Essex High School

Changes in Stream Health Indicated by Macroinvertebrates

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Introduction

We have been experiencing “The Hottest Year on Record” and would like to know if these temperatures have affected our local Vermont streams. There are many different things to consider and observe in order to determine that a stream is changing. We decided to look at macroinvertebrates.

Macroinvertebrates are bottom dwelling animals without a backbone that are able to be seen by the naked eye and are an important link in the food web as well as insight into stream health. High diversity as well as high population of macroinvertebrates are both indicators of a healthy stream. The stream temperatures often cause changes in the biodiversity of the stream, due to the levels of dissolved oxygen, nitrogen, and phosphorus. We hypothesized that the stream temperatures have been increasing with the increasing air temperatures and therefore macroinvertebrate population and diversity has been decreasing.

Objective:

To determine the relationship between temperature and macroinvertebrates.

Methods

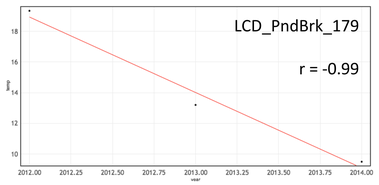
We took temperature data collected by the iButtons from Pond Brook, South Branch, and Potash dating back to 2012. We averaged the temperatures per year per stream in order to easily see if and how the temperatures change from year to year. We calculated 95% confidence intervals for the temperatures of each year to prove that temperatures were, in fact, changing. Although some intervals for some years overlapped, the years where testing began and testing ended did not overlap, indicating that the temperatures were changing.

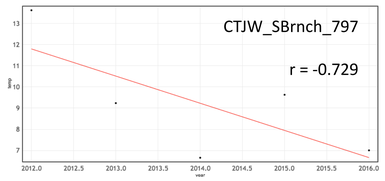
We looked at both macroinvertebrate population and diversity for an accurate representation of the affects that temperature may have on macroinvertebrate levels. For macro population, we took the sum of the total number of macroinvertebrates found during team collection each year. However for macro diversity, we totaled the number of species found in the stream, not how many of each species were found.

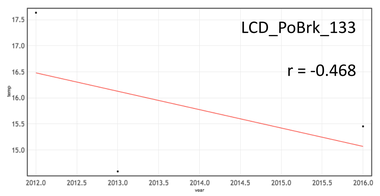
We next aligned the years where temperature data was taken with the years that macroinvertebrates were collected in order to see the relationship between the variables.

Results

Temperature vs Time

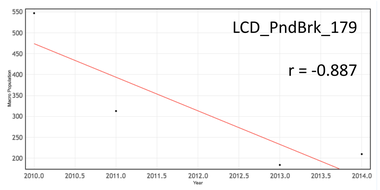


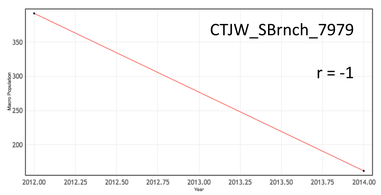


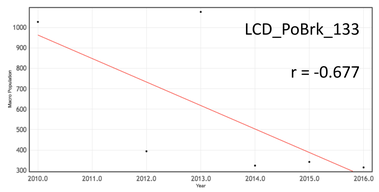


These graphs indicate that as the years increase the water temperature decreases. This is further proven by our 95% Confidence Intervals.

Macro Population vs Time

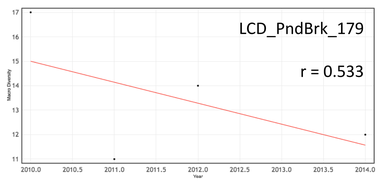


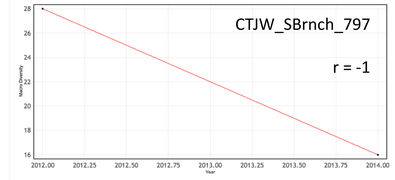


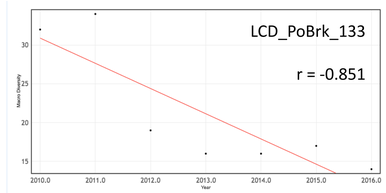


These graphs indicate that the overall macroinvertebrate population decreased as the years increased. This relationship is as predicted, but due to a decrease in temperature, as opposed to the hypothesized increase in temperature.

Macro Diversity vs Time

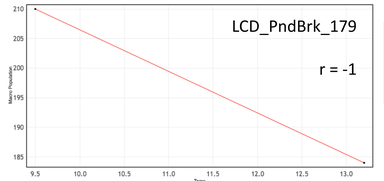


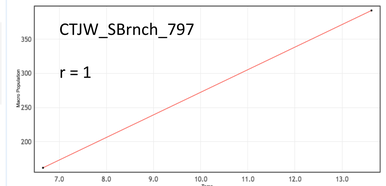


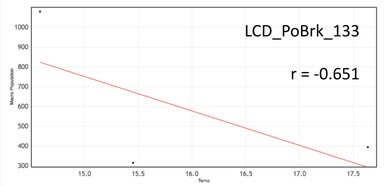


As predicted by our diversity versus Temperature and Temperature versus Year, the relationship between macro diversity and year is inverse meaning that as the years increased the diversity of the macroinvertebrates decreased.

Macro Diversity vs Temperature

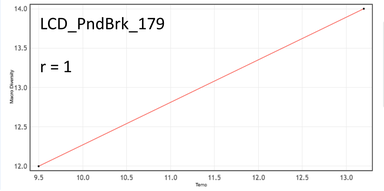


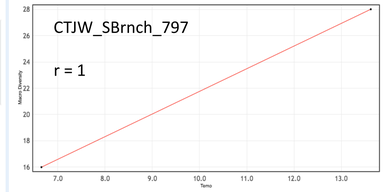


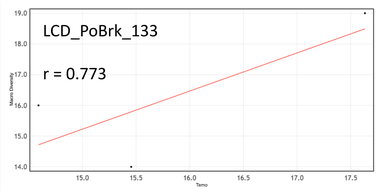


A direct relationship between temperature and macro diversity is indicated by these graphs which means that as the temperatures decrease so does the diversity of the macroinvertebrates within the stream. The outliers may show a direct relationship due to a lack of sufficient data.

Macro Population vs Temperature







In the majority of our streams the graphs indicate that as temperatures decreased the populations of macroinvertebrates decreased.

Conclusion

Our hypothesis before starting our research was that an increase in temperatures would negatively affect macroinvertebrate populations and diversity. Instead, we observed a decrease in temperatures over the past four years which also correlates with a decrease in macro populations and diversity. Thus the relationship we observed between temperature and macro populations and diversity is direct; with a decrease in temperature leading to a decrease in macro levels. More research will be needed to determine the reasons behind the observed decrease in macroinvertebrate populations. Future research should include, but not be limited to observing pH, oxygen, and nitrogen levels as well as comparing increasing stream temperatures with macroinvertebrate population and diversity.

Funding provided by NSF Grant EPS-1101317