MACROINVERTEBRATE STUDY: THE RESULTS

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(Graphics from Cornell University "Common Freshwater Invertebrates in New York State")

In the June issue of the BRASS newsletter I gave some background information about macroinvertebrates. Most of these macroinvertebrates in the Boquet are insect larvae, especially of mayflies and stoneflies. They are important to the ecology of the river because they are the most important way energy moves through the system, and they are the major source of food for fish.

BRASS is concerned about these aquatic insects because the heavy load of sediments the Boquet seems to carry might have an effect on the macroinvertebrates and, in turn, on the fish. The sands and silts can cover the bottom of the river, filling in the spaces between the rocks where the macroinvertebrates live. This may kill them directly, or interfere with their ability to feed or damage their gills.

To study whether the sediments are affecting the macroinvertebrates, we set up an experiment by picking pairs of sites where everything about the sites was as similar as possible except for the amount of sediments. BRASS measures sediments by determining the percentage embeddedness, i.e. the percent depth that rocks in the river channel are covered by the finer sediments. The design was to collect insects at these paired sites then compare the macroinvertebrate communities. When I wrote the June newsletter, we were collecting our samples. Our goal was to sample six sites; this would give us 21 samples and over 2100 individual specimens. After the sampling was completed, I identified the individual specimens.

Unfortunately, Mother Nature put a little crimp in our design when she delivered up the big flood in January. The rain and snow melt combined to give the largest river discharge since the US Geological Service began monitoring the river in 1925. Not surprisingly, all that water rearranged the river a bit. When BRASS measured the embeddedness in August and September, they found that although the average amount of embeddedness for the river as a whole didn't change very much, some of the individual sites changed a lot. Especially, by some quirk of fate, those we picked for the study.

Two site pairs–which from ‘93 to ‘95 had been very different–now showed almost identical levels of embeddedness. And, in our third pair, the levels of embeddedness reversed themselves; the site which had been previously low was now highly embedded, while the one that was high was now low.

To interpret our study data, I started with a list of how many of each kind of macroinvertebrate was found at every site. I wanted to see if there was any sort of pattern whereby certain species were present at some sites and not others, and whether this could be related to the embeddedness. Although the species present at the sites differed from one another, I could not detect any pattern to the presence or absence, or relative abundances, of any species or groups of species. I had expected this. A river is so complex and involves so many different geological, chemical, physical and biological factors, along with so many different species of macroinvertebrates, it would be unlikely that we could turn up a relationship in a study as small as ours.

So, I turned to a device ecologists use for situations like this: an index. An index is a number calculated from the data that summarizes some aspect of the data. The good thing about an index is that it gives you a way of summarizing the whole page of data into single number. You can then compare this number with the number from other sites.

Comparing the indices (we used several) with the embeddedness data was disappointing. No patterns showed up. I tried relating it to both the pre-flood embeddedness figures and the post-flood figures. Perhaps there is no relationship between embeddedness and the macroinvertebrates. Or, maybe there is and I just didn't find it. Maybe the flood and the rainy spring upset the insect communities so much that the river wasn't normal during the study. This seemed unlikely since macroinvertebrates are known to recover fairly quickly. Or, just maybe, the whole river is so embedded that the macroinvertebrates were affected at all the sites.

So, could our data tell us if this is what was happening? The first clue came from two different indices; one was the species richness index. It is a simple index representing the number of species in the sample. For our six sites, the number ranged from 8 to 19. By itself that doesn't tell you much, but when you compare it to work done by other researchers on other streams, it does. These numbers are low. In fact, according to the NYS Department of Environmental Conservation's (NYSDEC's) standards, these sites on the Boquet are considered to be severely to moderately impacted.

Now this species richness index is very simple to understand, but there are some flaws in it. A better and more reliable index is one known as the Shannon-Weiner. It comes from communications engineering theory and tells how much diversity there is in the sample. Values for our sites varied from 1.00 to 2.21. Compared to other rivers in New York, these numbers are low and most of the sites are considered severely impacted.

The indices tell us that these sites don't have as many species or as much diversity as you would expect. But why? These indices don't tell us. They are general indices and tell us that something is impacting the biological community, but not what it is.

To get an idea of what the problem is, we can make use of two other indices. These are not general indices. Because one of the most common problems in rivers is the presence of sewage, scientists have worked out indices to indicate its effect. The most simple of these is known as the EPT index. It is the percentage of the sample composed of members of three orders of insects: the mayflies (Ephemeroptera), the stoneflies (Plecoptera), and caddisflies (Trichoptera). All these orders are hurt by sewage pollution, so the higher the percentage, the less indication of sewage. Our six sites ranged from 87 to 100%. On other rivers, NYSDEC considers any number above 10% to be "non-impacted." We are obviously way above that, therefore our aquatic insects are not impacted by sewage.

Another more sophisticated index is the biotic potential index. This assigns a tolerance to each individual and gives an average for all the individuals in the collection. A higher score indicates more sewage pollution. Our sites ranged from 1.39 to 3.98. Anything less than 4.50 is considered to be "non-impacted."

So, whatever is causing the impact that shows up in the two general indices, the EPT and biotic potential indices tell us it is not sewage pollution. What is the culprit? Unfortunately, scientists have not yet come up with reliable indices to show other types of pollution.

We don't know of any other type of pollution in the Boquet, such as acids or toxic metals, that would affect all these locations. By the process of elimination, sediments is left as the most likely cause of the impact indicated by the general indices. It doesn't prove it, but then science never proves anything. It always works by eliminating all the possibilities except one.