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Chemical Analysis of Morris Water Pollutants via Electrochemical Detection Methods

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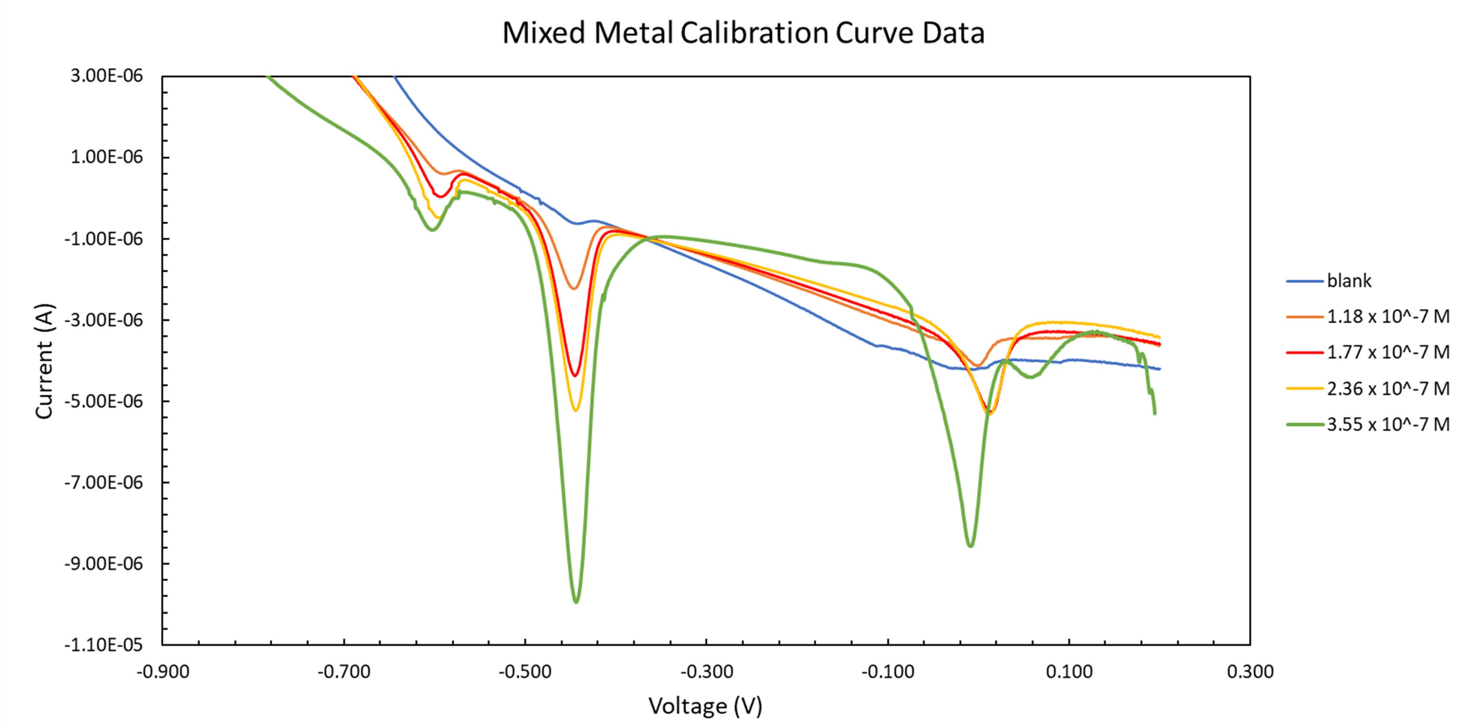
Introduction

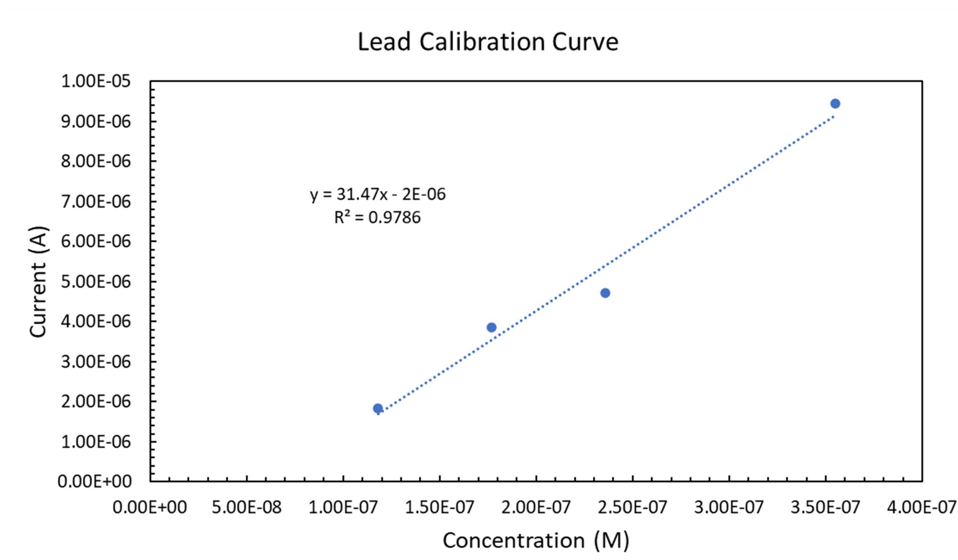
In small towns like Morris that are surrounded by agriculture, there's an increased likelihood of contaminants to be present in the water. These commonly include heavy metals and pesticides which, in high enough dosages or prolonged exposure, can quickly become poisonous and harmful with lasting effects for both plants and humans. Throughout our research we have been analyzing the presence, if any, of lead, copper and cadmium as well as the common pesticides atrazine and mesotrione in the water throughout Morris. We look at a variety of samples coming from melted snow (collected throughout Nov. 2022 – Apr. 2023), drinking water, and the Pomme de Terre River as well as the lake that feeds it. Our methods of detection include high performance liquid chromatography and various electrochemical techniques including linear sweep voltammetry, cyclic voltammetry, and square-wave voltammetry. We hope to then compare our data to the regulations and guidelines set by the Environmental Protection Agency and ensure that they fall below the recommended values for human consumption.

Experimental

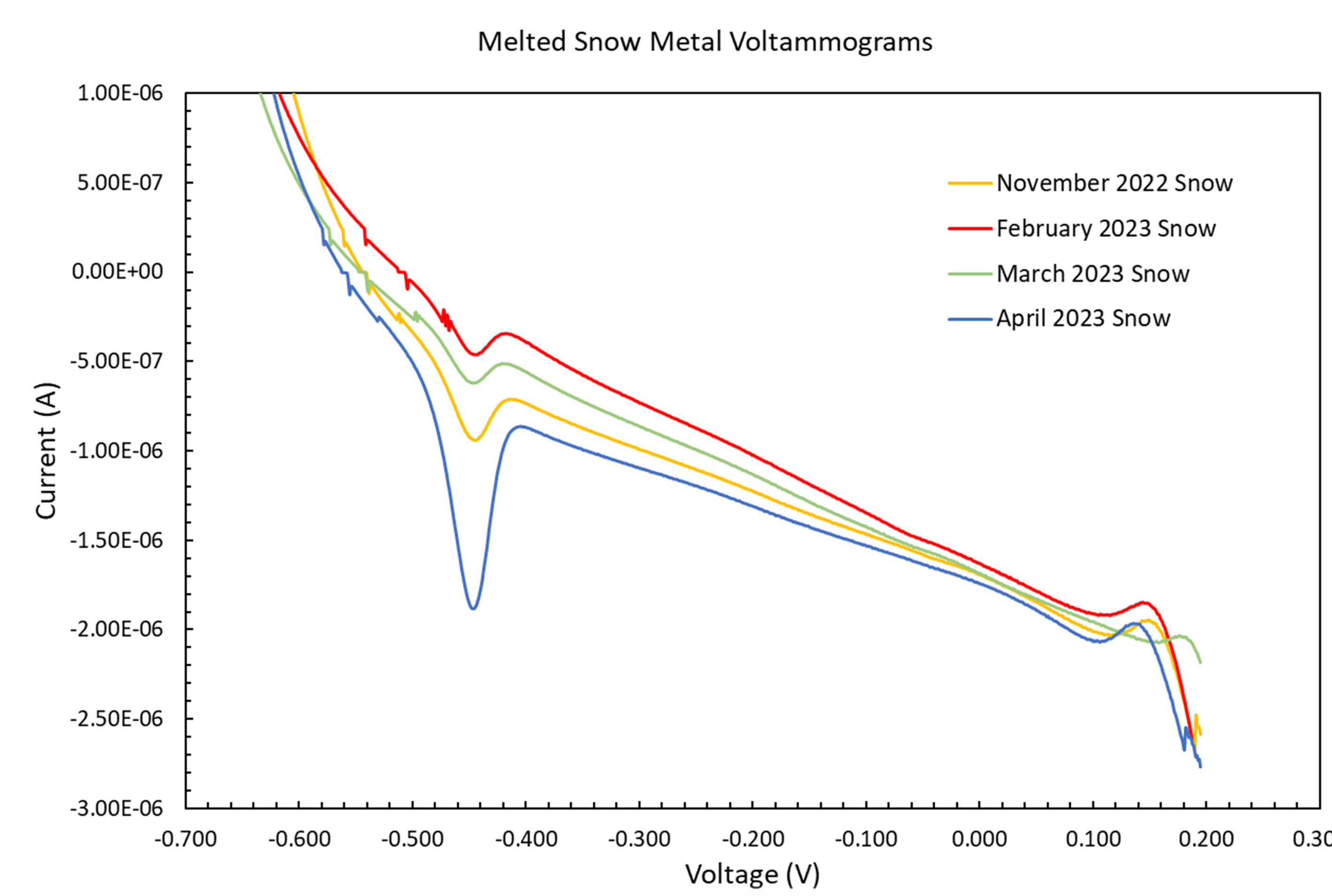
- The first thing we did was create five different concentrations for the three heavy metals, lead, copper, and cadmium in water to then be used to create a calibration curve with which we could compare the water results in order to determine the concentration of the metal present in each sample.
- We primarily used linear sweep voltammetry for this purpose and were able to obtain clear peaks where we could differentiate between the three metals when combined since each appeared at a different, predictable location on the voltammogram.
- After getting some data on the metals, we tried to detect our two pesticides, atrazine (in phosphoric acid) and mesotrione (in methanol), in the most concentrated form we would include in our calibration curve. We first attempted linear sweep voltammetry and didn't get many clear results, so we moved on to cyclic and square-wave voltammetry where we were able to see a clearer indication of the presence of the pesticides.[1,2]
- Ongoing work is being conducted to further explore the peak presence in the square wave voltammograms from the pesticides.

Detection: Metals



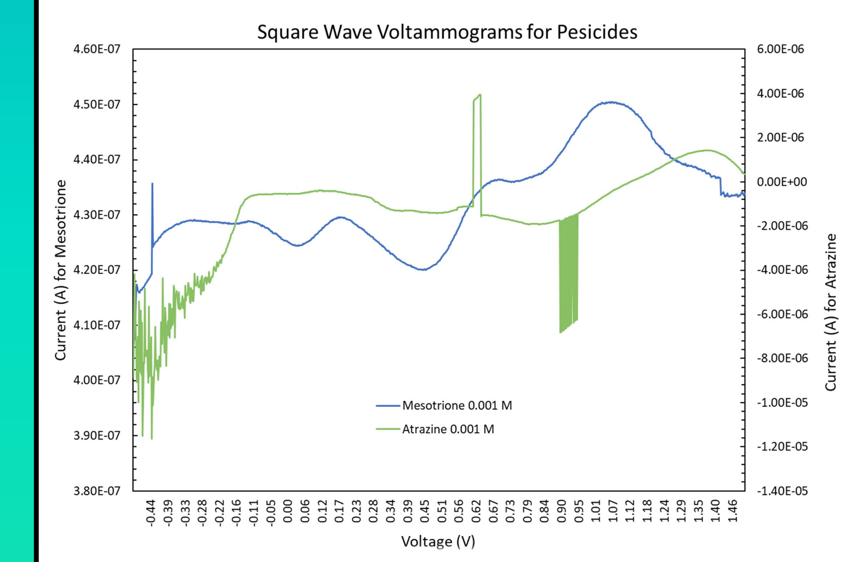


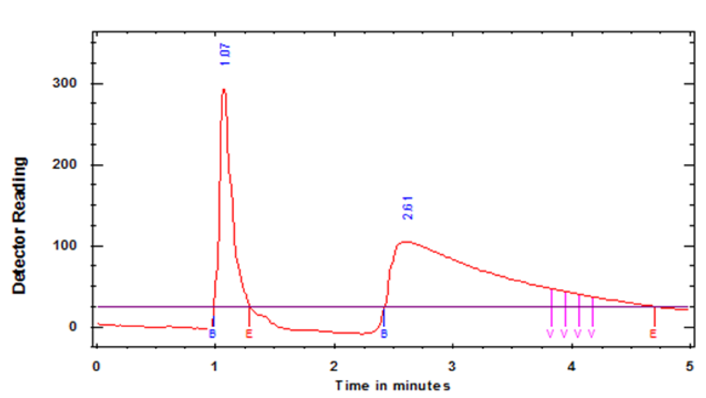
Calibration curves were constructed for the three metals with a representative calibration curve shown here for lead.



Water Sample	Copper (M)	Lead (nM)	Cadmium (M)
November 2022 Snow	Non-Detect	76.0*	Non-Detect
February 2023 Snow	Non-Detect	72.1	Non-Detect
March 2023 Snow	Non-Detect	68.8	Non-Detect
April 2023 Snow	Non-Detect	103*	Non-Detect

Detection: Pesticides





- Square wave and HPLC data for pesticides that are on-going in collection

Conclusions and Future Research

- Lead was detected in the November snowfall and the April snowfall to be greater than the EPA guidelines of 15 ppb or 72.4 nM.[3] The snow collected in February was also close to this limit. Snow melting will lead to lead introduction into our waterways.
- As this is a work in progress, we hope to create calibration curves for both atrazine and mesotrione so we can then collect data from our water samples that can be compared to the calibration curves in order to figure what concentration, if any, of the two pesticides is present.
- We also hope to determine the limits of detection and quantization to further the quality of our work.

Acknowledgements

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References

[1]Barchanska, H. *Electrochemical determination of mesotrione and its degradation products on a glassy carbon electrode.* 98. Int. J. Enviro. Anal. Chem. 2018.
[2]Wagheu, J.; Forano, C.; Besse-Hogan, P.; Tonle, I.; Ngameni, E.; Mousty, Christine. *Electrochemical determination of mesotrione at organoclay modified glassy carbon electrodes.* 103. Science Direct. 2013.
[3]US Clean Water Act of 1995

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