Sibun River Water Quality Monitoring Project

January 2010

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Introduction

The purpose of this research is to determine the health and water quality of the Sibun River; the section of river that was tested is in the Cayo District, Belize, were the Hummingbird Highway intersects the river. The river is formed from the tributary streams and rivers that flow into it from the Mayan Mountains and from rainfall that occurs in the mountains. The Mayan Mountains are made up of granite, with the surrounding hilly regions composed of limestone (Geography of Belize), with limestone acting as a natural filter, the ground water within the mountains would be filtered before it accumulates in the streams and then flows into the river. So the river should have a pretty well balanced and healthy water system, provided there are no sources of pollution running into it.

The Sibun River is a very important factor to many people that live around it and depend on it. Not only is the river used for a source of water, but it is also a place where people go to wash their clothes. Since people are washing their clothes and drinking out of the same river, these experiments will help to determine if this is a safe practice or if drinking the water could lead to health problems for the communities that depend upon the river.

Also many citrus farms border the river and the runoff from these fields goes directly into the river. If the farmers are using inorganic pesticides this could greatly alter the balance of the ecosystem and have dramatic effects on the waterway. The research done on the river and stream could determine if the farming is having any effects on the water, and if so what; then it can hopefully lead to a solution to the problem.

Chemicals

pH

The pH scale runs from 0 (acidic) to 14 (alkaline), with 7 being neutral. The normal range for a stream is 6-8 (http://ga.water.usgs.gov/edu/phdiagram.html), but certain organisms can only live in a very narrow range and will die if it shifts too much. Anything below 5 and above 9 is dangerous for many animals (Zurawski, Physical and Chemical Analysis 2009). pH is important because it aids in determining the solubility and biological availability of nutrients (http://ga.water.usgs.gov/edu/phdiagram.html). The pH of an ecosystem can be effected by many different factors, such as: industrial waste, agricultural runoff, and drainage from improperly run mining operations (LaMotte).

Nitrate

The ideal concentration for nitrates in a water ecosystem is zero (0) (Zurawski, Physical and Chemical Analysis 2009), but lower it is the better (LaMotte). Nitrates are essential nutrients that are needed in order to build proteins (LaMotte). Causes of nitrates include the decomposition of plants and animals within the water, waste from animals, with the main causes being sewage, fertilizer and agricultural runoff (LaMotte, Zurawski, Physical and Chemical Analysis 2009). High levels of nitrates can lead to an excess of plant and algae growth, this leads to an increased rate of decay, leading to even higher levels of nitrates; a high concentration would also encourage bacterial decomposition which will decrease the amount of available oxygen in the water (LaMotte).y

Oxygen

The required amount of dissolved oxygen in a water ecosystem cannot be lower than 5 parts per million (ppm) before it starts to effect and damage the flora and fauna (Zurawski, Physical and Chemical Analysis 2009); this is due to the fact that oxygen is "30 times less available in water than in air" (Giller and Malmqvist 2006). Depending on the type of water, fast moving and turbulent or slow and stagnant, the levels can vary; for fast moving, turbulent streams and rivers the concentration of oxygen would be greater, than if the water was slow and stagnant (Giller and Malmqvist 2006). It is said that at 14.6 parts per million (ppm) of dissolved oxygen the water is 100% saturated (Zurawski, Physical and Chemical Analysis 2009).

Phosphate

The recommended concentration of phosphates in the water is 0.1 parts per million (ppm) (Zurawski, Physical and Chemical Analysis 2009 and LaMotte). Phosphates are an important nutrient because they are an essential component in metabolic reactions; they also are required for plant and animal growth. Phosphates occur from industrial pollution, human and animal waste, agricultural runoff (LaMotte), and even detergents (Zurawski, Physical and Chemical Analysis 2009). If there is a high concentration, overgrowth of plants and algae can occur, along with increased bacterial activity, which in turn will eventually lead to a decrease in the levels of dissolved oxygen (LaMotte and Zurawski, Physical and Chemical Analysis 2009).

Materials and Methods

All of the experiments and research was done in the Cayo District of Belize, on the Sibun River and a small stream on the Sibun Education and Adventure Lodge Campus that flows into it. The date, that the experiments took place was January 3 and 4, 2010. The location which the river was tested was where the Sibun River and the Hummingbird Highway intersected on the east side of the road three-fourths of a mile back at 17°06′45.90″ N by 88°38′58.54″ W (Appendix A, Figure 1). The smaller stream was located on the grounds of Sibun Education and Adventure Lodge located off of the west side of Hummingbird Highway at 17°06′29.52″ N by 88°39′56.59″ W (Appendix A, Figure 2). The water was high due to a large amount of rainfall the week prior to testing so the flow of the river and stream was greater than expected.

A variety of methods were used to conduct the research at both the river and the stream. Kick nets were used to collect organisms that reside on the bottom. Two people held the net on the bottom, while placing rocks on the lower side of the net to hold it against the bottom and prevent organisms from escaping underneath it. Then several other people upstream from the net would kick up and rub the rocks to knock off any potential organisms that could be collected by the net. This was repeated several times moving upstream in the smaller stream and downstream in the river. It was moved downstream in the river in order to get to a section with a greater amount of flow compared to the calmer water were the net was first placed. The organisms that were collected were put in a cup and brought back for identification.

Snail shells were collected from both the stream and the river to determine sinistral, left-handed, or dextral, right-handed whorls. The snails are indicators of water quality and by knowing the handedness of the snails we can help to estimate the water quality. For a healthy system the snails would be dextral, and for a polluted system the snails would be sinistral (Zurawski, Macro Organisms 2009). A minimum of 100 snails were collected from both the stream and the river.

Water samples were taken from both locations and brought back to perform chemical test on them. These chemical tests included: pH, nitrate, phosphate, and dissolved oxygen. Each of the following tests was performed twice for each sample of water, river and stream, to ensure the most accurate results.

Results

Stream

The area that was sampled had a substrate composed of rocks and gravel. From the stream, 119 snail shells were collected and the handedness of them was determined. Out of the total number collected 100% were dextral, right-handed; there was not a single one that was sinistral, left-handed (Table 2). Along with collecting snail shells, other organisms were collected. Two different species of Damselflies, Order Odonata (Freshwater Aquatic Macroinvertebrates), were collected (Appendix B, Figures 2 and 3).

Along with collecting organisms, a chemical analysis was also done on the water using LaMotte Low Cost Water Monitoring Kit. The pH of the stream was tested three different times and the results were 7.5, 8.0, and 7.0; with an average of 7.5 (Table 1). The rest of the test; nitrate, phosphate, and dissolved oxygen, were conducted twice. The nitrate results were 0ppm and 0ppm (Table 1). The results for phosphate were 1ppm and 0ppm, with an average of 0.5ppm (Table 1). The dissolved oxygen results were 8ppm for both tests (Table 1).

	pH	Nitrate (ppm)	Phosphate (ppm)	Dissolved Oxygen (ppm)
Test 1	7.5	0	1	8
Test 2	8.0	0	0	8
Test 3	7.0	N/A	N/A	N/A
Average	7.5	0	0.5	8

Table 1. Stream chemical results

Table 2. Handedness of snail shells for stream

	Number of Snail Shells Collected
Sinistral (Left-Handed)	0
Dextral (Right-Handed)	119
Total Number	119

Sibun River

The area that was sampled had a bottom made up of rocks and gravel. A total of 270 snail shells were collected, and out of the sample size 100% of the shells were dextral, right-handed (Table 4); none of the shells that were collected in this sample were sinistral, left-handed. Species that were collected in the kick net included: Hellgrammites (Appendix B, Figure 1), Order Megaloptera (Freshwater Aquatic Macroinvertebrates); a Caddis fly (Appendix B, Figure 4), Order Trichoptera (Freshwater Aquatic Macroinvertebrates, Student Handout #2-Dichotomous Key for Aquatic Insects); and two different species of Damselflies (Appendix B, Figures 2 and 3), Order Odonata (Freshwater Aquatic Macroinvertebrates). Along with insects, an unidentified species of fish and a tadpole were collected (Appendix B, Figures 5 and 6).

A chemical analysis, using LaMotte Low Cost Water Monitoring Kit, was also done on the river with pH, nitrate, phosphate, and dissolved oxygen tested. The results for pH were 7.5 for both the first and second test (Table 3). Nitrate and phosphate both had final results of 0ppm for both of the two tests (Table 3). The two tests that were performed on the water sample for dissolved oxygen both came out to be 8ppm (Table 3).

	pH	Nitrate (ppm)	Phosphate (ppm)	Dissolved Oxygen (ppm)
Test 1	7.5	0	0	8
Test 2	7.5	0	0	8
Average	7.5	0	0	8

Table 3. Sibun River chemical results

Table 4. Handedness of snail shells for Sibun River

	Number of snail shells collected
Sinistral (Left-Handed)	0
Dextral (Right-Handed)	270
Total Number	270

Conclusion

After all of the chemicals were tested, they were compared to the ideal levels and concentrations stated in LaMotte Water Monitoring Kit and Zurawski Chemical Analysis 2009. The results attained from the samples of water, both the stream and river, matched the ideal levels. The only exception to the group was the phosphate test on the stream; the reading for the stream was 0.5, and the ideal is 1.0 (LaMotte), so the phosphate levels are just below the recommended levels, but it is not low enough to cause concern.

There was a 100% collection of dextral, right-handed, snails for both sample sites. This shows that the quality of the water is good because dextral snails are an indicator of a healthy system (Zurawski, Physical and Chemical Analysis 2009). By not having any sinistral snails, it is showing that the water is not polluted, only to support the chemical test showing good water quality.

The organisms that were collected are also indicators of the water quality. The Hellgrammites, Order Megaloptera, that were found in the Sibun River are very sensitive to pollution (Freshwater Aquatic Macroinvertebrates) and would not have been present in the river if it was polluted or contaminated. Along with the Hellgrammites, the Caddis Flies, Order Trichoptera, and the Damselflies, Order Odonata, are also “somewhat sensitive” to water pollutants (Freshwater Aquatic Macroinvertebrates). The results from this study have shown that the Sibun River and adjoining stream have a high level of water quality. If changes are noted indication of pollution and water contamination could be possible. These possible changes could come from citrus farms that switched to or started using chemicals in their fields, and those chemicals got washed into the tributaries and river. Future studies of this ecosystem should be performed to monitor and to help maintain the quality of the water. Sites further down river could be tested to determine the water quality and check if it is ideal. If after testing poor water quality was found, then test of the tributaries should be performed to determine the source of contamination. Along with more extensive test on the water, interviews with local farmers and community members could be done to find out exactly what they put on their fields and how the use the river.

Works Cited

"Geography of Belize - Geology, Physical Features, Natural Resources, Climate." *World Facts*. Web. 24 Feb. 2010. <http://worldfacts.us/Belize-geography.htm>.

Giller, Paul S., and Bjorn Malmqvist. *The Biology of Streams and Rivers*. Oxford: Oxford UP, 2006.

Google Earth

Low Cost Water Monitoring Kit. LaMotte. Earth Force. <www.lamotte.com>.

Travers, Kristen.. Medved, Christina., Williams, Vivian., McGonigle, James. *Freshwater Aquatic Macroinvertebrates: Insect Life Cycle and Habitat*. Stroud Water Research Center. LaMotte. <www.lamotte.com>.

"Water properties: pH, from USGS Water Science for Schools." *USGS Georgia Water Science Center*. Web. 24 Feb. 2010. <http://ga.water.usgs.gov/edu/phdiagram.html>.

Zurawski, Michelle. *Macro Organisms*. Moraine Valley Community College, 2009. <http://www.llcc.edu/LinkClick.aspx?fileticket=YkXUrXi8pao%3d&tabid=5454&mid=10430 >.

Zurawski, Michelle. *Physical and Chemical Analysis*. Moraine Valley Community College, 2009. <http://www.llcc.edu/LinkClick.aspx?fileticket=YkXUrXi8pao%3d&tabid=5454&mid=10430>.

Appendix A

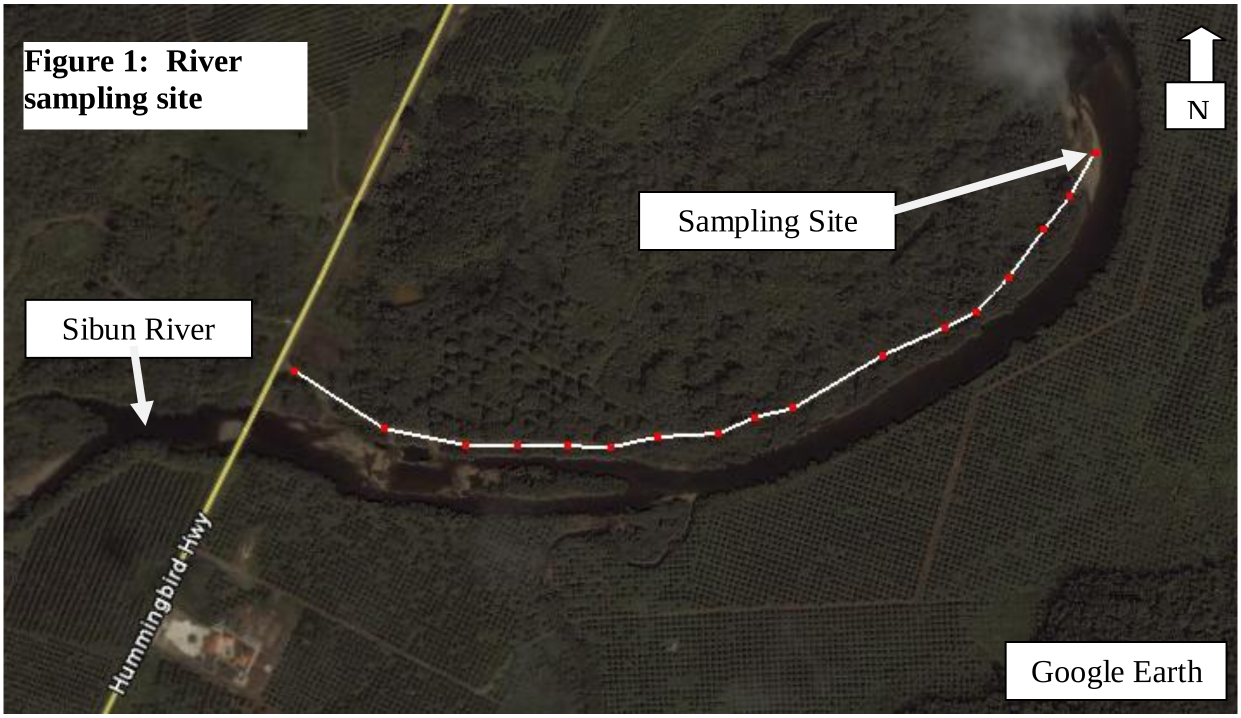

Figure 1: River sampling site

Figure 2: Stream sampling site

Appendix B

Figure 1. Hellgrammite

Figure 2. Damselfly

Figure 3. Damselfly

Appendix B (continued)

Figure 4. Caddis fly

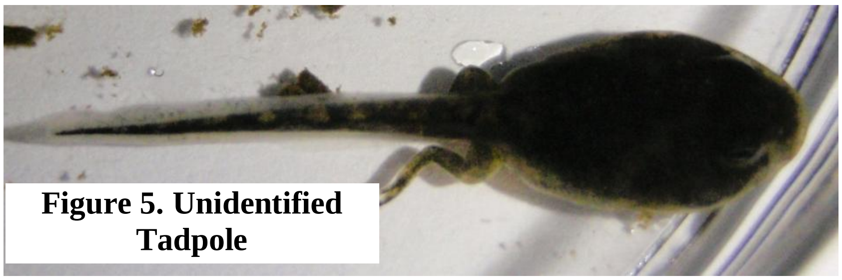

Figure 5. Unidentified Tadpole

Figure 6. Unidentified Fish