The Effect of Substrate Size on Macroinvertebrate Distribution in Little Niagara

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Introduction

Our research objective was to investigate how rock substrate size influences macroinvertebrate species richness and abundance within Little Niagara Creek of the University of Wisconsin – Eau Claire campus.

A restoration project of Little Niagara took place during the construction of the university's new Davies Center in 2012. Rocks and sediment were added to the stream during this time to enhance habitat and increase stream flow (Knight 2012).

We predicted that "medium-sized" substrate would promote the greatest richness and contain the highest numbers of macroinvertebrates because the size of the interstitial spaces created would be large enough for organisms to find refuge from predators (e.g., crayfish), but not so large as to allow access to predators.

To test our predictions, we constructed wire mesh trays containing either small, medium, or large size rocks, placed them into Little Niagara Creek for 2-weeks, and then examined the macroinvertebrates that colonized them.

Methods

Step 1. We constructed 12 galvanized wire mesh trays that were filled with one of 3 rock substrate sizes: small (13 mm), medium (32 mm) or large (93 mm). Each size tray was replicated 4 times.

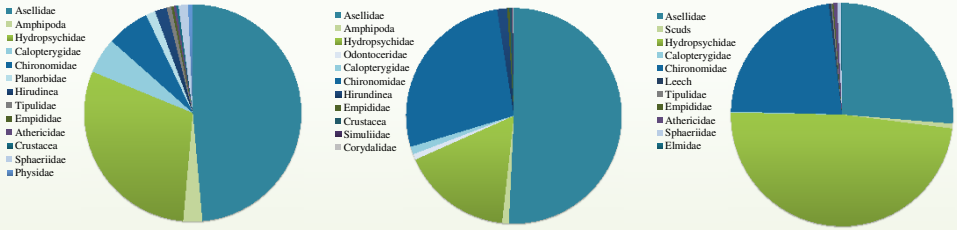
Step 2. Trays were placed at 2 sites in Little Niagara Creek having similar depth (42 cm), current (20 cm s^{-1}), and distance from shore.

Step 3. Trays were left in Little Niagara Creek from September 30 to October 14, 2014, to allow time for macro-invertebrates to colonize the substrates.

Step 4. Each tray's contents were screened to separate accumulated sediments and then benthic organisms were removed, sorted and identified.

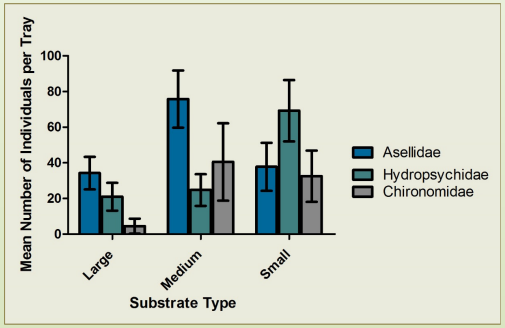
Step 5. Richness and abundance data were analyzed using one-way ANOVAs and Tukey's post-hoc comparison tests were used to determine differences.

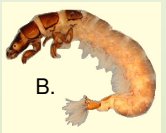
Results



Large Substrate | Medium Substrate | Small Substrate

Figure 1. Total numbers of individuals from each taxa found in the small, medium, and large substrate trays. Shannon's diversity (p= 0.14), taxonomic richness (p= 0.54), and abundance (p= 0.11) did not differ among substrata sizes. However, some taxa were found only on certain substrate sizes, specifically, Snails (Physidae and Planorbidae) were found only on large substrates, Riffle beetles (Elmidae) were found only on small substrates, and Caddisflies (Odontoceridae), blackfly larvae (Simuliidae) and Dobsonflies (Corydalidae) occurred only on medium substrates.





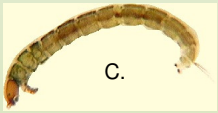


Figure 2. Mean (± SEM) of the three most abundant families from samples and what they look like: Asellidae (A), Hydropsychidae (B), and Chironomidae (C). Hydropsychidae were significantly more abundant on large as compared to small substrate sizes (p= 0.04), but all other comparisons were not different (p > 0.05).

Discussion

We initially hypothesized that taxonomic richness and abundance would be greater in medium-sized substrate trays. Our data showed no differences in taxonomic richness or diversity; however, we did find that hydropsychid caddisflies preferred large substrate size over small, and some taxa were present only on certain substrate sizes. Snails were found only on large substrates, and blackfly larvae (Simuliidae), Dobsonflies (Corydalidae), and another caddisfly (Odontoceridae), occurred only on medium substrates. Our work collaborates other work showing substratum size preference can vary among taxa (Reice 2012). We recommend that if the UW-Eau Claire were to continue restoration of Little Niagara Creek, a consideration of substrate size distribution should be incorporated into planning to better accommodate a diversity of stream organisms.

References

Knight, J., (2012). UW-Eau Claire's Little Niagara Creek being restored to its natural beauty. *The Leader Telegram, front page.* Retrieved from http://www.leadertelegram.com/news/front_page/article_8cd58ace-e373-11e1-8017-0019bb2963f4.html

Reice, S. R. (1980). The role of substratum in benthic macroinvertebrate microdistribution and litter decomposition in a woodland stream. *Ecology, 61*(3), 580-590. doi: 10.2307/1937424