The Impact of Bowman Creek on the Schoharie River

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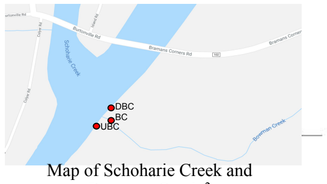
Introduction

The Schoharie Creek runs from the Catskill Mountains to the Mohawk River. The Creek was first settled by the Dutch in 1710, but at that time it was called the Schoharie River[1]. The Bowman Creek runs into the Schoharie Creek in Duanesburg, New York. To see how Bowman Creek affects the Schoharie Creek's water, the pH, alkalinity and various ion concentrations were recorded. The values for upstream of Bowman Creek (UBC), downstream of Bowman Creek (DBC) and Bowman Creek (BC) were compared.

These characteristics of the water affect the wildlife that live in the Schoharie Creek. The Creek supports Brown Trout, and Smallmouth Bass. It also a drinking water source for many land animals. Therefore, the water from both of these Creeks were compared to tap water from Union College, which has to meet EPA regulations.



Map of Schoharie Creek and Bowman Creek.[2]

Intersection between Bowman Creek and the Schoharie River.

Experimental

- Field tests for nitrate, sulfate, and phosphate were done using Hach field test kits, and the standard protocol for each kit was followed.
- An Ion Selective Electrode (ISE) was used to measure the activity of chloride and calculate the concentration of each sample. The samples were spiked with 1 ml of 2.00 M KNO_3 to adjust the ionic strength. The standards' concentrations were: 10, 50, 100 ppm.
- Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) was used to analyze the concentration of different metals in the samples. The concentration of the following metals were measured: Al, Fe, Mn, Cu, Zn, Sr, Cd, Ba, Pb, U.
- Ion Chromatography (IC) was used to analyze the concentrations of different cations and anions in the samples. The cations analyzed were: Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, Sr^{2+}. The anions analyzed were: F^-, Cl^-, NO^{3-}, SO_4^{2-}, PO_4^{3-}.
- Atomic Absorption Spectrophotometry (AAS) was used to determine the concentration of Ca^{2+} based on external standards. The concentrations of the three standards were: 1, 5, 10 ppm. Based on the IC data some of the samples were diluted to fall within the range of the standards.
- To calculate the alkalinity range of the samples a titration was run using methyl orange as the indicator and 0.02 N H_2SO_4.

References

[1] Summary of Schoharie Wildlife and Fishery. (n.d.). Retrieved May 27, 2018, from http://catskillstreams.org/wp-content/uploads/2013/09/Summary-of-Schoharie-Wildlife-and-Fishery.pdf
[2] (n.d.). Retrieved May 27, 2018, from https://www.google.com/maps
[3] Harris, D. C. *Quantitative Chemical Analysis,* 9th ed.; W. H. Freeman: New York, 2016.
[4] Fondriest Environmental, Inc. "pH of Water." Fundamentals of Environmental Measurements. 19 Nov. 2013. Retrieved May 27, 2018, from http://www.fondriest.com/environmental-measurements/parameters/water-quality/ph/

Results: Ion Concentrations

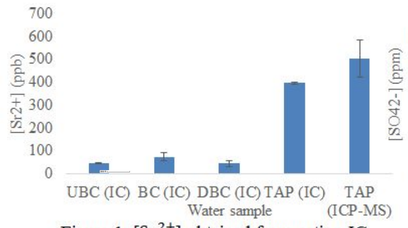


Figure 1: $[Sr^{2+}]$ obtained from cation IC and ICP-MS.

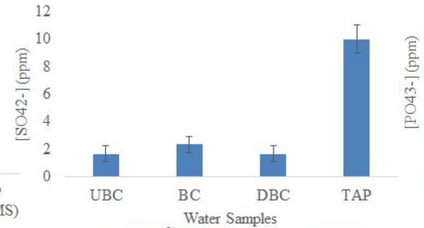


Figure 2: $[SO_4^{2-}]$ obtained using Hach kits.

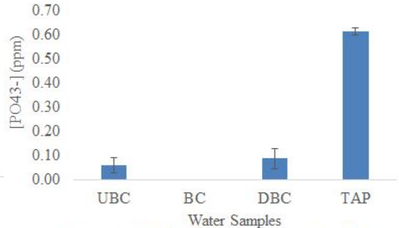


Figure 3: $[PO_4^{3-}]$ obtained using Hach kits.

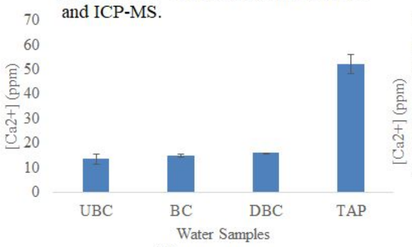


Figure 4: $[Ca^{2+}]$ obtained using the external standard method and AAS.

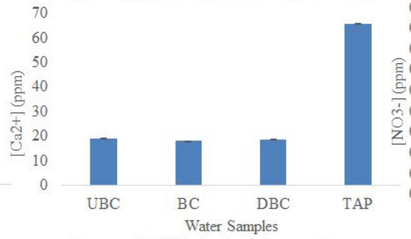


Figure 5: $[Ca^{2+}]$ obtained from cation IC.

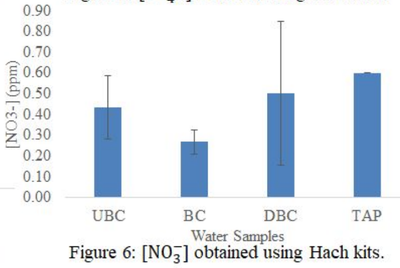


Figure 6: $[NO_3^-]$ obtained using Hach kits.

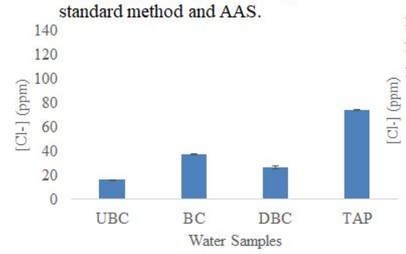


Figure 7: $[Cl^-]$ obtained from anion IC.

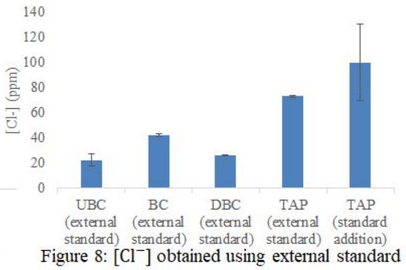


Figure 8: $[Cl^-]$ obtained using external standard and standard addition method and ISE.

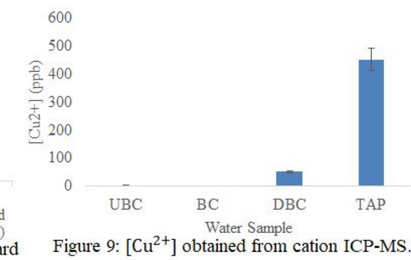


Figure 9: $[Cu^{2+}]$ obtained from cation ICP-MS.

- There are significantly more PO_4^{3-}, NO_3^-, Cu^{2+}, Sr^{2+}, Ca^{2+}, $SO_4^{2-}$and Cl^- ions in tap water sample than in river water samples.
- In analyzing Ca^{2+} and Cl^- concentrations for each water sample, though the analytical methods employed produced statistically different results, they are still close.

Results: pH and Alkalinity

Table 1: Alkalinity of the four water samples.

Sample	Alkalinity Range (ppm $CaCO_3$) (M/W Lab)	Alkalinity Range (ppm $CaCO_3$) (T/Th Lab)
UBC	50.0-54.0	51.0-58.0
BC	49.0-54.0	-
DBC	49.0-58.0	-
TAP	157-163	145-173

Table 2: pH values of the four water samples.

Sample	Field pH	M/W Lab pH	T/Th Lab pH
UBC	7.66	7.44	7.73
BC	7.61	7.21	-
DBC	7.63	6.61	-
TAP	-	7.36	7.41

- Alkalinity range of river water samples are overlapping with each other and their pH values are close.
- Tap water sample has a higher alkalinity range than river water samples and its pH is close to river water samples.

Discussion

- The Ca^{2+} and Cl^- results from the external standard/standard addition data were lower than the data from the IC as shown by the large variations between Figure 4 and 5 as well as 7 and 8.
- The t-test at 95% confidence for Ca^{2+} revealed that the difference between the Ca^{2+} concentration upstream and downstream from Bowman Creek are significant.
  - 14.56 (statistically measured) > 4.3 (confidence at 95%)[3]
- The t-test at 95% confidence for Cl^- revealed that the difference between the Cl^- concentration upstream and downstream from Bowman Creek are insignificant.
  - 9.3 (statistically measured) < 12.7 (confidence at 95%)[3]
- The SO_4^{2-}, Sr^{2+}, PO_4^{3-}, NO_3^-, and Cu^{2+} data shows that there is little to no increase between upstream and downstream Schoharie River from Bowman Creek.
- The pH measurements show a decrease in pH after Bowman Creek enters the Schaolarie River, indicating an impact of the Creek on the River in terms of pH.
- The alkalinity for all three field water samples are within the same range of 49-58 ppm.
- The Tap water had significantly more ions and a higher alkalinity than the three field samples.
- The pH and alkalinity were measured by two different groups as well as the pH was measured in the field. Measurements in the field were different from those in lab while measurements between lab groups were similar.

Conclusions

- Bowman Creek generally showed higher concentrations of ions as revealed by the Hach kit, IC and ICP-MS results
- Upstream of the Schoharie River had a higher average pH than the other water samples, but the difference was minimal.
- Schoharie River's pH of 7.63-7.66 and alkalinity of 49.0-58.0 are high for the aquatic life the river supports[4]
  - Brown Trout prefer a pH close to 5[1,4]
  - Smallmouth Bass prefer a pH of 5.5[1,4]
  - Alkalinity preference is 20 ppm for both species[1,4]
- The Tap water has relatively high concentration of all the ions compared to Bowman Creek and the Schaolarie River
  - The Tap water is controlled by EPA standards for drinking water and by comparison to the field water samples, it has more ionic content.
- Bowman Creek showed little to no significant impact on the Schoharie River based on the results

Acknowledgements

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