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| Water Quality of the Sangamon River |
| Belize 209-HH |
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| **4/16/2014** |

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**Introduction**

 The purpose of my research is to discover if the Sangamon River is relatively healthy throughout different parts of the river. Before beginning the testing, it is important to identify what the definition of healthy is being used. According to dictionary.com, healthy means “Prosperous or sound” (“Healthy”). What is my definition of a prosperous river? My definition of a prosperous river is a river that has normal pH levels, hardness levels, and ammonia level throughout different parts of it.

The Sangamon River is a large river located in central Illinois. It runs through many different parks, under bridges, and even through nature reserves. The Sangamon River is very accessible to people, especially those who want to partake in fishing. The Sangamon River is approximately two hundred six miles long (“Illinois Rivers and Lakes Fact Sheets”). The Sangamon River has many tributaries that flow into it, and it passes by a few different lakes and ponds. According to Illinois Rivers and Lakes Fact Sheets, it says that “Salt Creek and South Fork are the largest tributaries of the Sangamon River. Lake Decatur is the only lake located directly on this river. Springfield and Decatur are situated along this river” (“Illinois Rivers and Lakes Fact Sheets”). There are also many different types of organisms that call the Sangamon River their home.

In this experiment, pH levels, hardness levels, and ammonia levels are the primary variable of focus. The first of these is pH. According to “The Final Frontier of pH and the Undiscovered Country Beyond,” it says “The pH scale is based on the ionic product of water, Kw =[H+]x[OH-]. We used Kw [in a reversed way] to calculate the number of undissociated H2O molecules required by this equilibrium constant to yield at least one of its daughter ions, H+ or OH- at a given pH” (Bal, Kurowska, and Maret). A solution that has a higher concentration of hydrogen ions will be acidic or have a pH less than seven. A solution that has a higher concentration of hydroxide ions will be basic or have a pH greater than seven. The next variable is hardness. According to Aquarium Online, carbonate hardness tests “…the carbonate and bicarbonate extent contained in a sample of water” (Aquarium Online). Carbonate hardness also plays a role with the health of plants in and around the water of the river. According to Aquarium Online, it says that “A low Carbonate Hardness usually has a negative effect on the growth of plants. While a strong Carbonate hardness (around 100ppm) has a positive effect” (Aquarium Online). The last variable of interest is ammonia. The presence of too much ammonia can be dangerous. According to Hari and Neeraja, they say that “Ammonia is toxic to living animals and produces several biochemical and physiological changes at cellular level when present in higher concentration” (Hari and Neeraja). An increase in ammonia in rivers could be, according to Zimmer, Brauner and Wood, caused by “…ammonia transport across the skin of adult rainbow trout” (Zimmer, Brauner, and Wood).

Throughout this experiment, three different locations where used to increase the distance between samples. If any of the pH levels, hardness levels, or ammonia levels of the Sangamon River are either too high or too low, the balance of the ecosystem could be thrown off. However, the environment shifts its equilibrium to counteract the non-ideal conditions. This is why I predict that the pH levels, hardness levels, and ammonia levels of samples from Carpenter Park, Wheeland Park, and Irwin Bridge are not significantly different from one another. The alternative, however is that the pH levels, hardness levels, and ammonia levels of the fifteen samples from Carpenter Park, Wheeland Park, and Irwin Bridge are significantly different.

**Materials**

* 45 Zip Lock Bags
* 4 Large Plastic Containers
* 3 Test Tubes
* Test Tube Rack
* 3 Disposal Cups
* 1 Aquarium Pharmaceuticals pH Test Kit
* 1 Aquarium Pharmaceuticals KH Carbonate Hardness Test Kit
* 1 Aquarium Pharmaceuticals Ammonia NH3/NH4+ Test Kit
* Stopwatch
* 2 Pipettes
* Metal Bucket
* Permanent Marker

**Method**

 I decided to conduct my research at three different locations along the Sangamon River. I started collecting my samples on Sunday, April 13th. The first location was at Carpenter Park towards the northern side of Springfield, Illinois. Before arriving at Carpenter Park, my father, Dale Webb, wrote the sample number on each bag. Once arriving to the site, I brought a plastic container filled with the correctly labeled bags down to the bank of the river. Using random sampling techniques, I obtained fifteen samples from the river. After filling the bags, I loaded them back into the plastic container, left the first site and headed for the second site.

 The second location was at Wheeland Park in Riverton, Illinois. Before unloading the supplies, my father wrote the sample number on each bag. Once that was finished, I unloaded supplies and headed down to the river. I filled each bag in order until each bag was filled with enough water. I, again, used random sampling techniques to obtain fifteen samples from the Sangamon River. Once I filled the bags, I packed my supplies up, left the second site and headed for the third and final site.

 The third and final location was located by Irwin Bride just outside of Cantrell, Illinois. On the drive over, my father labeled the sample number on each bag. Once arriving at the site, I unloaded my supplies and went down to the bank of the river. I filled each bag with water from the river. I used the same sampling technique as I did at the other two sites to obtain fifteen samples from the Sangamon River. Once all of the bags were filled, I packed all of my supplies away, left the final location and headed home.

 On Monday, April 14th, I started testing my samples collected from the previous day. I used all three testing kits from Aquarium Pharmaceuticals, which included: pH test kit, KH carbonate hardness test kit, and ammonia NH3/NH4+ test kit. I tested each sample with all three tests before moving onto the next sample. I used the pipette to put five milliliters of each water sample into each test tube. I then started the ammonia test first, due to it being the lengthiest of all three tests and used the instructions from inside of the box to properly conduct the test. I added eight drops from the first bottle, shook the test tube, added eight drops from the second bottle, vigorously shook the test tube for five seconds and finally waited five minutes to read the results. The next test ran was the KH carbonate hardness test. While the ammonia test was running, I started the KH carbonate hardness test. I added a drop, shook the test tube, added a drop, shook the test tube and repeated this process until the color of the solution turned from blue to yellow while keeping track of the number of drops required to do so. Finally, I conducted the pH test. I added three drops of the pH solution, shook the test tube, and compared the results to the color-coded card provided in the box. I tested the samples from Carpenter Park first, and then I tested samples from Irwin Bridge. While conducting those tests, my father helped set up and run most of the tests on samples from Wheeland Park. I recorded the results after each individual test until all tests where completed.

**Results**

 At the first location, Carpenter Park, each sample was analyzed and recorded. For all sample except 1, 3, 6, and 8, the pH was 7.6. For samples 1, 3 and 8, the pH was 7.5. For sample 6, the pH was 7.4. The hardness of each sample consecutively is: 161.9 ppm, 179 ppm, 179 ppm, 179 ppm, 161.1 ppm, 196.6 ppm, 179 ppm, 179 ppm, 179 ppm, 161.1 ppm, 179 ppm, 179 ppm, 161.1 ppm, 196.6 ppm and 179 ppm. The ammonia concentration found in the river was consecutively: 0.05 ppm, 0.15 ppm, 0 ppm, 0.2 ppm, 0.25 ppm, 0.15 ppm, 0.2 ppm, 0.15 ppm, 0.1 ppm, 0.15 ppm, 0.25 ppm, 0 ppm, 0 ppm, 0 ppm and 0.15 ppm.

 At the second location, Wheeland Park, the samples were analyzed and then recorded. For all fifteen samples taken at this site, the pH levels stayed at a constant 7.6. The hardness of each sample consecutively is: 143.2 ppm, 143.2 ppm, 143.2 ppm, 125.3 ppm, 125.3 ppm, 125.3 ppm, 125.3 ppm, 125.3 ppm, 161.1 ppm, 143.2 ppm, 143.2 ppm, 125.3 ppm, 143.2 ppm, 125.3 ppm and 125.3 ppm. The concentration of ammonia found in the river was consecutively: 0.25 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0.25 ppm, 0 ppm, 0.25 ppm and 0.25 ppm.

 At the third location, Irwin Bridge, the samples were analyzed and then recorded. For all fifteen samples taken at this location, the pH levels stayed constant at 7.6 except for samples 13 and 15, which held constant at 7.5. The hardness of each sample consecutively is: 179 ppm, 143.2 ppm, 143.2 ppm, 161.1 ppm, 143.2 ppm, 179 ppm, 179 ppm, 161.1 ppm, 143.2 ppm, 161.1 ppm, 143.2 ppm, 161.1 ppm, 179 ppm, 179 ppm and 179 ppm. The concentration of ammonia found consecutively is: 0.25 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0 ppm, 0.25 ppm, 0.13 ppm, 0.2 ppm, 0.1 ppm, 0.2 ppm, 0 ppm, 0 ppm, 0.25 ppm, 0.2 ppm and 0.1 ppm.

**Conclusion**

 Out of all the things tested, which were pH, KH carbonate hardness and ammonia, there was a slight difference between the results. However, that does not mean that they were significantly different from one another. As the results show, the pH samples for each individual location were mostly the same number. There were only a few samples that varied from the average pH value of 7.6. This could possibly occur because there was nothing that would affect the pH value between locations. It must have been a more secluded area with little chance of being exposed to pollutants. For Carpenter Park, the median pH value was 7.600. Twenty-five percent have values of 7.500 and under. Seventy-five percent have values of 7.600 and above. For Wheeland Park, the median pH value was 7.600. Twenty-five percent have values of 7.600 and under. Seventy-five percent have values of 7.600 and above. For Irwin Bridge, the median pH value was 7.600. Twenty-five percent have values of 7.600 and under. Seventy-five have values of 7.600 and above. Throughout all three locations, none of the samples were missing or could not be tested. According to a statistical analysis done over my results suggests that the pH values are not significantly different; however, these pH values are close to being significantly different. The p-value was equal to 0.100 (p=0.100).

 For the KH carbonate hardness test, hardness values varied a great deal from sample to sample in each location. Not only did hardness values vary from sample to sample at each location, but they also varied greatly from location to location. The most of the number of drops required to complete the test was seven to ten drops, which equates to 125.3 ppm to 179 ppm. This could be accounted for by the different types of organisms that live in the river such as different types of snails. For Carpenter Park, the median hardness value is 179.000 ppm. Twenty-five percent have values of 161.100 ppm and under. Seventy-five percent have values of 179.000 and above. For Wheeland Park, the median hardness value is 125.300 ppm. Twenty-five percent have values of 125.300 ppm and under. Seventy-five percent have values of 143.200 ppm and above. For Irwin Bridge, the median harness value is 161.100 ppm. Twenty-five percent have values of 143.200 ppm or under. Seventy-five percent have values of 179.000 ppm and above. None of the samples were missing; however, there is a statistically significant difference of hardness values between locations. The p-value was less than or equal to 0.001 (p=<0.001). When comparing Carpenter Park to Wheeland Park, there was a q-value of 7.234, and it has a p-value less than 0.05. When comparing Carpenter Park to Irwin Bridge, there was a q-value of 2.585, and it has a p-value greater than 0.05. When comparing Wheeland Park and Irwin Park, there was a q-value of 4.649, and it has a p-value greater than 0.05. This data means that it provides moderate evidence against my null hypothesis.

 For the ammonia test, values slightly varied from sample to sample. However, the ammonia values from all locations stayed within the same range, which is from 0 ppm to 0.25 ppm. The amount of ammonia could vary depending on organisms living in the river, possibly pollution from human negligence or runoff from farmers. For Carpenter Park, the median ammonia value is 0.150 ppm. Twenty-five percent have values of 0.000 ppm. Seventy-five percent have values of 0.200 ppm or above. For Wheeland Park, the median ammonia value is 0.250 ppm. Twenty-five percent have values of 0.000 ppm. Seventy-five percent have values of 0.250 ppm or above. For Irwin Bridge, the median ammonia value is 0.200 ppm. Twenty-five percent have values of 0.000 ppm. Seventy-five percent have values of 0.250 ppm or above. When dealing with ammonia concentrations, my samples are not statistically different from each other. The p-value is equal to 0.242 (p=0.242).

 These findings are somewhat conclusive with my null hypothesis. When talking about pH, my hypothesis was correct in saying that the pH levels would not be significantly different throughout each location. My hypothesis was incorrect, however, when it comes to hardness because hardness is significantly different throughout each location. When dealing with ammonia, my hypothesis was correct in saying that the ammonia levels would not be significantly different throughout each location. These tests were fairly accurate; however, accuracy could have been increased with a couple of different ideas. If I had access to more expensive testing equipment, I could have gotten more accurate, quantitative data. If I had more chemicals available, I could have increased my sample size. With an increase in sample size, accuracy is bound to increase. A variety of more tests are required to truly find the overall quality of water in the Sangamon River.

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