FIRE: THE FIRST-YEAR INNOVATION & RESEARCH EXPERIENCE

SUSTAINABILITY ANALYTICS

Effects of Plastic Bag Regulations on the Chesapeake Bay

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Research Question

What are the effects of the plastic bag ban and tax on water quality in the Chesapeake Bay?

Background

- Plastic bag bans have been implemented all around the Chesapeake Bay area in the past decade.
  - Harford County in Maryland implemented a plastic bag ban September 2017.
  - Arlington and Fairfax counties in Virginia implemented a plastic bag tax in January 2022.
- Seeley et al. (2020) and Shen et al. (2020) discussed how microplastics can impact ocean carbon sequestration and dissolved organic carbon levels.
- Our research attempts to see what effects, if any, plastic bag bans and taxes have on dissolved carbon levels in the Chesapeake Bay.

Data

- banthebag.com provides dates of when each county implemented plastic bag policies.
- Chesapeake Bay Foundation provides a list of counties in the Chesapeake Bay watershed.
- EPA's US Water Quality Portal provides dissolved carbon measurements across counties and time. Specifically, we looked at organic dissolved carbon levels in counties in the Chesapeake Bay watershed.

Methodology

1. We checked when each county on the Chesapeake Bay watershed implemented a bag ban or a bag tax.
2. We calculated average dissolved carbon levels for each county and month.
3. We merged regulation data with dissolved carbon data and analyzed its trends.

Results

- Harford County is the only county in Maryland that implemented a bag ban before 2024 and had sufficient dissolved carbon data.
- Arlington County is the only county in Virginia that implemented a bag tax before 2024 and had sufficient dissolved carbon data.

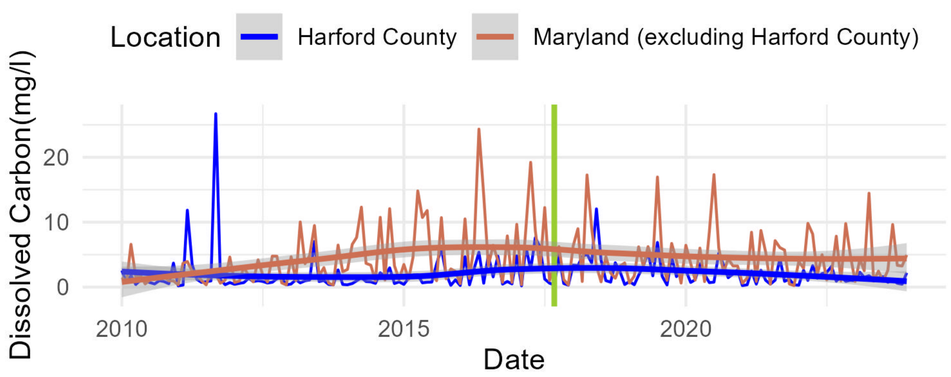

Figure Description:

This graph shows dissolved carbon levels in Harford and other counties with Maryland before and after September 2017 (shown in green line). There is no significant change in Harford County's carbon levels after the ban.

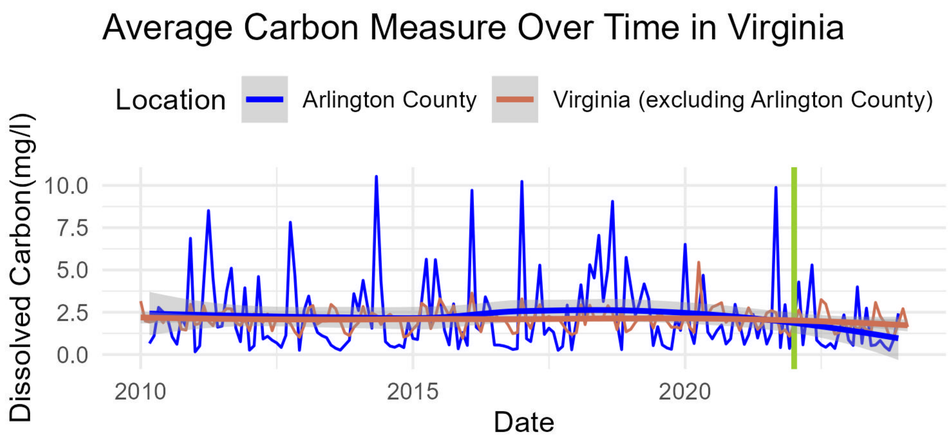

Figure Description:

This graph shows dissolved carbon levels in Arlington and other counties with Virginia before and after January 2022 (shown in green line). There appears to be a decrease in carbon levels for Arlington, but dissolved carbon levels decrease for all of Virginia as well.

Conclusion

- The effects of the plastic bag ban on microplastic pollution in the Chesapeake Bay are unclear from our current results.
- This is due to a lack of available data and because many counties have only recently implemented the ban in 2024.
- We hope to look into a number of external factors, such as precipitation and stormwater runoff, that also could play a role in changing the levels of dissolved carbon.
- Existing literature have linked microplastics level in water with soil nitrogen-15/nitrogen-14 ratios, but we do not have sufficient nitrogen ratio data.

References

Seeley, M. E., Song, B., Passie, R., & Hale, R. C. (2020). Microplastics affect sedimentary microbial communities and nitrogen cycling. *Nature Communications,* 11(1).

Shen, M., Ye, S., Zeng, G., Zhang, Y., Xing, L., Tang, W., Wen, X., & Liu, S. (2020). Can microplastics pose a threat to ocean carbon sequestration? *Marine Pollution Bulletin*, 150, 110712.