INTRODUCTION

- Plastic waste is widely recognized as a pervasive marine pollutant [1].
- Microplastics (plastic fragments < 5 mm) have been found in fish and shellfish intended for human consumption (Fig. 1A) and commonly consumed by higher tropic marine wildlife (Fig. 1B) [2].
- We recently determined that microplastics can scavenge the zoonotic protozoan pathogens *Toxoplasma gondii*, *Cryptosporidium parvum*, and *Giardia enterica* in contaminated seawater, thus acting as vectors for pathogen transport (Fig. 2).
- The aim of this project was to conduct a literature review to summarize the spatial distribution and overlap of microplastics and targeted zoonotic protozoan pathogens in North America coastlines.

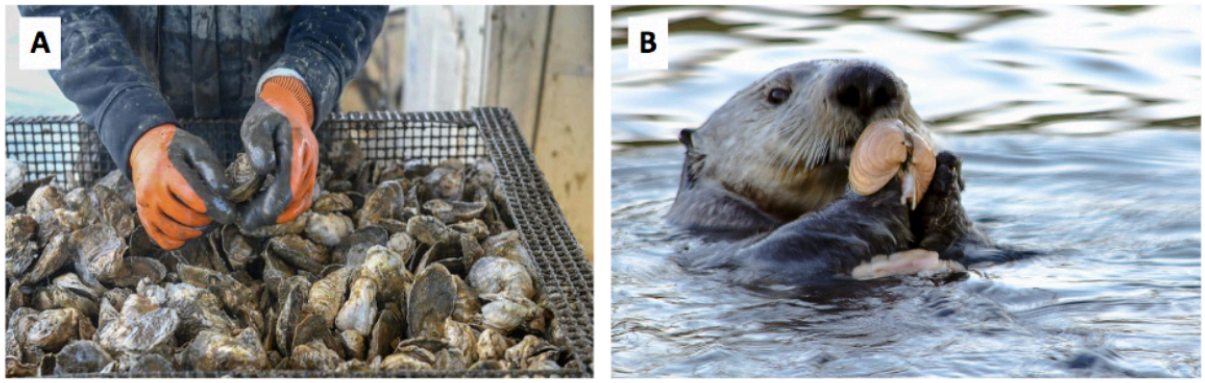

Figure 1: Microplastics, which are fragments of plastic debris have been found in shellfish destined for human consumption such as oysters (A) as well as prey of iconic marine wildlife species such as the California sea otter (B).

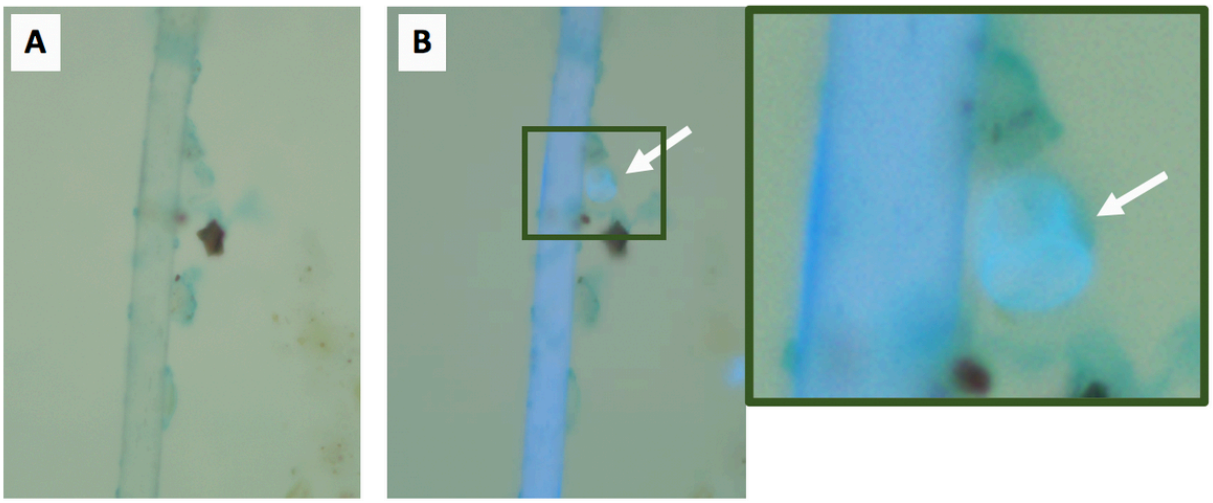

Figure 2: Polyester microfibers were preincubated in seawater to induce biofilm formation and placed in new seawater containing parasites for 8 days. A biofilm stained with alcian blue is visualized under brightfield microscopy (A). Using UV epifluorescence and brightfield illumination, we can see a *Toxoplasma gondii* oocyst (arrow) incorporated within the biofilm on the fiber surface (B and enlarged inset).

METHODS

- Two databases were used for identifying relevant literature: Web of Science and Aquatic Sciences and Fisheries Abstracts
- Keywords included: microplastic* OR Toxoplasma* OR giardia* OR cryptosporidium* AND Coast* OR marine OR estuar* OR shore* OR gulf OR bay AND "North America" (Fig. 3)
- Excluded studies included those where microplastics or protozoa were found in marine mammals, sea birds, or the open ocean
- R was used to develop a spatial map of the distribution of microplastics and parasites.

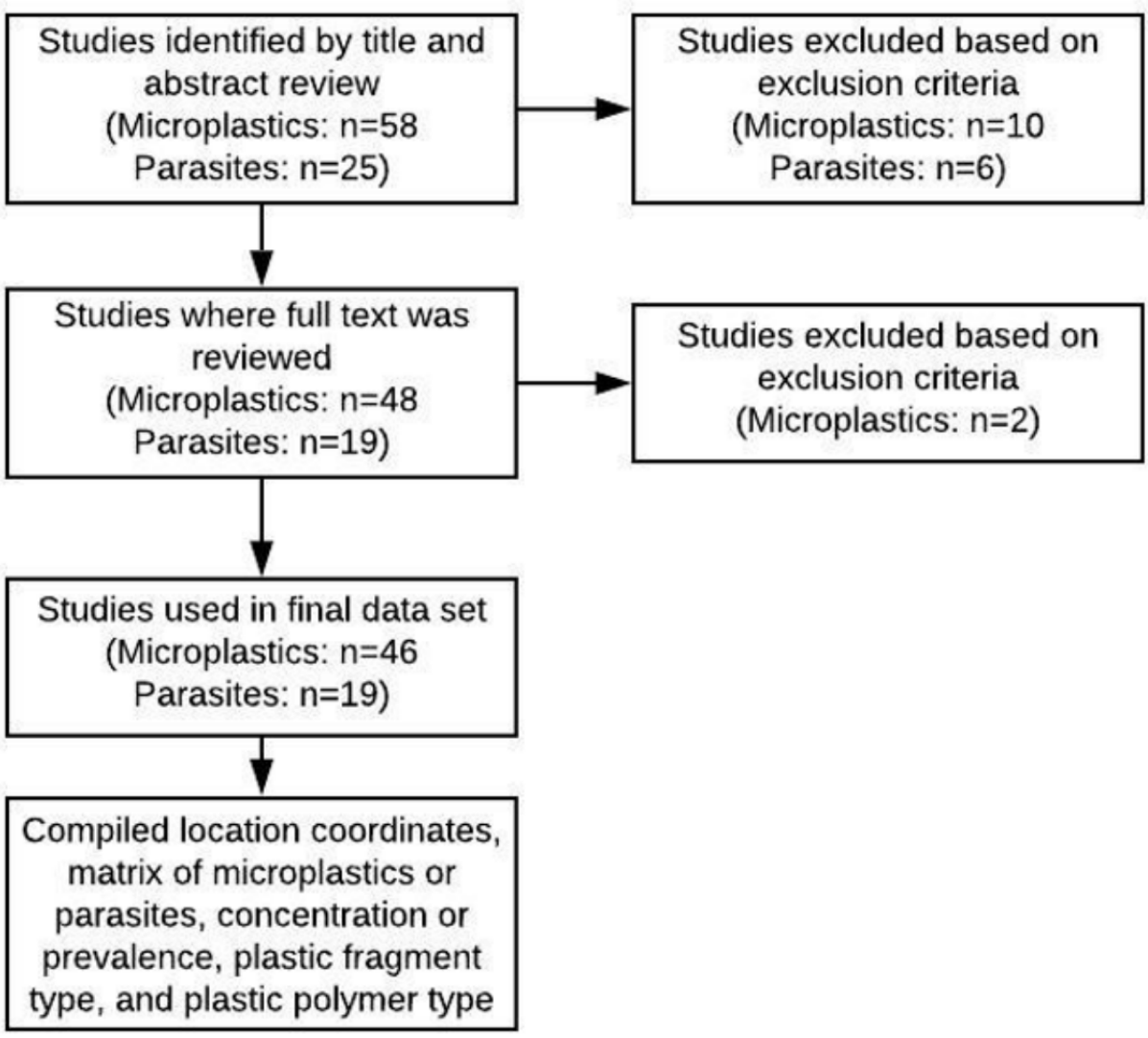

Figure 3: Microplastics and parasite literature selection process.

RESULTS & FIGURES

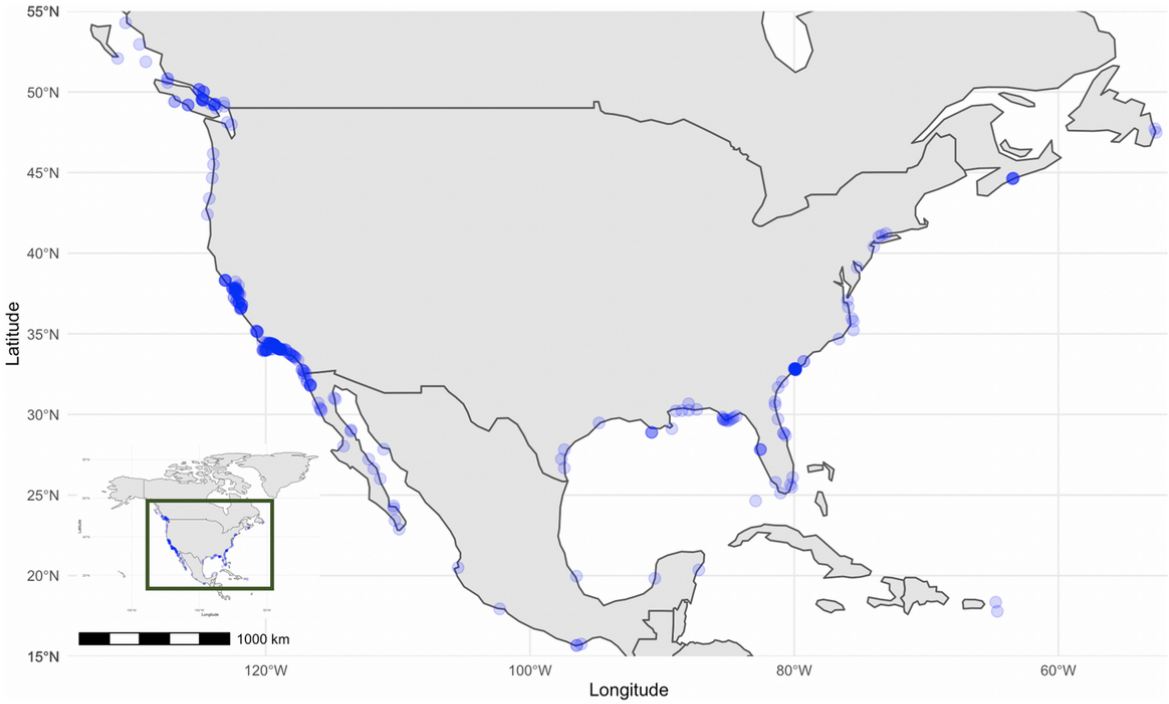

Figure 4: Microplastic distribution along North America coastlines with darker blue circles respresenting regions where more studies were reported.

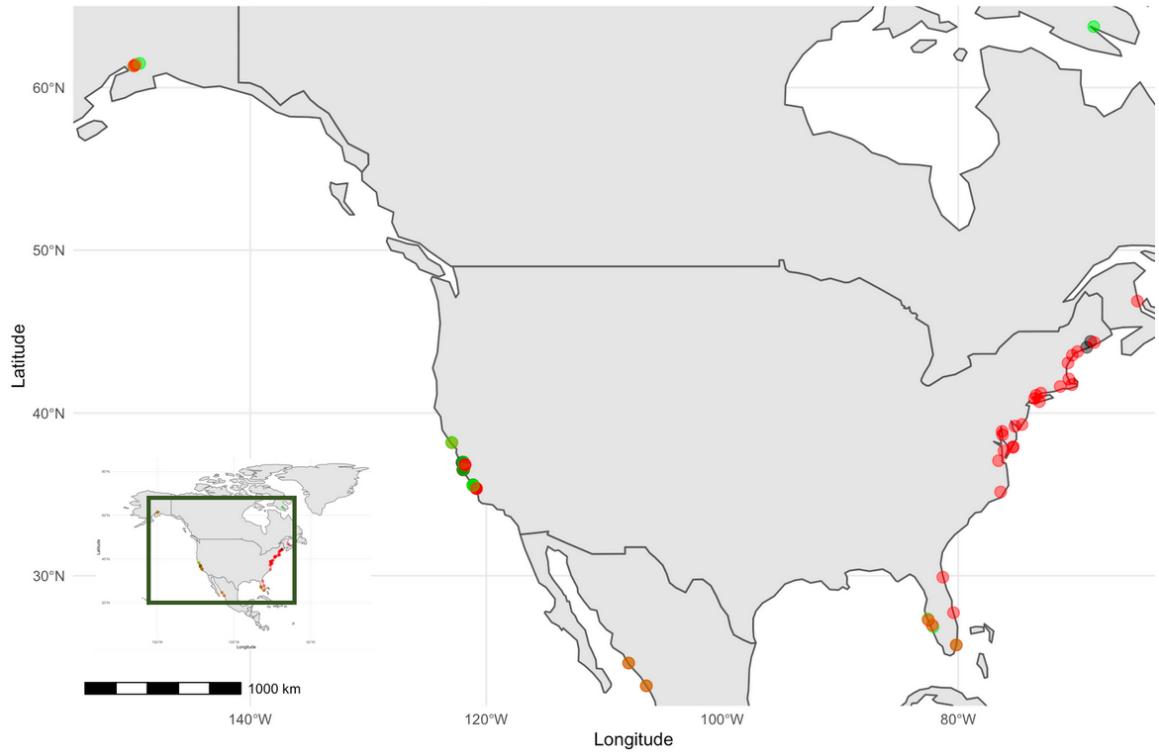

Figure 5: Parasite distribution along North America coastlines with darker circles representing regions where more studies were reported. Red = *Cryptosporidium* spp., Black = *Toxoplasma gondii,* Green = *Giardia* spp.

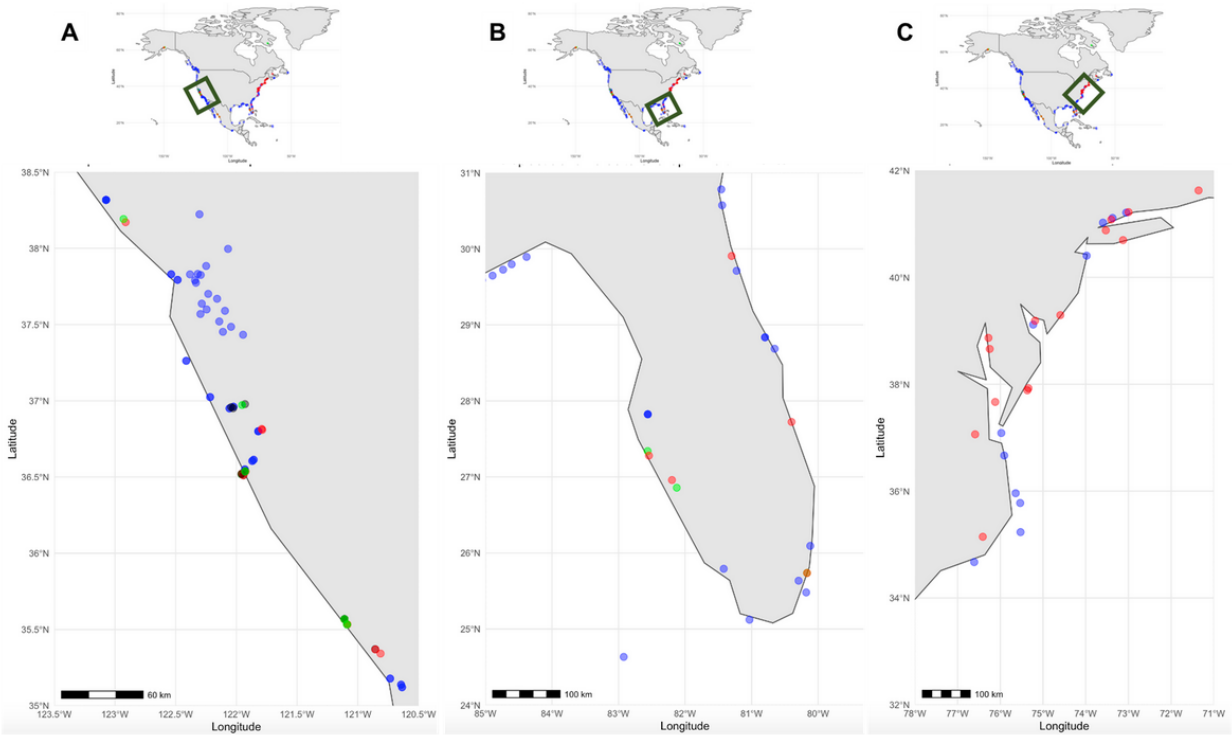

Figure 6: An overlap of reported microplastics and parasite contamination was observed on the California coast (A), Florida coast (B), and portions of the East Coast (C). Blue = microplastics, Red = *Cryptosporidium* spp., Black = *Toxoplasma gondii,* Green = *Giardia* spp.

DISCUSSION & FUTURE WORK

- A spatial overlap of reports documenting microplastics and pathogen contamination was found in coastal regions of California, Florida, and certain regions of the East Coast.
- The observation that microplastics and zoonotic pathogens contaminate the same coastal areas supports our hypothesis that anthropogenic pollutants such as plastics may alter the transmission behavior of zoonotic parasites in the marine environment.
- Most studies documented microfibers as the primary microplastic found. Our previous experiments demonstrated that microfibers have a greater ability of associating with parasites than microbeads. And so, microfibers may play an important role in mediating the transport and fate of these pathogens.
- Future work will focus on live aquaria studies to determine whether parasites associated with microplastics are more likely to be ingested by oysters than parasites in plastic-free seawater. These results will help elucidate the potential health impact due to the interaction between plastic and pathogen pollution on both marine wildlife and human health.

ACKNOWLEDGEMENTS AND REFERENCES

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References

1. Andrady AL. Microplastics in the marine environment. Marine Pollution Bulletin. 2011;62:1596-1605.

2. Barboza LGA, Vethaak AD, Lavorante BRBO, Lundebye AK, Guilhermino L. Marine microplastic debris: An emerging issue for food security, food safety and human health. Marine Pollution Bulletin. 2018;133:336-348.

3. The full list of studies included in the literature review are omitted for brevity but can be provided upon request.