**Water Qualities of Woodstock Pond and the Raquette River Based on Biodiversity of Benthic Macroinvertebrates**

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**Abstract:**

The purpose of this project was to study the water qualities of Woodstock Pond and the Raquette River based on the biodiversity of the two. Benthic Macroinvertebrates, which are common bioindicators, were collected from each location using a “jab and scoop” technique. They were then identified, and the data was recorded and analyzed. Woodstock Pond was found to have a group HBI score of 3.7 and a group SBI score of 5.6. The Raquette River was found to have a group HBI score of 2.4 and a group SBI score of 3.4. The null hypothesis that the water quality and biodiversity of both locations would be the same was accepted, based on the p-values for the HBI and SBI tests being larger than .05. The hypothesis that Woodstock Pond would have a better water quality was supported by the raw data, but the p-values resulting from the t-test showed no significant differences.

**Introduction:**

Improving water quality is an important battle in terms of helping the environment. In order to improve the water quality, one must know how to test it. This can be done using bioindicators, such as Benthic Macroinvertebrates (Perry, 2008). These bioindicators have varying tolerances to pollutants. Some species, such as Right-Handed Snails and Mayfly Nymphs, are very sensitive to pollutants. Other species, such as Left-Handed Snails and Rat-tailed maggots, are very tolerant of pollutants (Custodio, 2018). These species can be used to perform tests that give quantitative data to water quality, such as Hilsenhoff’s Biotic Index (HBI) and Simpson’s Biodiversity Index (SBI). The HBI test uses the pollutant tolerances of different species, and the richness of these species in a certain environment to quantify biodiversity and water quality. The SBI test uses a similar method and focuses more on the diversity of the species as opposed to richness (Barbone, 2012). These tests are integral in determining water quality. This study focused on identifying and comparing the water qualities and biodiversity of Woodstock Pond and the Raquette River in Potsdam, NY. The null hypothesis states that the water qualities of these two bodies of water are identical. However, since the Raquette River has some movement to it, it would be predicted that the Raquette River has a better water quality rating than Woodstock Pond.

**Materials and Methods:**

To determine the water quality of both Woodstock Pond and the Raquette River, samples were taken from both areas to identify several specific biological indicators. During the first week, on September 26th, 2018, samples were taken from Woodstock Pond on Clarkson University’s campus in Potsdam, NY. On this day, the water temperature was measured to be 21\* C, and the air temperature was measured at 19\* C. Experimenters wore chest waders and entered the Pond with a dip net. A “jab and scoop” method was used to obtain benthic macroinvertebrates from the bottom of the pond. The contents of the dip net were then emptied onto a tray, and one to two inches of water was poured over the contents to makes the organisms easier to see. The organisms were then removed from the tray and placed on a petri dish. Once on the petri dish, the organisms were identified using The Taxonomic Key to Macro Invertebrates. Data was recorded, and the organisms were returned to the water. A total of 5 samples were taken from Woodstock Pond, and multiple bioindicators were identified in each sample. The same procedure was repeated the following week on October 3rd, 2018, at the Raquette River in Potsdam, NY. On this day, the water temperature was measured at 18\* C, and the air temperature was measured at 21\* C. The data was analyzed using a two tailed t-test to find a p-value that would show if there was a significant difference between the water quality and biodiversity of Woodstock Pond and the Raquette River.

**Results:**

**Table 1: Air and Water temperatures that were taken at each location on the day of data collection.**

|  |  |  |
| --- | --- | --- |
|  | **Air Temperature (\*C)** | **Water Temperature(\*C)** |
| **Woodstock Pond** | **19** | **21** |
| **Raquette River** | **21** | **18** |

**Table 2: Calculated HBI Score for Woodstock Pond, Individual Data**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pollution Tolerance Group**: | | | **# of Species:** | **Multiplication Factor:** | **Index Value:** |
| 1 | | | 4 | 4 | 16 |
| 2 | | | 2 | 3 | 6 |
| 3 | | | 0 | 2 | 0 |
| 4 | | | 0 | 1 | 0 |
| **Species Total:** | | | 6 |  | 22 |
| **Biotic Index:** | 3.7 |

**Table 3: Calculated HBI Score for Raquette River, Individual Data**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pollution Tolerance Group**: | | | **# of Species:** | **Multiplication Factor:** | **Index Value:** |
| 1 | | | 1 | 4 | 4 |
| 2 | | | 2 | 3 | 6 |
| 3 | | | 0 | 2 | 0 |
| 4 | | | 2 | 1 | 2 |
| **Species Total:** | | | 5 |  | 12 |
| **Biotic Index:** | 2.4 |

**Table 4: Calculated SBI Score for Woodstock Pond, Individual Data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species:** | | | **# of Individuals:** | **n(n-1)** |
| Stonefly Nymph | | | 1 | 0 |
| Rifle Beetle Larva/Adult | | | 2 | 2 |
| Mayfly Nymph | | | 7 | 42 |
| Right-Handed Snail | | | 5 | 20 |
| Dragonfly Nymph | | | 4 | 12 |
| Damselfly Nymph | | | 3 | 6 |
| **Biotic Index:** | 5.6 |

**Table 5: Calculated SBI Score for Woodstock Pond, Individual Data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species:** | | | **# of Individuals:** | **n(n-1)** |
| Right-Handed Snail | | | 6 | 30 |
| Cranefly Larva | | | 1 | 0 |
| Dragonfly Nymph | | | 2 | 2 |
| Left-Handed Snail | | | 1 | 0 |
| Aquatic Worms (Segmented) | | | 1 | 0 |
| **Biotic Index:** | 3.4 |

**Table 6: Calculated Class HBI and SBI Scores and T-Test Results for each test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Raquette:** | | **Woodstock:** | |
| **Group:** | HBI: | SBI: | HBI: | SBI: |
| 1 | 3.7 | 5.6 | 2.4 | 3.4 |
| 2 | 3 | 5.13 | 3.5 | 1.33 |
| 3 | 3.3 | 4.36 | 2.8 | 7.86 |
| **P-Value:** | 0.328634 |  |  | 0.709709 |

The data collected shows that based on raw, individual scores alone, that the Raquette River would have a higher water quality, and more biodiversity than Woodstock Pond. However, once a two tailed t-test was performed, this was not the case. The P-value for the difference of HBI scores was 0.329 and the P-value for the difference of SBI scores was 0.710. These number are both greater than .05, there is no significant difference in the two areas.

Notes: Tables outlining whole group data more specifically should be included if data is available to students.

Make sure tables are labeled on top, and figures are labeled on the bottom.

**Discussion:**

The results of this lab showed that Woodstock Pond has a higher water quality than the Raquette River when using the raw data of Hilsenhoff’s Biotic Index and Simpson’s Biodiversity Index seen in tables 2-5 to rate the quality. However, once a two-tailed t-test was performed, as seen in table 6, the results showed that there was no significant difference in the water quality or biodiversity of the two locations. This means that we fail to reject the null hypothesis that states that there is no significant difference between the water qualities and biodiversities of the two bodies of water. Based on this information, I would also have to reject my hypothesis that the Raquette River would have a higher water quality rating than Woodstock Pond. I had originally hypothesized that the Raquette River would have better water quality because it has some movement, which I though would cause less pollutant build up. This hypothesis was not even supported by the raw data and was shown to be inaccurate by the analyzed data as well. We found a similar amount of species at each location, but Woodstock Pond had a larger number of organisms overall, and this could have affected the overall outcome of the data analysis. Our group scores for the Raquette River were higher than the rest of the classes scores and our score for Woodstock Pond fell right in the middle of the class data. Based on this information, it is hard to determine if our data as well as the class data, is reliable. There was a large range of SBI scores at Woodstock Pond, ranging from 1.33 to 7.86. This large of a range makes it very difficult to trust the class data, as the range shows two very different outcomes. If I were to repeat this experiment again, I would take more than five samples from each location. I think that so few samples did not allow for the maximum number of organisms to be found, which would cause error in the analysis of the data. Another potential source of error could be misidentification of species. If a species was misidentified using the taxonomic key, it is possible that the entire data set could have been affected. For example, if a pollutant tolerant species was falsely identified as a pollutant intolerant species, this information could have caused a location to have a higher water quality and biodiversity rating than it should have.

Notes: Make sure the discussion is an analysis of results, not simply a restatement of raw data.

**Conclusion:**

Overall, this study of Benthic Macro Invertebrates at Woodstock Pond and the Raquette River turned out to be unsuccessful in my opinion. Sometimes no significant differences in data can be a good thing, as it can provide insight. However, in this case, I feel that the insignificance occurred because not enough data was collected. If more organisms had been found at each location, more accurate HBI and SBI scores would have been calculated, and a more significant difference might have occurred. Although the results of the experiment were unsuccessful, I still think that this experiment was successful in terms of gaining field experience. I learned new techniques on how to collect samples, and new ways to analyze data. I also learned about the water qualities and biodiversity of Woodstock Pond and the Raquette River, two bodies of water that play an important role in the ecosystem around Clarkson University. In conclusion, this experiment, although unsuccessful in terms of results, was a success in terms of learning and applying new skills to the area around us.

Notes: This is more of a personal conclusion as opposed to a conclusion of the project. This is acceptable, but not the only approach that students can take.

Based on the rubric, some students may have conclusion as part of the discussion. Try to have separate sections if possible.

**References:**

Barbone, E. (2012). Linking classification boundaries to sources of natural variability in transitional waters: A case study of benthic macroinvertebrates. *Ecological Indicators*, *12*(1).

Custodio, M. (2018). Quality of the aquatic environment and diversity of benthic macroinvertebrates of high Andean wetlands of the Junín region, Peru. *The Egyptian Journal of Aquatic Research*, *44*(3).

Perry, W. B. (2008). Everglades restoration and water quality challenges in South Florida. *Ecotoxicology, 17*(7), 569-78.

Notes: Make sure references are listed in alphabetical order.