

Understanding plastics pollution: A case study of the Great Lakes

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Objective

Use plastic transect data from 2018 to understand the patterns of plastic waste distribution across the Great Lakes, locating its sources, and identifying key polluting polymers.

Background

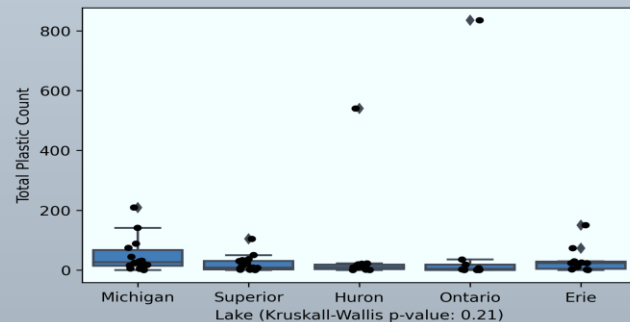
Plastic waste is amongst the most harmful disposable materials globally. As reported by the Great Lake advocacy group, about 85 percent of the trash collected by volunteers in 2018 was plastic. These products included bottles, bags, and microplastics. This problem requires understanding the types of waste, their sources, and efficient ways to manage them.

Question

Are there any patterns in the type and use of certain plastics across each of the Great Lakes?

Data

Datafiles were obtained from supplemental data in the publication “Plastic debris in the Laurentian Great Lakes System, North America: Analysis of types, abundances, and sources” by Ian Arturo under Creative Commons 4.0. Data consisted of counts for plastic particles using 10m by 1m transects along beaches across all lakes. Data columns of interest included ‘polymer’, ‘lake’, ‘size fraction’, ‘count’, and ‘item use’.



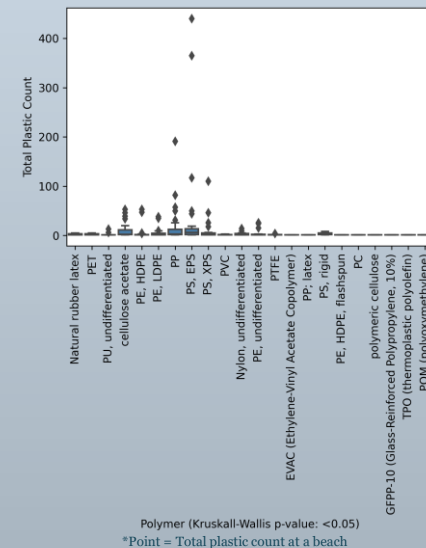
*Point = Total plastic count for a polymer at any beach



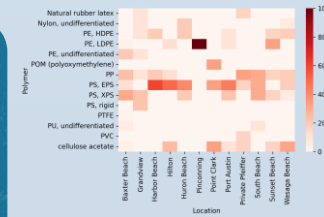
Methods

Exploratory Data Analyses: Boxplots, Bar Graphs, and Heat Maps

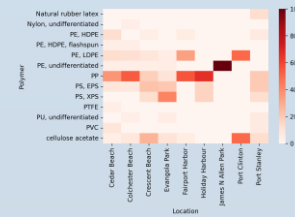
Statistical Tests/Models: Chi-squared Tests, Linear Models, Kruskal-Wallis Tests (w/ adjusted pair-wise comparisons)



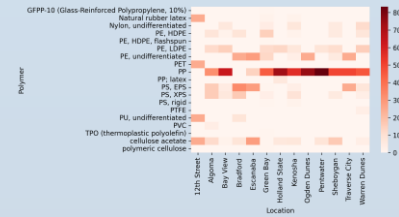
Polymer (Kruskal-Wallis p-value: <0.05)
*Point = Total plastic count at a beach



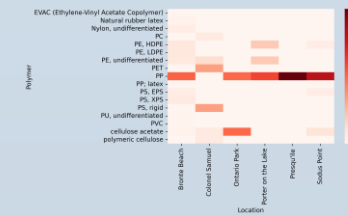
Lake Huron Test for Independence between Location and Polymer
 $p < 0.05$



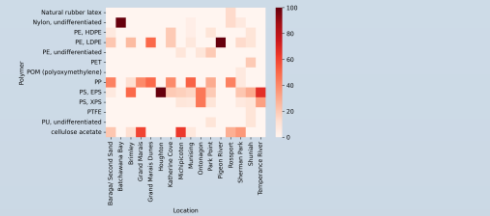
Lake Erie Test for Independence between Location and Polymer
 $p < 0.05$



Lake Michigan Test for Independence between Location and Polymer
 $p < 0.05$



Lake Ontario Test for Independence between Location and Polymer
 $p < 0.05$



Lake Superior Test for Independence between Location and Polymer
 $p < 0.05$

Heat Map (Chi-Squared) Conclusions

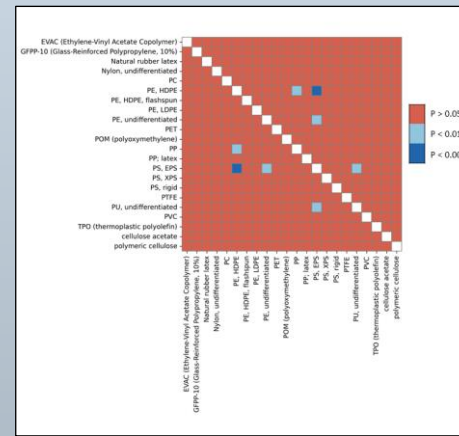
There is a relationship between beach and plastic type found. Regulating certain types of plastic at certain beaches could be effective.

Kruskal-Wallis Test Conclusions

At the beach level for any of the five Great Lakes, there is no significant difference between lakes in terms of plastic count. There are differences in terms of the type of plastic that can generally be found at a given beach but pairwise-comparisons show few differences by polymer. A more granular approach (e.g. beach to beach comparisons by lake) could provide more meaningful insights.

Main Takeaways

- Plastic pollution is an ongoing issue in the Great Lakes with primary plastic types found varying between beaches.
- Each of the Great Lake beaches generally have similar concentrations of plastic in terms of count.
- More research on the effects of certain polymers on local ecosystems is needed.



*Holm correction applied

Top 3 most abundant plastics across all lakes:
Polypropylene (PP, ex: Bottle caps), Polystyrene (PS, ex: foam cups), Cellulose Acetate (ex: cigarette butts)