

ESTABLISHING A BASELINE: TESTING PH LEVELS IN BELIZE'S WATER SUPPLY

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My project in Belize was to test the pH level of the water in the New River Lagoon and its tributaries, including the drinking water, well water, and rainwater catch. The data was analyzed for evidence of acid rain and can be used in the future to establish a baseline to compare future pH levels. The results have been analyzed, resulting in no evidence of acid rain. None of the test results revealed levels harmful to humans.

LITERATURE REVIEW

Acid deposition refers to any type of acidic material reaching the surface of the Earth (EPA, 2007c). Wet deposition is commonly referred to as acid rain but also includes any type of precipitation that has a stronger concentration of acid, such as snow, fog, and frost. This acidic precipitation is formed when sulfur dioxide (SO₂) and nitrogen oxides (NO_x) from the air mix with water droplets. Dry deposition occurs when particles of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) become caught in dust or smoke, fall to the ground, and stick to the surface they land on. When the particles are washed into the soil by rainwater, they create an acidic mixture (EPA, 2007c).

The particles of SO₂ and NO_x can originate from a variety of different sources. A few are natural but most are human in origin. The most common natural causes are volcanoes, which spew an abundance of chemicals during an eruption, and decaying vegetation. The largest cause of acid rain is factories burning inexpensive fossil fuels, such as coal or oil, to produce electricity. Because of the huge investment of money it would take to install measures to filter out the particles of SO₂ and NO_x, factories are reluctant to take action (EPA, 2007c).

When the acidic precipitation reaches the ground, it soaks into the earth and some of the acid is neutralized by bicarbonate within the soil. This is known as the soil's buffering capacity. The size of the buffering capacity depends on the type of bedrock that underlays soil. Siliceous rock, such as granite or quartz, is highly sensitive to acid rain and has a low buffering capacity. Once the buffering capacity of the soil is used up, the rain releases toxic quantities of aluminum, manganese, iron, mercury, cadmium, and lead from the soil and into nearby bodies of water. In addition, the pH level rises, increasing potential harmful effect to the life of aquatic organisms and animals (Congressional Quarterly Inc., 1982).

Acid rain can also affect the health of trees and plants. The acid in the rain attacks trees from two different angles. First, the leaves of the trees are damaged, which limits the nutrients available to the leaves. Second, the acid rain is soaked up by the roots when the roots are seeking nutrient-rich water. As a result, the tree collects water that has little to no nutrients. Above the ground, the leaves are damaged and below the ground the tree is starved. This usually does not kill the tree, but it does weaken it. In extreme cases of acid rain and other contributing factors, trees can die completely (Congressional Quarterly Inc., 1982).

Acid rain is not directly harmful to humans. If a person swims in or drinks water that has a low pH, health will not be affected. However, the individual chemicals that are in acid rain are harmful. If those chemicals are inhaled after being released into the air, they become trapped deep inside the lungs. Studies have shown that elevated levels of these fine particles can cause premature death and increased illnesses from lung disorders, such as asthma and bronchitis (EPA, 2007a).

RESPONDING TO COMMUNITY NEED

Testing the pH of the water in Belize is critical because acid rain could greatly affect the people of Belize. The tourist industry is a main source of income in Belize. Many people come to see the country's various natural wonders and experience a relatively untouched environment. Belize is a beautiful country: it has many rivers, lagoons, and rainforests. If acid rain becomes a problem, the health of the country's trees and streams could decline, making the forests less healthy and magnificent and the streams less populated. This could affect the entire ecosystem, which in turn could be devastating to the amount of income brought in by tourism. This could lead to a significant change in lifestyle for the people of Belize.

Two years ago our guide, Ivan Gillett, did not think that there was acid rain in Belize. However, after a hurricane passed over the country in 2006, he noticed a large number of fish kills. This prompted the question of whether or not there was acid rain in Belize.

PROJECT DESIGN

I tested the pH level of the water in the New River Lagoon and its tributaries, including the drinking water, well water, and rainwater catch. The tributaries included Irish Creek, Bergen's Creek, Ram Goat Creek, and Harry Jones Creek. My testing materials included a YSI Environmental Ecosense pH meter and a Garmin GPS unit. At each testing site I recorded the date and



time of day and the GPS coordinates. I placed the pH meter into the water and waited for the meter to settle on one value. I then recorded the pH level and water temperature. Where time permitted, I performed multiple trials. If multiple trials were performed, the values were averaged and placed in a data table.

RESULTS AND ANALYSIS OF FINDINGS

Comparison of the pH level taken in 2007 (Mavroidis, 2008) and that taken this year shows the pH level has become more basic (or less acidic) in most places in the last year. Irish Creek stayed the same, Bergen's Creek became more basic by two tenths (0.2), Ram Goat Creek

became more basic by 0.35, Harry Jones Creek by 0.4, and the mouth of Irish Creek by 0.5.

The results varied very little, ranging from 7.15–8.94, which are values that are normal for water. Completely neutral water is 7.0, but pure water is the only water that ever has values of 7.0. There is a possibility that some samples changed slightly when water was collected in a small plastic bottle before testing. This was the case when water was taken from spigots and there was no good way of immersing the pH meter into the water.

CONCLUSION

After reviewing the pH results, there is no evidence of acid rain in and around the Rio Bravo Conservation and Management Area. The pH level in the water was either very close to neutral or slightly base, the main reason for this being that the majority of the bedrock in Belize is limestone. A second cause of the fish kills was determined to be run-off of fertilizer. Fertilizer creates algae blooms, which take oxygen away from water-dwelling

animals, killing them. Directly after heavy rains, the run-off would be great. Therefore, any fish kill that happened near a papaya farm or any other type of agricultural field could be attributed to fertilizer in the soil being washed from the soil into drainage ditches and then into streams. Acidic readings were not taken from drainage ditches or tributaries simply because it did not rain while we were there. Had it rained while we were on the ground, slightly more acidic pH readings might have been found due to potential fertilizer run-off.

The pH readings tended to vary as we moved away from the New River Lagoon. The pH readings were most base in and near the lagoon. Test samples became more acidic the farther away from the lagoon they were taken. This is because all of the agricultural fields are farther from the lagoon and any run-off from those fields must first travel through drainage ditches and streams. By the time water reaches the lagoon, the lower levels of pH will already be diluted. The data collected strongly confirm this theory by showing more base readings closer to the lagoon and more acidic readings farther away from the lagoon.

Comparison of the pH level taken in 2007 by McMaster Fellow Spiro Mavroidis (2008) and the pH level taken this year shows that the pH level has become more base in most places in the last year. Irish Creek stayed the same, Bergen's Creek became more base by two tenths (0.2), Ram Goat Creek became more base by three and a half tenths (0.35), Harry Jones Creek became more base by four tenths (0.4), and the mouth of Irish Creek became more base by five tenths (0.5).

REFLECTION

My results do not have an immediate impact on Belize. Had the test results found increased acidity in the streams, then my information would have had more immediate impact. However, I was able to get test results to establish a baseline data set. This contribution will be helpful in comparing future test results for changes in the pH level. Because of my results, anyone who tests the pH level of the water will quickly and easily be able to see if there has been a change in the pH level.

Regardless of the impact I had on the people of Belize, I was able to learn quite a lot from them. Even though my particular project was not related to education, as an education major I gained a better understanding of the education system just from listening to the Belizean school teachers talk.

The partners in Belize, such as Ivan Gillett and Programme for Belize, were very easy to work with and appreciated our help. They were also patient with us when our knowledge of subjects was lacking. I will always remember and appreciate how well they treated us. They were fantastic.

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