Analysis of Persistent Organic Pollutants in *Sargassum* from Puerto Rico

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Introduction

Since 2011, there has been a significant increase in Sargassum biomass, which is correlated with factors associated with climate change and nutrients. As a result, Sargassum is more frequently observed on the beaches and in the waters of the Gulf of Mexico, the Caribbean, and West Africa as ocean currents transport the seaweed around in these areas. The objective of this research is to determine if Sargassum mats accumulate pollutants and serve as a source of pollutants in coastal environments as these mats form and sink to the bottom of these bodies of water. The results of this work indicate that Sargassum can accumulate persistent organic pollutants (legacy contaminants in particular) and serve as a vector for transporting POPs.

Figure 1. *Sargassum* accumulated on a Barbados beach (Oxenford, as pictured on PBS).

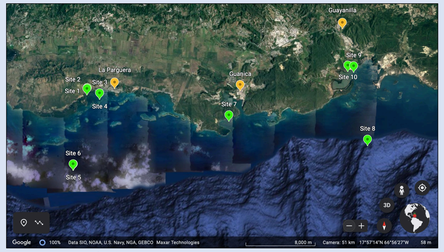

Figure 2. Map of collection sites. Sites are indicated by green pins and locations by yellow pins. Sites 1-6 are from La Parguera, Site 7 is from Guanica, and Sites 8-10 are from Guayanilla. Map created using Google Earth.

Methods

- *Sargassum* samples were collected in foil packets from ten (10) sites off the southern coast of Puerto Rico (Figures 1 & 2).
- *Sargassum* was extracted using a suite of persistent organic pollutants (POPs) via accelerated solvent extraction (ASE) followed by solid phase extraction (SPE) cleanup
  - POPs included polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), polybrominated flame retardants (PBDEs), and organochlorine pesticides
- Sample extracts were analyzed using gas chromatography mass spectrometry (GC-MS)

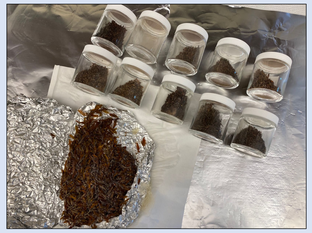

Figure 3. *Sargassum* specimens. Top: Desiccated *Sargassum* samples. Bottom: A frozen *Sargassum* sample.

Results

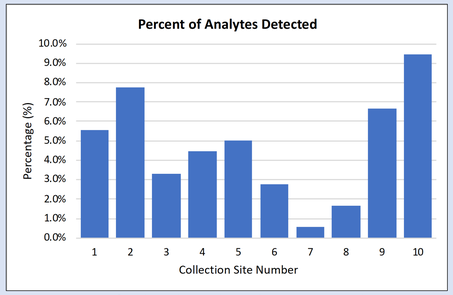

Figure 4. Percentage of analytes detected in each Sargassum sample. Equation used:

$$\% = \frac{(total\ \#\ of\ analytes\ detected\ in\ a\ sample)}{(total\ \#\ of\ analytes\ samples\ were\ analyzed\ for)} \times 100$$

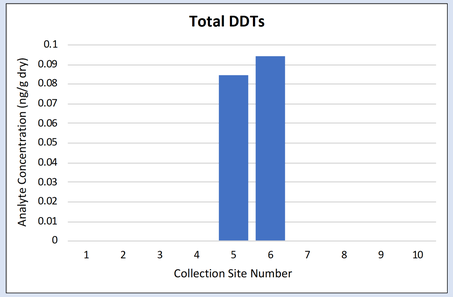

Figure 6. Total concentration of DDTs detected in each *Sargassum* sample. Only two samples (from Sites 5 and 6) contained detectable amounts of DDT breakdown products. The *Sargassum* sample from Site 6 also contained hexachlorobenzene, another type of OC pesticide.

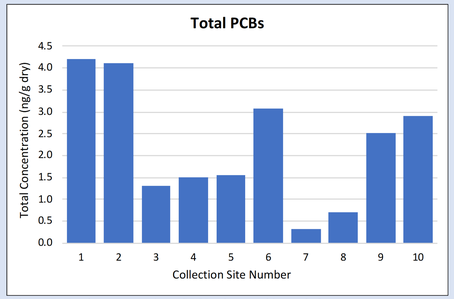

Figure 5. Total concentration of PCBs detected in each *Sargassum* sample. The mean concentration of PCBs with standard deviation across the ten sites was 2.2 ± 1.35 ng/g dry.

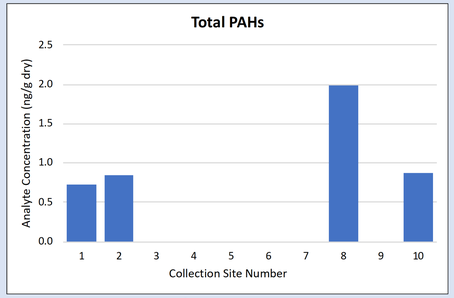

Figure 7. Total concentration of PAHs detected in each *Sargassum* sample.

Discussion

- Each *Sargassum* sample was analyzed for 180 POPs.
  - 50 PAHs, 14 PBDEs, 91 PCBs, and 25 OC pesticides
- All POP detections were at trace levels (none exceeded the effects range low (ERL)).
  - ERL is the threshold chemical concentration below which harmful biological effects are scarcely observed (Long et al., 1995).
  - The ERL values for total PCBs, total DDT, and total PAH is 22.7, 1.58, and 4022 ug/kg (ppb) dry weight, respectively (Long et al., 1995).
- Of all analyte classes we analyzed for, most were PCBs.
- Based on our results, we concluded that *Sargassum* can accumulate and be a vector for transporting POPs.
  - Problematic due to ocean currents' ability to spread contaminated *Sargassum* around to other areas besides origin of pollution
  - Persistence of these pollutants in the environment is a major issue due to their possible carcinogenic and toxic nature towards humans and animals
- Future studies are needed to determine ways to mitigate *Sargassum* and minimize contamination, and to understand the potential impacts of trace contamination in *Sargassum.*

Acknowledgements

I would like to thank my mentor, Emily Pisarski and the entire Ecotoxicology Branch at the Hollings Marine Laboratory for their continuous guidance and support throughout this project. I would also like to thank the NOAA EPP/MSI program for their funding. ERL definition and values by: Long, E. R.; Macdonald, D. D.; Smith, S. L.; Calder, F. D. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management* **1995**, *19* (1), 81–97. https://doi.org/10.1007/BF02472006. Figure 1 citation: Gaskill, M. Sargassum Blooms: Too Much of a Good Thing? https://www.pbs.org/wnet/nature/blog/sargassum-blooms-much-good-thing/.

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