Evaluating Anthropogenic Impact on Water Quality of Ohio Rivers Over Time

Kelsey Dailey
dailey.154@osu.edu

Introduction

Natural and anthropogenic factors affect the geochemistry of rivers and streams in both rural and urban areas. Much of the impact on fresh water in the U.S. comes from non-point sources, with population and land use playing an important role. A major component of salt input into rivers and streams is chloride, derived mostly from modern urban contributions such as road salt. Road salt lowers the freezing point of snow and ice, creating a brine that can run off roadways, diffuse into surrounding surface waters, and perhaps infiltrate into the ground. The EPA currently recommends a 230 mg/L chloride concentration threshold for organisms in streams. Near this threshold, water may take on a salty taste and contain toxic impurities and elevated levels of sodium, making it not potable for human consumption. Nitrate represents another large anthropogenic input, largely from agricultural sources such as fertilizers as well as the burning of fossil fuels.

Objectives

• Water quality studies exist for rivers and streams in parts of the U.S. such as Chicago[1], Maryland, New York, New Hampshire[2] and the Great Lakes[3], all of which have yielded increases in chloride concentration over time. The Canadian government has recommended that road salt be added to the list of toxic substances under the CEPA due to threats of irreversible environmental damage.

• The metro Columbus area has grown in recent decades, resulting in expanding urbanization and suburban sprawl. Little is known about the relationship between urban and suburban development across the U.S. and long-term changes in baseline salinity of fresh surface water.

• To our knowledge, historical data on fresh water quality exists for rivers and streams throughout Ohio, but much of it has never been utilized to observe trends such as chloride and nitrate flux over time.

Methods

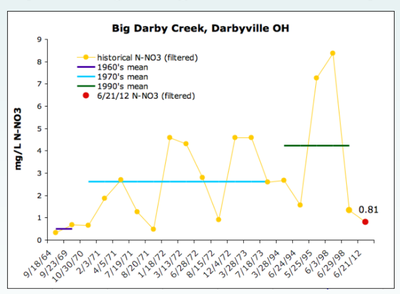
Historical data from state and federal sources including USGS and ODNR was used to identify long-term trends in chloride, sodium, and nitrate concentrations in 5 Ohio rivers and streams. Past data from Dr. Lyon's research group pertaining to the Olentangy River and Big Darby Creek near Columbus also contributed to the historical data sets. Subsequently, new samples were taken at 13 locations:

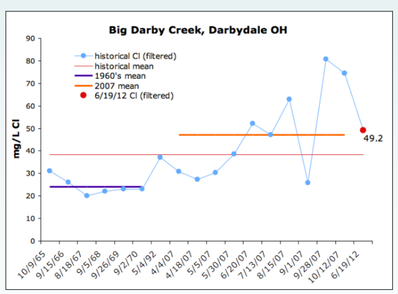
Olentangy River (4 locations)
Big and Little Darby Creeks (4 locations)
Hocking River (3 locations)
Little Miami River (1 location)
Alum Creek (1 location)

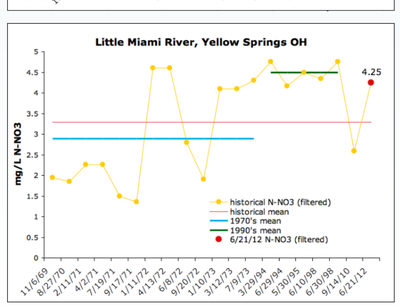
The filtered samples were then analyzed via ion chromatography. Samples were also collected at each site for isotopic analysis.

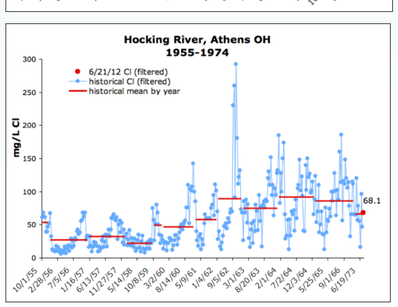
Results

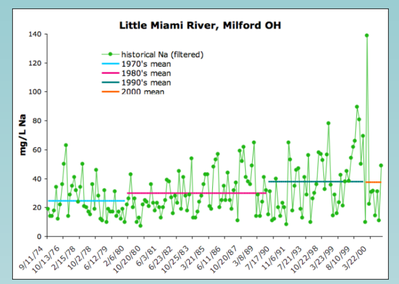
Isotopic analysis showed that samples were unevaporated, indicating the ion data can be treated as a "primary" signal of water quality.











Conclusion

Identifiable trends were found in the river locations with complete historical data sets, showing general increases in ion concentration over time.

• Time series of some localities are not complete due to many gaps in data collection over the past 40-50 years

• Recognizable increase in nitrate concentration from the 1970's into the 1990's; possible indication of decrease in the 2000s, but there is not enough information to confirm

• Clear increase in chloride observed over the time intervals in many rivers and streams

• Increase in sodium in some localities from the 1970s through the 1990s, but there is the least amount of data for this ion and fewer rivers sampled in the past

• Observations of the Ohio rivers displayed in the results are similar to what have been observed elsewhere in the U.S., but others show no real trends; a lack of long-term, consistent data lead to a lack of certainty in interpretation of time series

References

1.Kelly, W. R., Panno, S. V., & Hackley, K. C. (2012). *Impacts of Road Salt Runoff on Water Quality of the Chicago, Illinois, Region.*

2.Kaushal, S. S., Groffman, P. M., Likens, G. E., Belt, K. T., Stack, W. P., Kelly, V. R., Band, L. E., & Fisher, G. T. (2005). *Increased salinization of fresh water in the northeastern United States.*

3.Chapra, S. C., Dove, A., & Rockwell, D. C. (2009). *Great Lakes chloride trends: Long-term mass balance and loading analysis.*

A special thanks to Dr. Berry Lyons and his research group.

Funding Source:Shell Oil Company 2012