Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

EIGHTH INTERIM PERFORMANCE REPORT

MAY 31ST, 2023

Project Title: The Fate and Toxicity of Microplastics and Persistent Pollutants in the Shellfish and Fish of Matagorda Bay

Submitted To:

Matagorda Bay Mitigation Trust

Performing Laboratory:

Texas A&M University on behalf of Texas A&M University at Galveston

Authors:

Ms. Emily Meese (Ph.D. student)

Mr. Asif Mortuza (Ph.D. student)

Mr. Marcus Wharton (Ph.D. student)

Dr. David Hala, Ph.D.

Dr. Karl Kaiser, Ph.D.

Dr. David Wells, Ph.D.

Dr. Lene H. Petersen, Ph.D.

Dr. Antonietta Quigg, Ph.D.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

The Fate and Toxicity of Microplastics and Persistent Pollutants in the Shellfish and Fish of Matagorda Bay

Personnel

Principal Investigators:

Drs. David Hala, Karl Kaiser, David Wells, Lene H. Petersen, Antonietta Quigg

Consulting MBMT Project Coordinator:

Mr. Steven J. Raabe

Location(s):

Texas A&M University at Galveston

Project Duration:

01 June 2021 – 31 August 2024

Objectives:

Objective 1: Quantify the extent of microplastics pollution in the surface waters and biota of Matagorda Bay.

Objective 2: Measure levels of persistent pollutants in surface waters, adsorbed to microplastics, and bioaccumulated in the biota of Matagorda Bay.

Objective 3: Study the toxicity of microplastics and adsorbed pollutants using embryo-larval life stages of sheepshead minnow.

Objective 4: Public educational outreach to local high school students on the science of ecosystem health monitoring.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

1. INTRODUCTION

1.1 Background

This project is studying the extent of microplastics, and persistent pollutant exposure of resident biota (shellfish and fish) sampled from Matagorda Bay and assessing any likely toxicity effects due to exposure. The *new knowledge* gained from the successful completion of this project will contribute to an understanding of the long-term fate and toxicity of microplastics (and adsorbed pollutants) in the Matagorda Bay system.

In this eighth interim report (March 1st, 2023 – May 31st, 2023) we provide a list of key accomplishments as per the fourth quarter of Year 2 of the project.

2. Key Updates

As of the period encompassing the eighth interim report (March 1st, 2023 – May 31st, 2023), the key achievements associated with each stated objective are detailed below.

Objective 1: Quantify the extent of microplastics pollution in the surface waters and biota of Matagorda Bay.

- The *fifth* interim report details the levels of various microplastics measured in the surface waters of Matagorda Bay. We are collecting additional dockside samples at various locations around Matagorda Bay through Summer 2023. Water samples collected using a pump system (> 5 µm filter size) along shoreline sites will be processed and analyzed by the end of this Summer (2023).

- The previously submitted *seventh* interim report presented the results of surface water samples and showed significant microplastic contribution from polyethylene (PE). Polyvinyl chloride (PVC) and nylon-66 (N-66) followed PE in relative abundance (%). Polypropylene (PP) was significantly higher at the Port O'Connor Jetty and Mid- Bay near the oyster reef. As stated, additional sampling and analysis is underway to understand the transport of these plastics throughout the estuary.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

- The analysis of microplastics levels in select biota from Matagorda Bay has been completed (**Fig. 1**).

- The plastics measured in muscle tissue (skin off) of fish and gill/mantle of oysters were, Polyethylene (PE), polypropylene (PP), polystyrene (PS), styrene butadiene rubber (SBR), polyvinyl chloride (PVC), polyamide N-6 (PA), nylon-66 (N66), polycarbonate (PC), polyurethane (PU), poly(methyl methacrylate) (PMMA), polyethylene terephthalate (PET) and Acrylonitrile butadiene styrene (ABS).

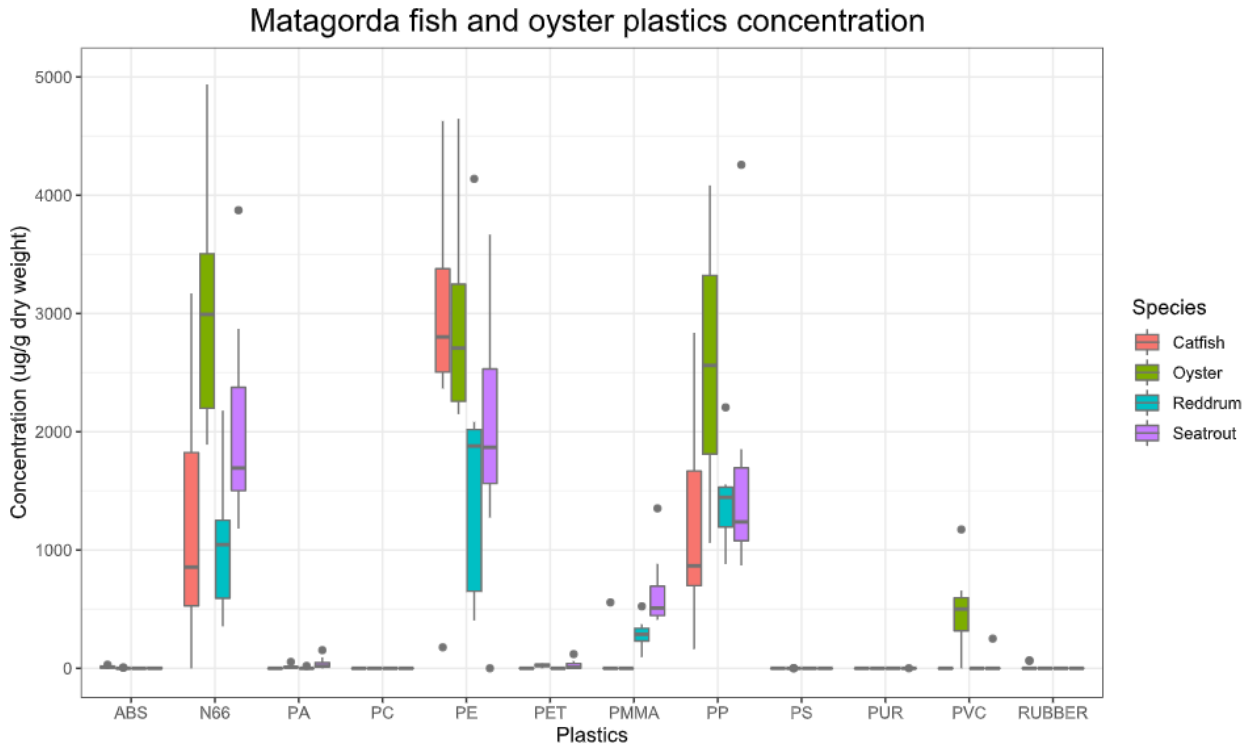

Fig. 1. Microplastics concentration of fish (Catfish, Red drum, Seatrout) and oyster collected from Matagorda Bay, reported in µg/g dry weight.

- In Matagorda Bay, the prominent plastics in fish and oyster were found to be N66 (Nylon), PE (Polyethylene) and PP (Polypropylene). Traces of PMMA (Poly(methyl methacrylate) were found in red drum and spotted seatrout; PVC (Polyvinyl chloride) was found in oysters.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

- Overall, oyster seemed to have the highest concentrations of N66, PE and PP compared to all the other species. Whereas catfish exhibited high concentrations of PE.

- Plastics such as PE and PP are used as single use plastics and found in plastic wrappers and bottles. Whereas, cast nets could contribute to nylon pollution in the bay (Singh et al., 2017).

- We can compare our findings to that of other authors (Ribeiro et al. (2021)), who have reported elevated concentrations of plastics in field deployed oysters near the mouth of Brisbane river in Australia. These authors have reported similar concentrations of plastics (i.e., ~3000 - 5000 µg/g of tissue) as reported in our study from Matagorda Bay (Ribeiro et al., 2021). And in agreement with our findings, Ribeiro et al., (2021) report higher levels of PE and PP. Although, they have not tested for Nylon.

Objective 2: Measure levels of persistent pollutants in surface waters, adsorbed to microplastics, and bioaccumulated in the biota of Matagorda Bay.

- Quantification of the levels of PAHs and PCBs in biota from Matagorda Bay has been completed and previously summarized in the previous *sixth* interim report.

- In addition to the pollutant body-burden analysis, we also performed a risk assessment for human sea food safety and cancer risk was also completed and reported in the *seventh* interim report. The Food and Drug Administrations (FDAs) cancer risk of consumption of fish and oysters from the two bays was determined to compare consumer safety.

Objective 3: Study the toxicity of microplastics and adsorbed pollutants using embryo-larval life stages of sheepshead minnow.

- This objective will be engaged with starting in Fall 2023 and onwards.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

- An Animal Use Protocol (AUP) to perform *in vivo* experimentation with early life-stages of embryo-larval sheepshead minnows (*Cyprinodon variegatus*) has already been approved by the A&M Institutional Animal Care and Use Committee (IACUC).

Objective 4: Public educational outreach to local high school students on the science of ecosystem health monitoring.

- Educational outreach engagement was pursued in collaboration with the TAMUG Sea Camp program in Summer 2022. Outcomes from the outreach activity was reported in the *sixth* interim report.

3. FURTHER WORK

Planned work for completion over the duration of the *ninth* interim report (start of Year 3) are as follows:

1) Prepare a manuscript for publication by Summer/Fall 2023 on the PAH and PCB data generated comparing pollutant levels in Matagorda vs. Galveston Bays.
2) Prepare a manuscript describing microplastics analysis methods and application to measuring levels in biota from Matagorda Bay (Summer/Fall 2023).
3) Plan the initiation of toxicological studies on the effects of microplastics and PAH/PCB mixtures on embryo-larval life stages of fish (Fall 2023).

4. REFERENCES

Ribeiro, F., Okoffo, E. D., O'Brien, J. W., O'Brien, S., Harris, J. M., Samanipour, S., Kaserzon, S., Mueller, J. F., Galloway, T., & Thomas, K. V. (2021). Out of sight but not out of mind: Size fractionation of plastics bioaccumulated by field deployed oysters. *Journal of Hazardous Materials Letters, 2,* 100021.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

Singh, N., Hui, D., Singh, R., Ahuja, I., Feo, L., & Fraternali, F. (2017). Recycling of plastic solid waste: A state of art review and future applications. *Composites Part B: Engineering, 115*, 409-422.

Texas A&M University at Galveston
1001 Texas Clipper Road
Galveston, TX 77554

Reviewed by:

5/31/2023

_____ Date: _____

Dr. David Hala, TAMUG, P.I.

Approved by:

_____ Date: May 31, 2023

Mr. Steven J. Raabe, Trustee