Effects of Temperature on Mercury Content

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Introduction

Over the course of the past four months, we have been collecting and recording various factors of streams local to Hartford, Vermont. We have gathered macroinvertebrates, several measurements of the streams' widths and depths, and recorded the flow of the stream every time we have visited. From the macroinvertebrate data and other relevant sources, we have been able to research how varying temperatures affect the macroinvertebrates inside of the water, and how the mercury within said macroinvertebrates has been affected as well.

Our research question is, how exactly do those different temperatures affect the mercury content of dragonfly larvae? The infiltration of global warming could have a significant effect on the warming of streams and other water bodies, thereby either reducing or increasing the presence of mercury in macroinvertebrates, fish, and the stream itself. We believe that with raised temperatures, the mercury content present in the wildlife and water body will decline.

What we wanted to research was the different mercury contents during different seasons, and how the changes in weather affect that mercury content. Due to the fact we were only able to collect dragonfly larvae with a span of 1 week in between, we decided as a group that we would use the data from Acadia National Parks, Hodgdon Pond in 2011-2012 as well. The data they provided helped us show the different mercury contents during the different seasons.

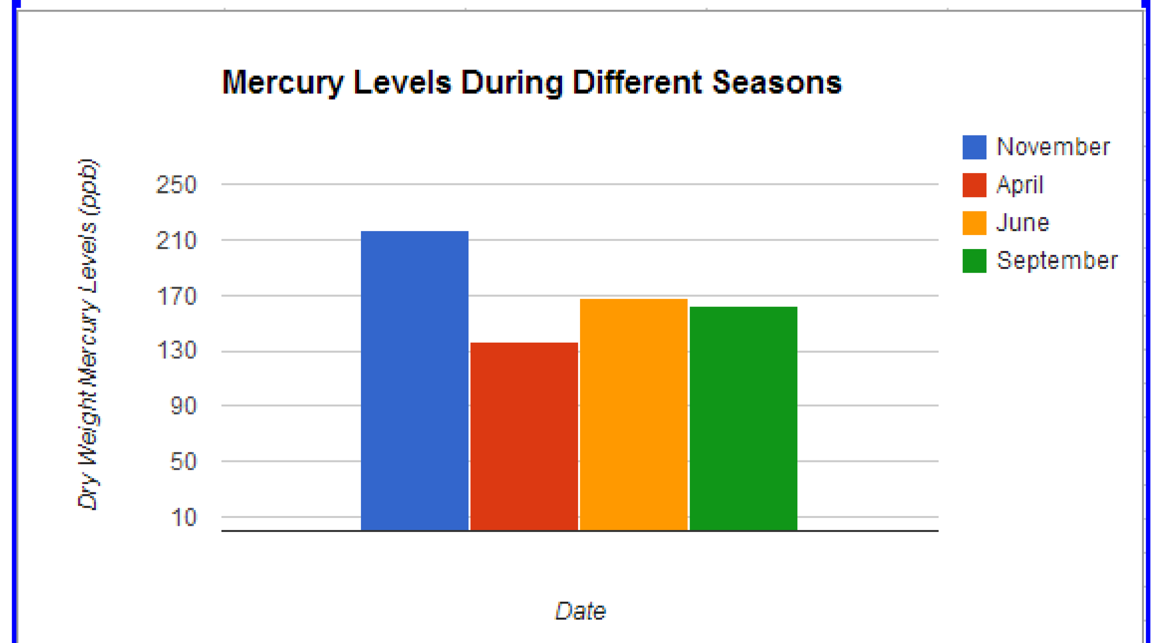
Materials and Methods

In collecting the dragonfly data from Dothan Brook in Hartford we used the clean hands, dirty hands technique. The clean hands, dirty hands technique is a way to prevent the bugs from being contaminated with more mercury from our hands.

- To collect the larvae we took large D-nets and scraped the bottom of the pond against the dirt, trying to unveil the dragonfly that hid at the bottom. After scraping the bottom, we searched the nets for any crawling dragonfly larvae.
- Practicing the clean hands, dirty hands technique we collected the appropriate bugs into the bags. Clean hands have gloves on and are not allowed to touch anything but the bags. The dirty handed person is only allowed to hold the spoon and the sharpie. The clean hands hold the bag open while the dirty hands put the appropriate bugs into the bag. Dirty hands are not allowed to touch the bag until clean hands have double bagged the bugs.
- The next step is delivering the larvae to Dartmouth, where they are stored in a freezer until processing
- Processing includes:
  - Thawing larvae in a "clean room"
  - Rinse in highly purified water
  - Take the net weight
  - Freeze dry the larvae for 48 hours until no more moisture remains
  - The bugs are then homogenized and taken to the Dartmouth Trace Element Analysis Core where they are analyzed by the Direct Mercury Analyzer
  - The DMA burns any form of mercury and is converted to elemental and as they say "trapped" using gold.
  - The mixture is heated until the mercury is released and then the mercury level is measured by absorption spectrophotometer

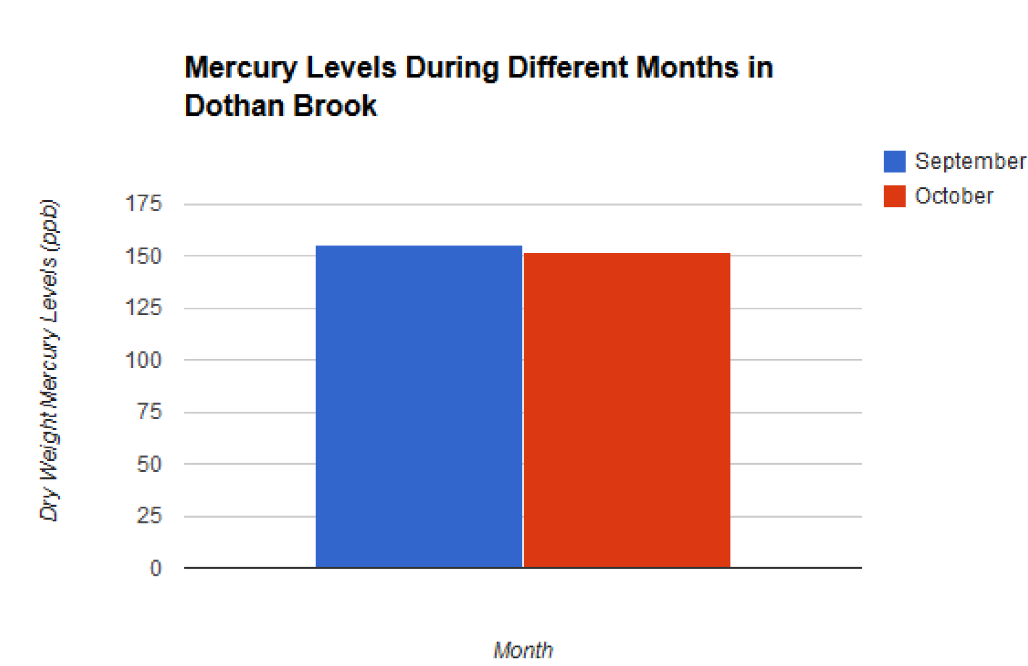
Results

The first graph shows the results from Hodgdon Pond in Acadia Park, Maine. This graph shows that the blue bar is the date of November 12^{th} 2011 and the Mercury content was 217.2 ppb. The red bar was April 6^{th} 2012 and the mercury content was 136.9 ppb. The orange bar was June 27^{th} 2012 and the mercury content was 168.3 ppb. The green bar is September 30^{th} 2012 and the mercury content was 162.7ppb. The problem we had was that in November the data only had 2 samples of Gomphidae, April had 3, June had 7, and September had 5.



More Results

The second graph shows the mercury content of Cordulegastridae in Dothan Brook that we collected. The first date was on September 25th 2013 and the temperature of the water was 12.5 degrees celsius. The second day we collected was October 3rd 2013 and the water temperature was 14 degrees celsius. The first day 5 bugs were measured and the second day 7 bugs were measured.



Literature Cited

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Conclusions and Discussion

We have come to the conclusion that if weather changes the mercury levels is the case, the colder the weather, the higher the mercury levels will be rather than in the warmer weather. The sunlight also has something to do with the mercury levels found, and although there is no solid evidence of this yet, it is an ongoing investigation. In fact, our sources at Acadia National Park are currently exploring the idea that sunlight plays a vital role in the presence of mercury within a body of water. We have found that the more sunlight the water gets the less chance the water is to have a high level of mercury. The less sunlight the body of water gets, the higher chance it has to have a high level of mercury in it. This being said, there is no way of proving our thesis of the impact temperature has on mercury, because it could be overlayed with interference from the sunlight or lack thereof. I would recommend for next years students to spread out the time that you collect a multitude of same-species macroinvertebrates, such as the dragonfly larvae, over the course of several months. Because our data was only a week apart, there was no way of seeing any absolute change in the mercury content of the stream. Other factors include run-off from snowmelt into the streams, whether or not the mercury content is a direct result of exposure to the stream or instead due to the macroinvertebrates diet, and sediments within the stream breaking down and releasing mercury. Those things must also be investigated in order to achieve a higher understanding of where the mercury comes from, and therefore how to limit how the mercury gets into the water.
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