DOI

STREAM HEALTH ASSESSMENT BASED ON MACROINVERTEBRATE DIVERSITY

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ABSTRACT

Our study was done in Crooked Creek, Muddy Run, and Standing Stone Creek by collecting macroinvertebrates, measuring steam characteristics such as pH, oxygen content and temperature, and measuring the EPT% index. These streams showed three different stream types and areas. We found that Standing Stone Creek had the highest EPT% index followed by Crooked Creek and then Muddy Run. These macroinvertebrates also showed four different functional guilds. Muddy Run had the most species abundance but the fewest number of species while Crooked Creek and Standing Stone Creek were dominated by one species. Standing Stone had the most amount of individual organisms collected followed by Crooked Creek and then Muddy Run. Before the study was started, we assumed that Muddy Run would have the lowest stream health due to its location and visible pollution. We had assumed that Standing Stone and Crooked Creek would be similar in water quality and species richness and abundance due to their location and appearance of stream quality. A chi-square test proved that the difference in the EPT% index of Standing Stone and Crooked Creek from Muddy Run was significant. In conclusion, the stream health of Muddy Run was significantly worse than Standing Stone and Crooked Creek.

Key words: *EPT% Index, Species Abundance, Urbanization, Macroinvertebrates, Functional Guild*

INTRODUCTION

Waterways are extremely important ecosystems that carry a lot of ecological value. The health of waterways in our immediate areas not only affects human lives but impacts the lives of organisms within the waterway itself. Clean and healthy streams provide quality drinking water for humans and organisms and allow for recreational uses. For this study, our group wanted to test the EPT% Index in three different streams and see how they ranked. The three streams that we collected our samples from were Crooked Creek, Muddy Run, and Standing Stone Creek. We had hypothesized that the EPT% index at Muddy Run would be significantly lower than that of Standing Stone and Crooked Creek which would have higher EPT% indexes. We also looked at the functional guild of each macroinvertebrate that we found. The different functional guilds that we focused on were predators, scrapers, collectors, and shredders.

Muddy Run has the most urbanization around it and is the smallest of streams by width. Crooked Creek has the second most water flow and width. It also has some urbanization but less than Muddy Run. Standing Stone Creek is the highest water flow and the largest width. There is also less urbanization than in the other streams. The purpose of this study was to see how urbanization affects stream health and contributes to the macroinvertebrate abundance of these streams. These streams had a good distribution of these attributes which contribute to stream health.

A study done in Kansas City, Missouri, found that the EPT% index in urban areas was lower than in rural areas. This can be attributed to the rise of the human population in the area which leads to increased soil erosion, changes in hydrologic characteristics, and loading of contaminants associated with urban runoff due to urbanization. These changes in the stream were the main cause of degradation in the aquatic life which included the loss of fish and aquatic macroinvertebrate species which led to these species being replaced with more tolerant organisms. The results of the study stated that 217 macroinvertebrate taxa were collected while only 34 of these taxa were EPT. The EPT richness ranged from 1-14 across all study sites. The non-urban control sites had the highest EPT% each year of the study followed by the control storm sewer system site, then the transitional sewer site, and lastly the urban sewer site. This study shows how over time the transition from rural to urban areas of the stream greatly impacts the EPT richness of the stream and its overall health. (Poulton, 2019)

In another study in Hulu Terengganu, Terengganu used the EPT% index to see if the human and agricultural presence had an effect on macroinvertebrate type and abundance. An upstream site with little to no human/agricultural presence was sampled and a downstream site with human/agricultural presence near and upstream was also sampled for macroinvertebrates. The study concluded that upstream had more abundance and diversity of ETP (Ephemeroptera, Plecoptera, Trichoptera) and fewer pollution sensitive species whereas downstream had less diversity and abundance of ETP and more diversity and abundance of pollution sensitive species such as Chironomidae. This study concludes that the ETP% index can be used to determine if and how much pollution is present in waterways (Wahizatul, 2011).

FIELD SITE

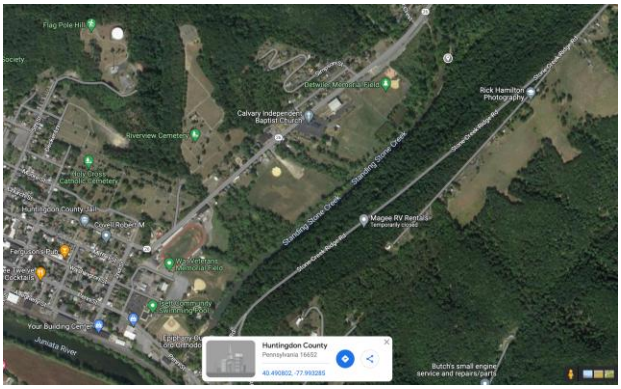

Figure 1. Aerial photo of where macroinvertebrate and water qualities were approximately collected from Standing Stone Creek.

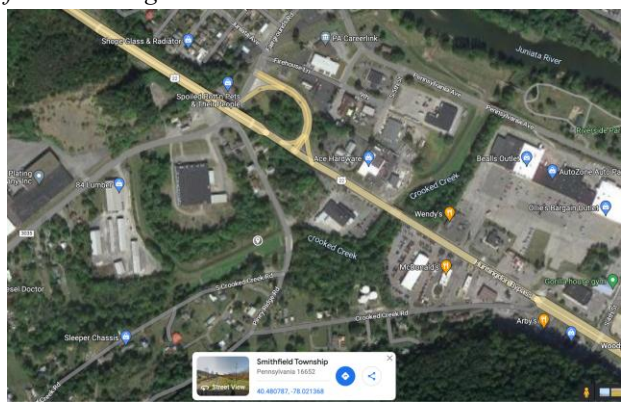

Figure 2. Aerial photo of where macroinvertebrate and water qualities were approximately collected from Crooked Creek.

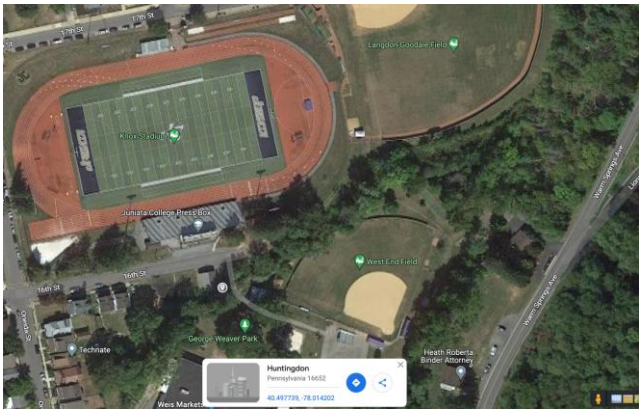

Figure 3. Aerial photo of where macroinvertebrate and water qualities were approximately collected from Muddy Run.

MATERIAL AND METHODS

The materials for testing water qualities included a pH reading device, a temperature reading device, and an oxygen content reader. These were taken at each of the three sites. For collecting macroinvertebrates, kick nets, three collection jars, and a sorting tub. At each of the three sites, 10 samples were collected randomly from the locations above. One individual held the kicknet while the other individual stirred up the stream bed roughly 1 meter by 1 meter in front of the net. After each sample was collected, it was carefully sorted in a tub and all visible macroinvertebrates were placed in one of the jars. Later in the lab, the macroinvertebrates within the three jars were carefully sorted, identified, and counted using a website.

RESULTS

	Temperature (C)	pH	O2 Content (mg/L)	Total Number of Individuals	PTI	EPT Index (%)
Crooked Creek	9	7.51	10.93	76	22	78.9
Standing Stone	9.1	7.24	10.83	98	23	86.7
Muddy Run	9.5	6.86	11.08	45	12	0

Table 1. Quantifications of the characteristics recorded for each field site.

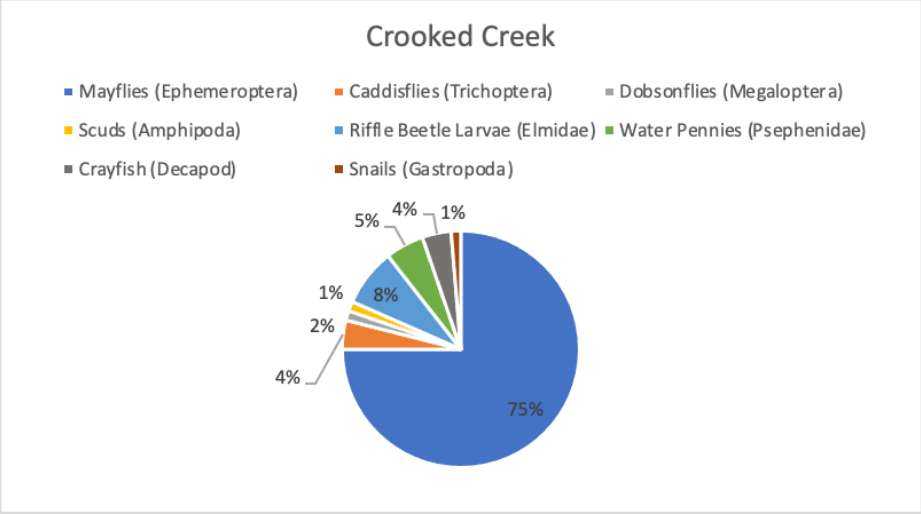

Figure 4. Chart displaying the proportion of different macroinvertebrates found at Crooked Creek.

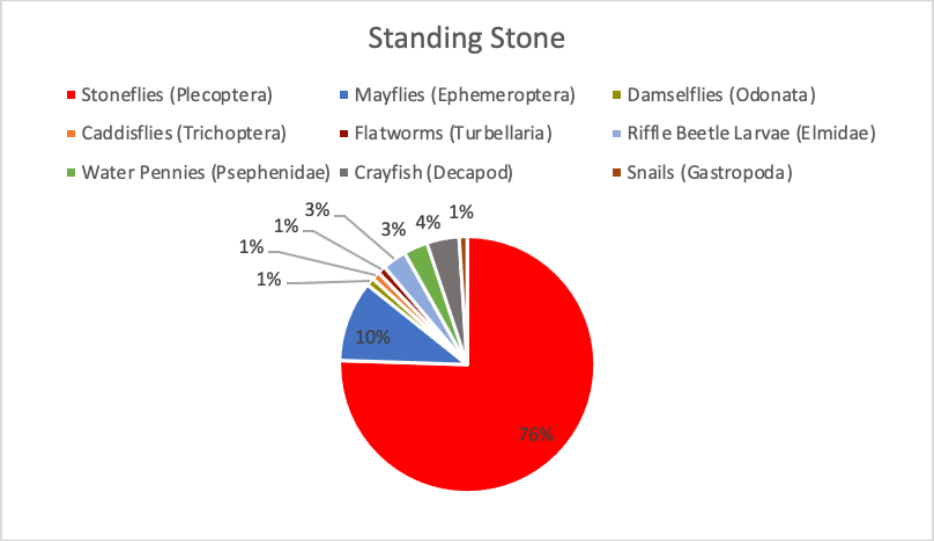

Figure 5. Chart displaying the proportion of different macroinvertebrates found at Standing Stone Creek.

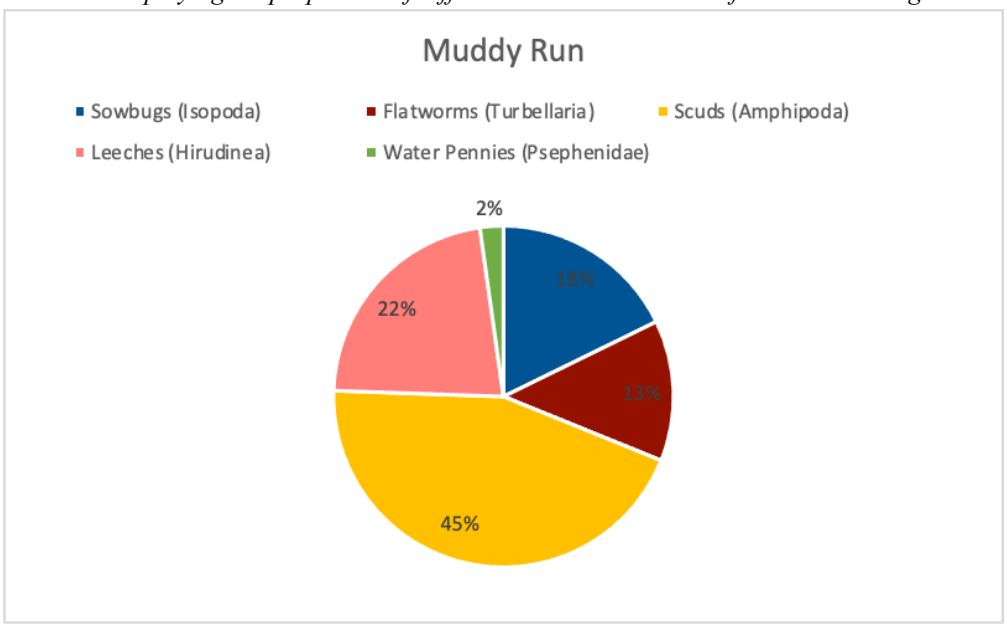

Figure 6. Chart displaying the proportion of different macroinvertebrates found at Muddy Run.

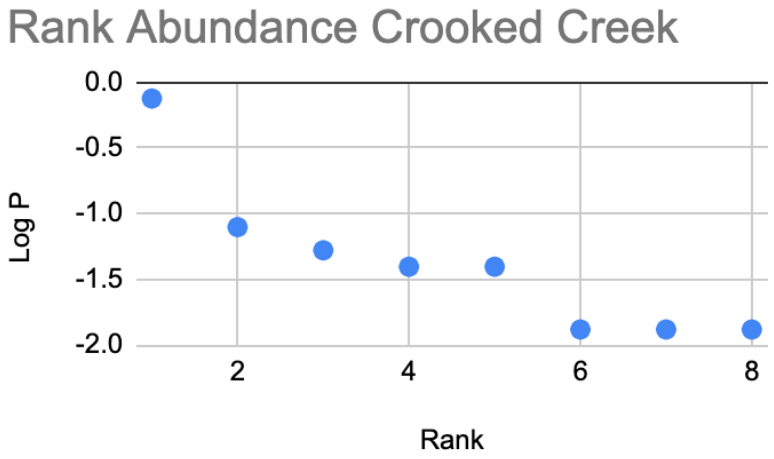

Figure 7. Graph displaying the rank of species (according to the number found at the field site) by the log of P (the proportion of total taxa that the individual species makes up) for macroinvertebrates collected from Crooked Creek.

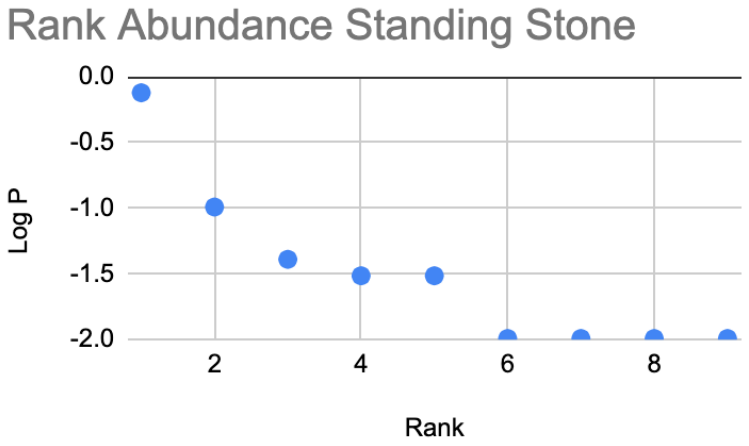

Figure 8. Graph displaying the rank of species (according to the number found at the field site) by the log of P (the proportion of total taxa that the individual species makes up) for macroinvertebrates collected from Standing Stone Creek.

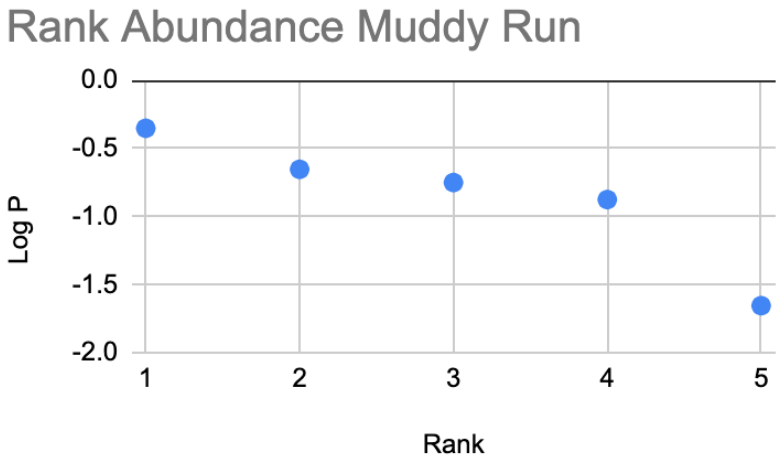

Figure 9. Graph displaying the rank of species (according to the number found at the field site) by the log of P (the proportion of total taxa that the individual species makes up) for macroinvertebrates collected from Muddy Run.

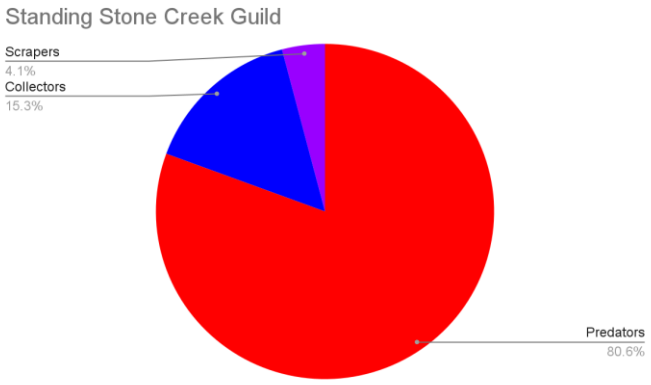

Figure 10. Chart displaying the proportion of taxa from Standing Stone that fall into each feeding guild.

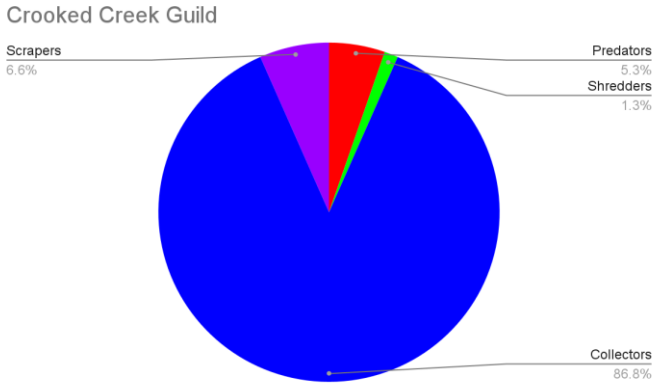

Figure 11. Chart displaying the proportion of taxa from Crooked Creek that fall into each feeding guild.

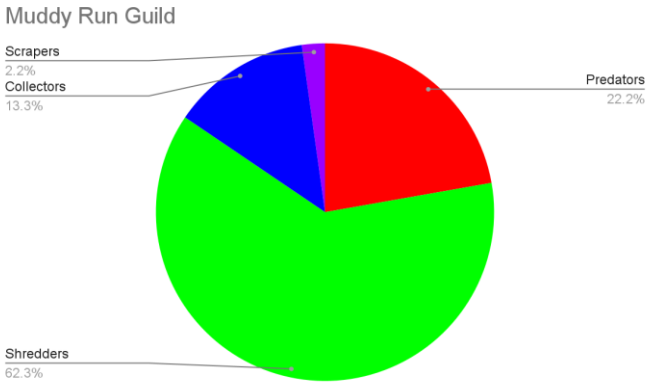

Figure 12. Chart displaying the proportion of taxa from Muddy Run that fall into each feeding guild.

	EPT Individuals	Non-EPT Individuals
Crooked Creek	60	16
Standing Stone	85	13

Muddy Run	0	45

Table 2. Count of taxa that qualify as EPT and Non-EPT at each field site.

To determine if there is a significant difference in the number of EPT individuals collected from Standing Stone and Crooked Creek compared to Muddy Run, a chi-square test of independence was performed using the values found in Table 2. The test produced a X^2 value of 112.14 and a p-value of ~0.000000.

DISCUSSION

Based on observations of taxa and stream characteristics of Standing Stone Creek, Crooked Creek, and Muddy Run, we can infer that the more rural streams (Standing Stone and Crooked Creek) are healthier than the urban stream (Muddy Run). Standing Stone and Crooked Creek had EPT Indexes of 86.7% and 78.9% respectively while Muddy Run had an EPT Index of 0%. These values tell us that the rural streams possess more macroinvertebrates that are critical for good stream health than the urban stream. The chi-square test that was performed on the count of EPT individuals at each stream produced a p-value of approximately 0.00000 (an extremely small value). At a 5% significance level, this p-value allows us to reject our null hypothesis, in which the rural and urban streams will have similar EPT indexes.

Not only does the EPT index provide an indication of stream health, but assumptions of stream health can be made based on other characteristics of the stream. The pH of a stream can be used to determine stream health. None of the streams studied possessed excessively acidic or basic waters; all of the pH values fell within a ±0.5 range from 7 (the standard pH of water). In general, more acidic water can lead to corrosion in the water which limits available food sources for organisms in the stream.

When comparing the proportion of different feeding guilds of each stream based on the pH of the streams, there are noticeable differences. The more basic streams (Standing Stone and Crooked Creek) possessed a much smaller proportion of shredder species than the acidic stream (Muddy Run). Shredders are organisms that feed on pieces of large organic matter such as the sowbugs and scuds found in Muddy Run. Other feeding guilds include collectors, predators, and scrapers. Collectors are organisms that consume small organic matter such as the mayflies and caddisflies that make up a large proportion of the species found in Crooked Creek. Predators are organisms that feed on other invertebrates in the stream such as the stoneflies and crayfish that make up a large proportion of the species found in Standing Stone. The final guild is scapers, which are organisms that scrape algae off of different surfaces in the stream such as water pennies and snails which were found in smaller proportions at all three streams (Lewis, 2014).

ACKNOWLEDGMENTS

We would like to acknowledge and thank Dr. Douglas Glazier for putting in the time and effort to guide and teach us this semester. We would also like to thank Teacher Assistant Conner Frey for helping us during the lab and Juniata College's Environmental Science and Studies Department for letting us borrow the supplies necessary to conduct the study.

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