The Effect of Extreme Weather on Water Quality in the Ashuelot River and Beaver Brook in Keene, New Hampshire

Research Question: Have the recent extreme weather events in Keene (3 floods since 2005) affected the water quality in the Ashuelot River and Beaver Brook as they flow through the city? Because the Ashuelot River has a flood control dam north of the city, it has not caused significant flooding. Beaver Brook, on the other hand, has caused major problems each time it overflows its banks. We expect that water quality in Beaver Brook will be worse than water quality in the Ashuelot River.

Method

We began our study in the fall, using test kits provided by GLOBE. We found that most of the kits yielded very unspecific results. For instance, the dissolved oxygen test kit only offered three levels of dissolved oxygen. The pH test kit was the exception and would test to the nearest whole pH level. We also found that practicing the protocols took a lot of time and patience. This spring, thanks to Judy Tumosa at NH Fish and Game, we were able to borrow two multimeters to test pH, conductance and water temperature, two dissolved oxygen meters, and one turbidity meter. We were able to return to the Ashuelot River to test pH, water temperature and dissolved oxygen. We also went to Beaver Brook to complete the same tests. In addition to the chemical tests, we collected macro-invertebrates at both locations. In the fall, we used a leaf pack to collect from the Ashuelot River. Unfortunately, we had to pull our leaf packs out a week early because of the Source To Sea River Clean Up, and we wound up losing one pack to aggressive volunteers! As a result, it's possible that our Biotic Index for the Ashuelot River is a little higher than it would have been if we had recovered both leaf packs after 3 weeks instead of only one leaf pack after 2 weeks. This spring we were able to use waders and kick nets to collect macro-invertebrates from Beaver Brook. In addition to the data we collected, we were able to access data collected by the Ashuelot River Local Advisory Council from 2007 through 2012. It was helpful to compare our data to theirs to get a sense of whether our measurements were reasonable. Finally, we looked at historical climate date for New Hampshire to see if there are any obvious trends in air temperature and precipitation.

Data and Analysis

Our Test Results

Ashuelot River

Test	Nov. 19	April 18
Water temp	3°C	10.1°C
DO	5.67 ppm	7.5 mg/L
pH	8	6.7

Beaver Brook

Test	April 28
Water temp	14.1˚C
DO	7.95 mg/L
pH	7.1

Dissolved oxygen and pH results in both the river and the brook were comparable. The temperature difference is likely the result of a difference in water depth. Beaver Brook is much shallower and narrower than the Ashuelot River.

Macro-Invertebrates

Ashuelot River

Group	Number Found
Mayfly Nymphs	14
Stonefly Nymph	1
Caddisfly Larvae	2
Dragonfly Nymphs	2
Snails	33
Biotic Score	5.02

Beaver Brook

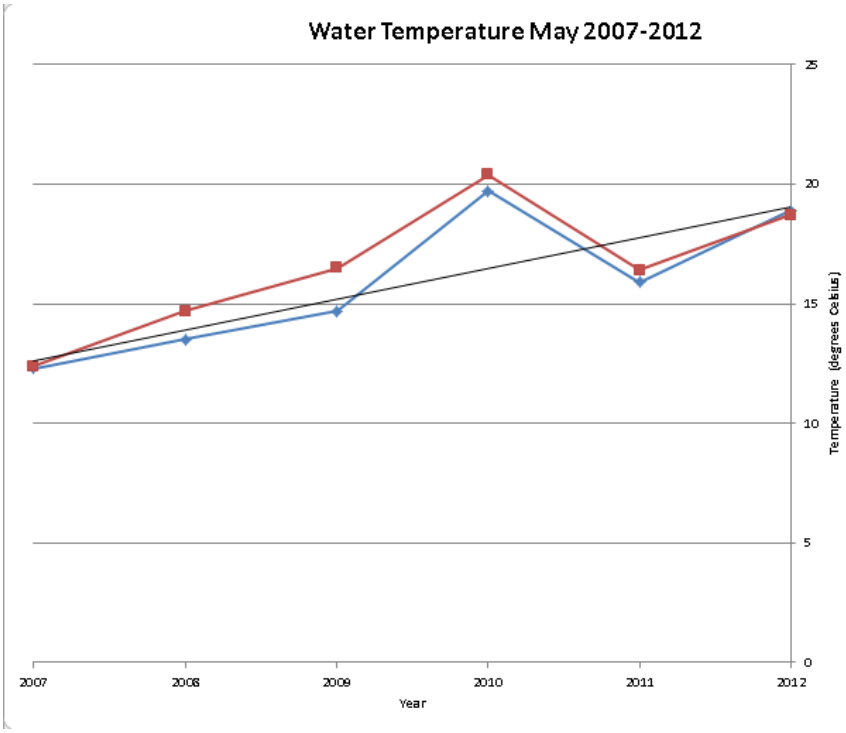
Group	Number Found
Mayfly Nymphs	45
Caddisfly Larvae	20
Dragonfly Nymphs	16
Damselfly Nymphs	1
Beetles	3

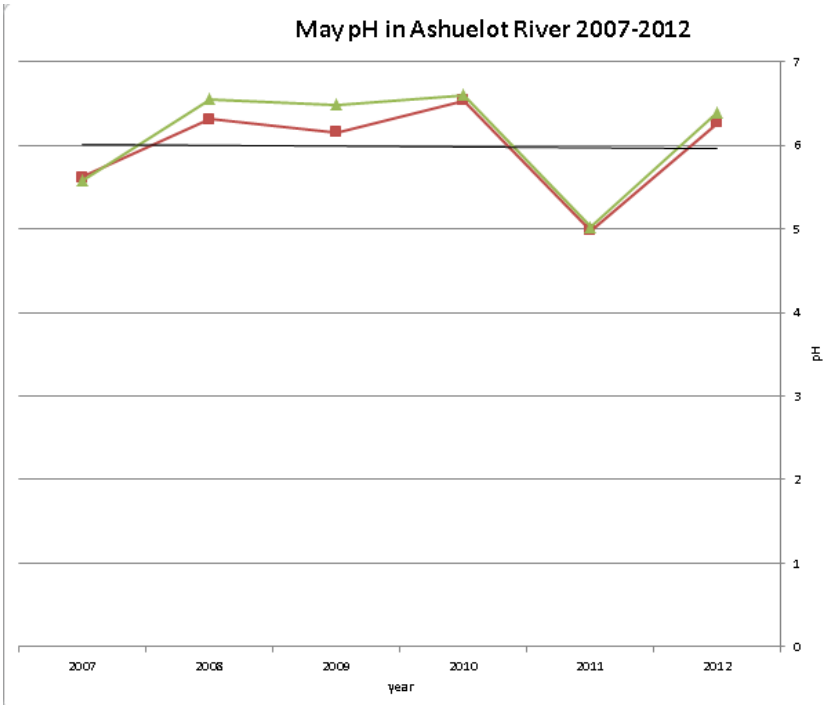
Crayfish	3
Snails	3
Aquatic Worms	1
Biotic Score	3.67

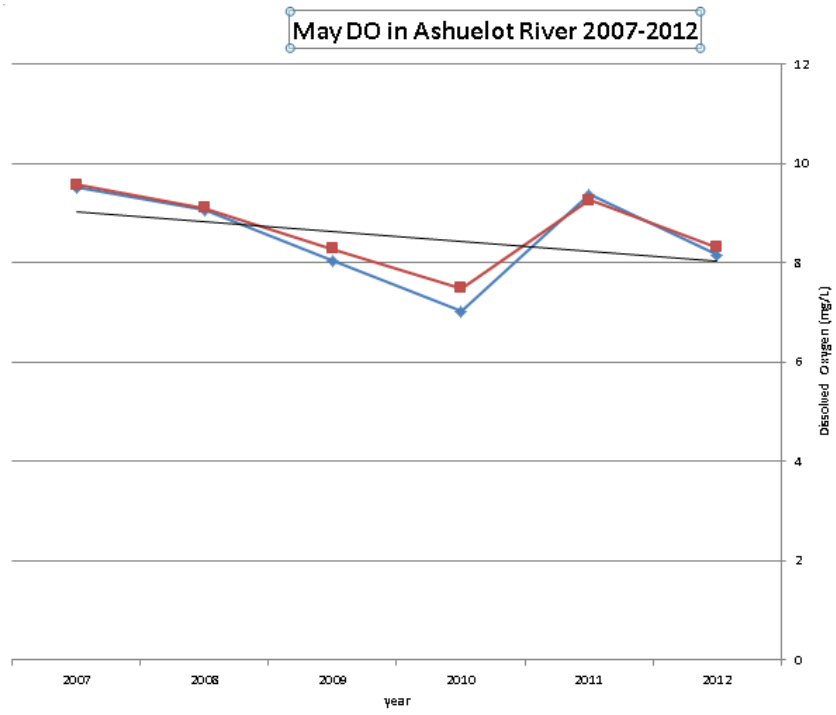
Since a biotic score of >3.5-4.8 is considered good, it appears that Beaver Brook provides a better habitat for macro-invertebrates than the Ashuelot River.

ARLAC Data

To get a sense of the reliability of our data, we compared it to data posted online by the Ashuelot River Local Advisory Council (ARLAC) from 2007 through 2012. We graphed this data and inserted trendlines to see if there have been any changes over the last few years and how our data fit with those changes. ARLAC tests the Ashuelot River approximately 1.5 miles upstream of our study site and approximately 2 miles downstream of our study site, where Beaver Brook and another tributary join the Ashuelot. Data from both sites are on the graphs.



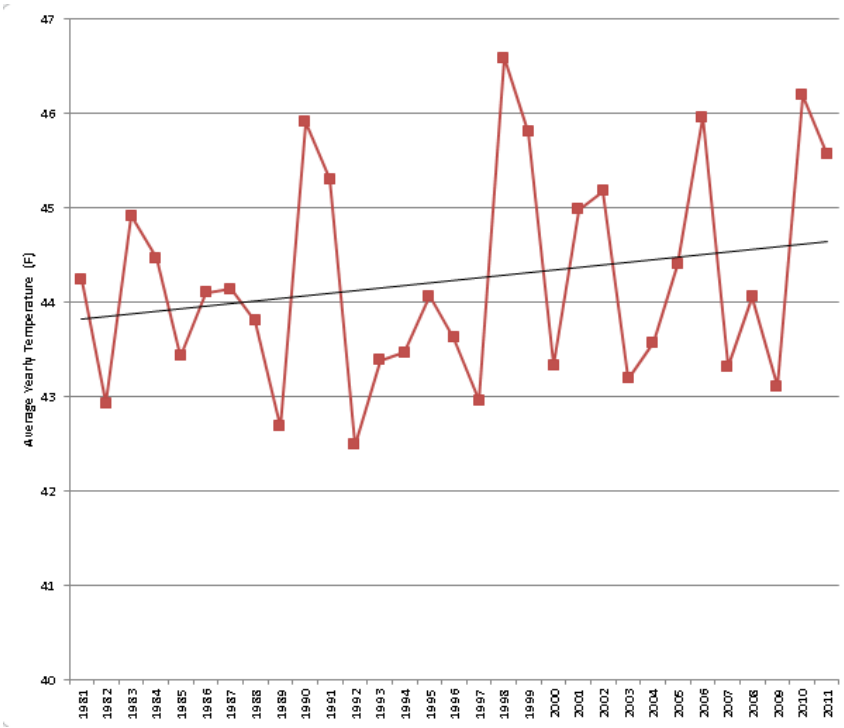


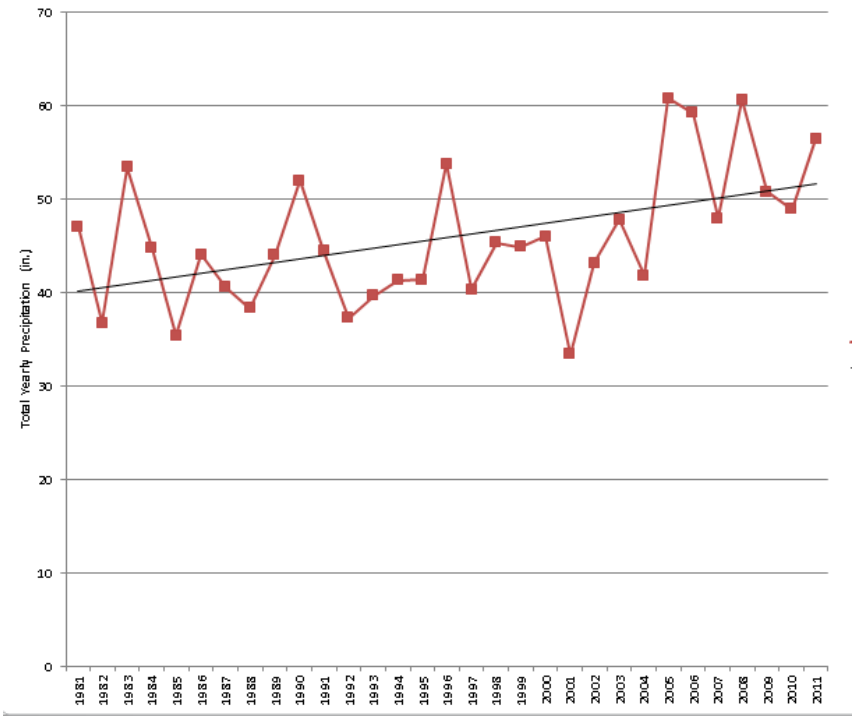


We noticed that temperature shows an increase over the 6 years included in the graph, while dissolved oxygen shows a decrease. Our temperature data is somewhat lower than last year's, perhaps because of our long, cold winter. Last winter was unusually warm and dry, so the lack of snowmelt added to 70 degree temperatures in March must have contributed to the higher water temperature in 2012. Our dissolved oxygen measurements of 7.5 and 7.95 appear consistent with the trend on the graph. We found it interesting that pH has remained pretty stable except for 2011. The most interesting thing

about our pH data is that the Ashuelot River upstream and downstream of Keene is much lower than the pH of the river as it flows through Keene itself.

Historical Climate Data





Finally, we looked at average yearly temperature and total yearly precipitation for the state of New Hampshire over the last 30 years. When we added trend lines, it became clear that our yearly average temperature has increased by 1°C and precipitation has increased by approximately 12 inches.

Conclusion

We concluded that the water quality in the Ashuelot River and Beaver Brook is actually quite similar. The biggest differences were in temperature and macro-invertebrates. The 4° difference in temperature occurring over a 2 week difference in time is likely due to the depth of the river versus that of the brook. The difference in macro-invertebrate diversity and numbers may be due to using different collection methods as well as the fact that one of our leaf packs got cleaned out of the river and we had to remove the other leaf pack a week early. Overall, it does not seem that its frequent flooding is impacting the water quality in Beaver Brook. In looking at the data from ARLAC and the historical climate data, it does seem that climate change may already be affecting the temperature of the water and, thus, the dissolved oxygen levels.

Questions For Further Study

- What is the water quality like farther downstream on Beaver Brook? There is a section of the brook that has no riparian zone at all, only concrete. What does that do to the macro-invertebrate habitat?
- Will further extreme weather have more of an impact on the waterways? How long does it take a waterway to recover from an extreme weather event?
- Why is the pH of the waterways in Keene higher than the pH upstream and downstream of Keene?