	27	5
Stream 9	3	6.12	45	95	5.5
Stream 10	4	6.31	41	87	6
Stream 11	5	7.47	140	297	6
Stream 12	15	6.03	44	93	6
Stream 13	11	6.2	55	117	6
Stream 14	5	6.27	12	25	5.5
Stream 15	7	6.01	31	65	5.5
Stream 16	9	6.57	41	87	4.5
Stream 17	1	6.75	38	80	6
Stream 18	4	6.36	27	57	6.5
Stream 19	14	6.55	33	70	6
Stream 20	6	6.3	32	68	5.5
Stream 21	5				
Stream 22	13				
Stream 23	13	6.08	32	68	6
Stream 24	11	6.05	35	74	7
Stream 25	10	6.09	26	55	6
Stream 26	8	6.14	28	59	6

Stream 27	15	6.35	21	44	6
Stream 28	7	5.93	45	95	6
Stream 29	11	6.11	56	119	6
Stream 30	9	6.2	39	82	6
AVERAGES	8.0333	6.3175	37.429	79.179	5.679

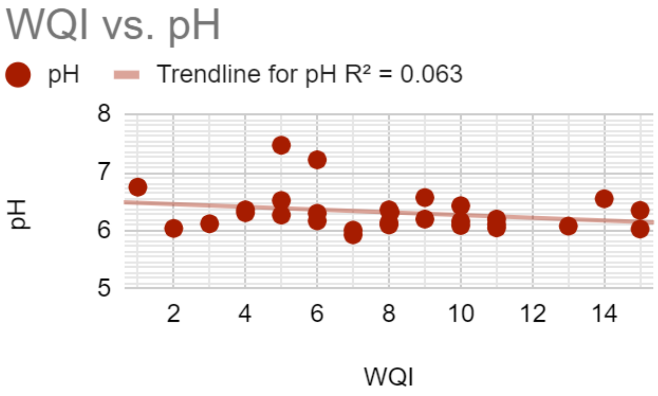

Figure 1. Water Quality Index Score vs. pH

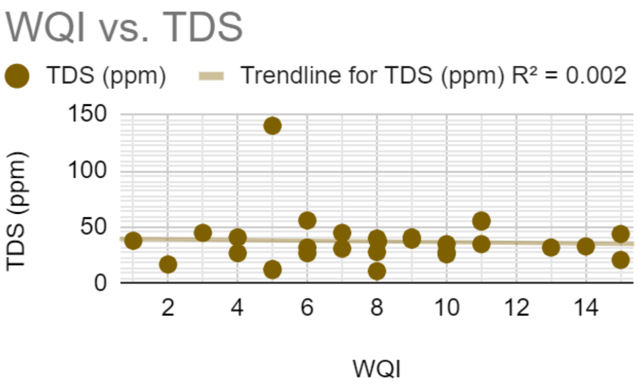

Figure 2. Water Quality Index Score vs. Total Dissolved Solids

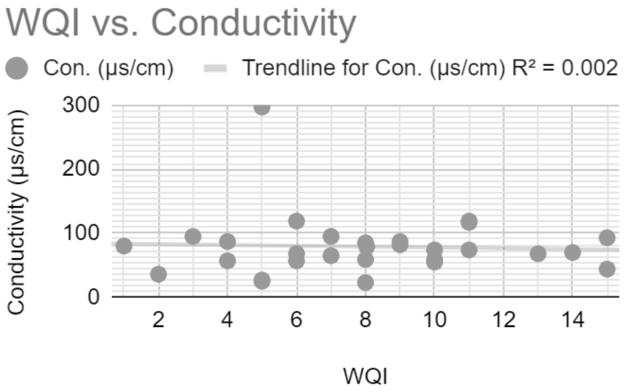

Figure 3. Water Quality Index Score vs. Conductivity

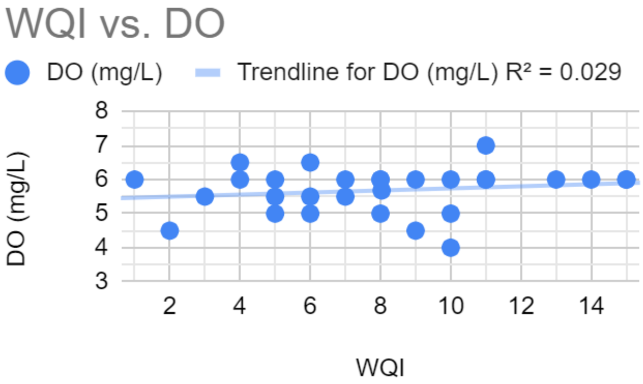

Figure 4. Water Quality Index Score vs. Dissolved Oxygen

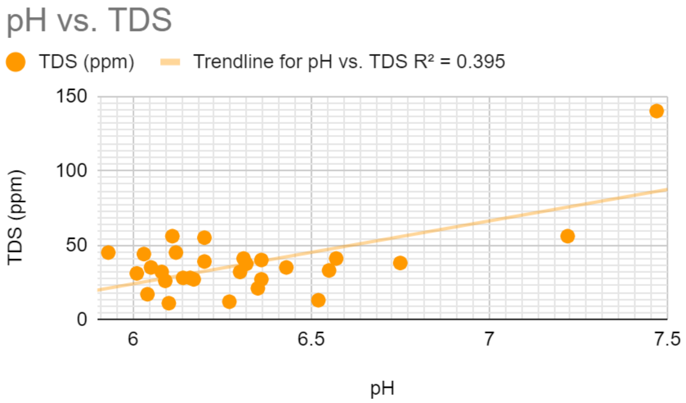

Figure 5. pH vs. Total Dissolved Solids

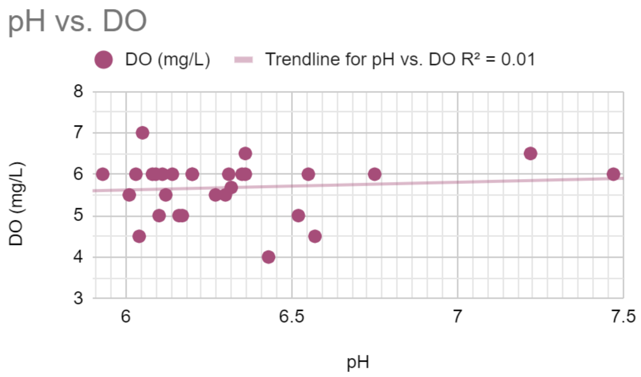

Figure 6. pH vs. Dissolved Oxygen

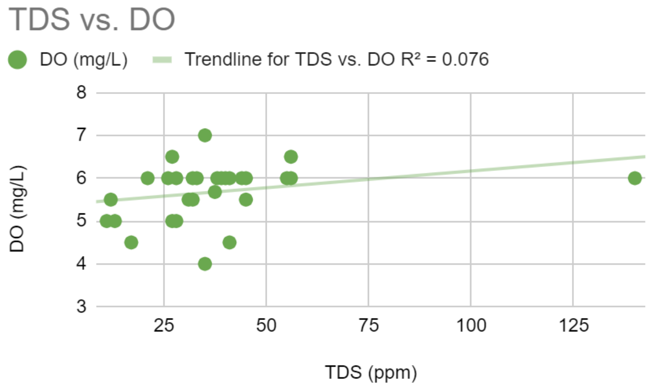

Figure 7. Total Dissolved Solids vs. Dissolved Oxygen

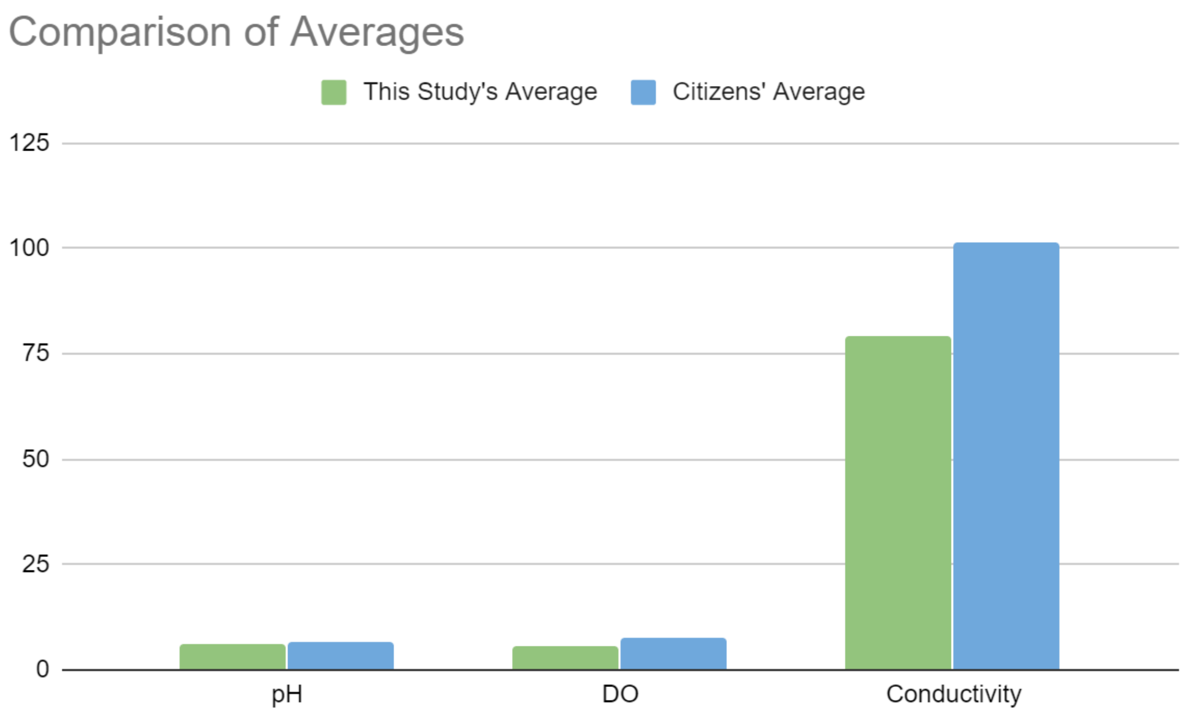

Figure 8. This study’s averages vs. Georgia volunteers’ averages

ANALYSIS: There appears to be no significant correlation between WQI and any of the chemical tests. Figures 1 through 4 show WQI graphed against the various chemical parameters. No graph shows significant correlation. However, a connection may be drawn from Figure 5. Figure 5 shows pH graphed against TDS, and a positive correlation exists. This is logical, because solids dissolved in water is the driving factor behind pH changes. Plain water would have a pH of 7.0, so more TDS means more change in pH. This is interesting, but not what this study is trying to investigate.

There are few studies on macroinvertebrate and chemical stream health in the state of Georgia, despite the state’s established Adopt-A-Stream Program. One study, by Anne Stahley and Christopher H. Kodani, assessed streams in the Upper Ocmulgee watershed and found a positive correlation between WQI and pH approaching 7, and a positive correlation between WQI and DO (Stahley, 2011). This study’s findings do not support theirs, though this could be due to location or equipment differences. Despite a lack of scientific studies on Georgia streams, there is a large amount of data available on the Adopt-A-Stream website. Cobb County volunteer data averages can be found in Figure 8. This study matches that data closely, which helps bolster the credibility of these results.

DISCUSSION: There are multiple reasons why WQI does not correlate with chemical parameters. One could be the time between studies. The WQI data is from 2017, while the chemical data is from 2019. The stream health could have changed during that time, which would affect the chemical readings. There are not many studies linking chemical environments to macroinvertebrate health, so it is not exactly known how macroinvertebrates will react to chemical changes. The average pH of this study is lower than Georgia recommended levels (between 6.5 and 8.2), and even some streams with high WQIs had low pHs. This could show that macroinvertebrates are more resilient than previously thought, or it could be that the streams surveyed are not healthy (evident from their rather low WQIs) and have more resilient-than-average macroinvertebrates as an adaptation. This project is important because it studies a new region and adds much-needed data to the 2017 study. It can be used to pinpoint streams in need. Those streams that have low WQIs and poor chemical readings could be scouted out and cleaned. Or, those streams that had good WQIs in 2017 but now have poor chemical health could be studied to see if a negative event occurred in that time, such as construction or pesticide use. Further research must be done on how exactly macroinvertebrates react to chemical changes, and whether the resilience level of the invertebrates depends on the specific stream, as this study suggests it might. If this project were to be redone, more precise equipment would be used and the streams would be monitored for both macroinvertebrate and chemical health at the same time.

CONCLUSION: Streams and rivers are the most accessible and prevalent sites of freshwater for most people around the United States. Because of this, they are wonderful teaching tools for citizens. They can be used as stepping stones to get everyday people interested in the environment. Many people around the East Cobb area have streams in their backyards and do not realize how important these bodies of water are. With this data, citizens can see in which health factor their stream lacks, and they can work on improving or locating the source of the problem. In addition, this study can be used to promote Georgia’s Adopt-A-Stream program and the importance of Georgia watersheds. It is not difficult to make a difference in the environment. Improving the world can start in the everyday person’s backyard.

References

Chattahoochee River. (n.d.). Retrieved January 3, 2020, from https://garivers.org/chattahoochee-river/.

Georgia Adopt-A-Stream. (n.d.). Retrieved January 3, 2020, from https://adoptastream.georgia.gov/.

Georgia Environmental Protection Division. (2004). WATER QUALITY IN GEORGIA 2002 - 2003. Atlanta, GA: GAEPD. Retrieved from https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Water_Quality_In_Georgia_305b303d_Y2004.pdf

Hugh, C. (2017). Measuring and Finding the Effects of Water Temperature on Macroinvertebrates in Streams Around the Cobb Area.

Norris, L. (2008). Municipal In-Stream Monitoring. Stormwater, 9(6), 116–123. Retrieved from http://search.ebscohost.com.proxygsu-int1.galileo.usg.edu/login.aspx?direct=true&db=8h&AN=33964152

Sargen, M. (2019, September 26). Biological Roles of Water: Why is water necessary for life? Retrieved January 3, 2020, from http://sitn.hms.harvard.edu/uncategorized/2019/biological-roles-of-water-why-is-water-necessary-for-life/.

Skofronick-Jackson, G. (n.d.). The Importance of Freshwater. Retrieved January 3, 2020, from https://pmm.nasa.gov/waterfalls/science/freshwater.

Stahley, A., & Kodani, C. H. (2011). Assessing Small Streams in the Upper Ocmulgee

Watershed Using the Georgia Adopt-A-Stream Macroinvertebrate Monitoring Protocols. Georgia Journal of Science, 69(4), 135. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=aqh&AN=72269062