

**Quarterly Progress Report  
(June 2023)**

**Project Title**

**Mercury and Plastic in Commercial and Recreational Fisheries in Lavaca, Matagorda, and San Antonio Bays: Risk Assessment and Interaction between the Two Contaminants**

**Submitted to**

**Matagorda Bay Mitigation Trust**

**Domicile Laboratories**

<sup>1</sup>Coastal Health & Water Quality Laboratory, Department of Physical and Environmental Science, Texas A&M University – Corpus Christi

6300 Ocean Drive Unit 5802, Corpus Christi, TX 78412.

<sup>2</sup>Department of Biology, Texas State University

Freeman Aquatic Biology, 601 University Drive, San Marcos, TX 78666

**Principal Investigator**

Dr. Abdulla Hussain, PhD

Dr. Jeremy Conkle, PhD

**Co-Principal Investigator**

Dr. Jessica Dutton, PhD

(Texas State University, San Marcos)

**Project Team members**

Dr. Oluniyi Olatunji Fadare, PhD

Nigel Lascelles

Justin Elliott

Liam McInerney

Stephanie Lewis

Nikki Mayo

Kiersten Ivy

**Prepared by:** Dr. Oluniyi Olatunji Fadare, PhD

## **Objectives of the proposed project**

**Objective 1.** Quantify the abundance and spatial distribution of plastic debris, Hg, and Hg sorbed to plastic in water, sediment and fisheries throughout the three bays

**Objective 2.** Investigate the influence of water chemistry (salinity and dissolved organic matter concentration), temperature, plastic type, and age on the accumulation of Hg on plastic through a series of controlled laboratory experiments

**Objective 3.** Determine environmental rates of Hg sorption to new and fouled plastics in the three bays over one year.

**Objective 4.** Undertake a Hg risk assessment to determine the percentage of each species that exceed federal and state Hg advisory levels in each bay, determine how much of each species a person can consume per week, and calculate the Se:Hg molar ratios in fishes and shellfishes to determine whether Se has a protective role against Hg toxicity, how Se:Hg molar ratios vary with body length, and whether the ratios can be used as a seafood safety criterion in risk assessment.

## **Project Summary**

Lavaca Bay is a hotspot for plastic and mercury which can be transported to surrounding bays. This study will investigate the prevalence of plastic, measure Hg concentrations, and calculate the selenium:mercury molar ratios in commercial and recreational fisheries (e.g., red drum, black drum, spotted seatrout, shrimp, blue crab, oyster) in Lavaca, Matagorda, and San Antonio Bay. Experiments will investigate the extent Hg can bind to plastic and its potential role as a source of mercury to biota. They will help to improve ecosystem and human health while aiding the recovery of economically important fisheries in the three bays.

## **Introduction**

It is common knowledge and an issue of public concern that Lavaca Bay is highly polluted with plastics of various sizes, colors, and shapes which has been traced to the sharp practices of Formosa Plastics Cooperation and other anthropogenic activities. Also, Lavaca Bay was contaminated with mercury (Hg) from the industrial process of aluminum by the then Alcoa Point Comfort plant in the Superfund Site which was shut down in the 1980s. Therefore, this project investigates the extent and impact of plastics-mobilized mercury in different environmental matrices across the Lavaca and its surrounding bays.

The knowledge from this study will advise on the possible impact of both plastics and mercury on the biota, and its implication on the ecosystem as well as human health.

## Project Update

**Objective 1.** Quantify the abundance and spatial distribution of plastic debris, Hg, and Hg sorbed to plastic in the water, sediment, and fisheries throughout the three bays

The last sampling was carried out between March 24 and 25, 2023. Samples were collected from all 12 locations in San Antonio (SA) and Matagorda Bay (MB) except Seadrift. The Seadrift sampling site has been overrun by the construction on the site. Water/sediment parameters, sampling locations GPS, and photographs of each sampled location were documented. Processing of collected plastic litter continues at TAMU-CC. The FTIR characterization and polymer identification for two batches of samples (March, and July 2022) have been completed (Table 1); October 2022 and March 2023 are ongoing and await data cleaning and analysis. The samples collected from previous surveys await mercury quantification and data analysis.

**Table 1:** Summary of the FTIR characterization and polymer identification of the total samples collected in March, July, and October 2022 across all twelve sites.

Sampling Period	PE	PP	PET	Nylon	PS	PVC	PU	Other	Total
March 2022	158	122	43	37	38	36	9	57	500
July 2022	216	110	35	35	57	15	4	88	560
October 2022	376	179	47	37	45	11	15	22	732 <sup>+</sup>
March 2023	-	-	-	-	-	-	-	-	-

+ FTIR Characterization ongoing.

\*PE- Polyethylene; PP- Polypropylene; PET- Polyethylene terephthalate; PS- Polystyrene; PVC- Polyvinyl chloride; PU- Polyurethane

**Objective 2.** Investigate the influence of water chemistry (salinity and dissolved organic matter concentration), temperature, plastic-type, and age on the accumulation of Hg on plastic through a series of controlled laboratory experiments

Jordan Daniels is working on this objective for her thesis. Experiments start in Spring 2023.

**Objective 3.** Determine environmental rates of Hg sorption to new and fouled plastics in the three bays over one year.

The materials needed for this study await supply from various vendors.

**Objective 4.** Sampling is now complete for Austwell, Seadrift, Port O'Connor, and Matagorda. All species except southern flounder have been collected from Port Lavaca. Significant progress has been made to collecting all the specimens from the Closed Area (Point Comfort). The current sample size for each species and collection location is shown in Table 4.

**Table 4:** Fish and shellfish sample sizes to date at each collection location. NA = not available.

	<b>Austwell</b>	<b>Seadrift</b>	<b>Port Lavaca</b>	<b>Point Comfort</b>	<b>Palacios</b>	<b>Port O'Connor</b>	<b>Matagorda</b>
<b>Red drum</b>	4	82	54	54	28	63	86
<b>Black drum</b>	20	53	70	63		17	53
<b>Spotted seatrout</b>	29	62	60	25	29	122	90
<b>Southern flounder</b>	1	25	1	11	4	52	52
<b>Sheepshead</b>	NA	2	3	7		3	4
<b>Hardhead catfish</b>	54	67	56	56	3	62	50
<b>Striped mullet</b>	6	60	60	83	60	61	60
<b>Atlantic croaker</b>	1	61	60	5	60	99	60
<b>Blue crab</b>	NA	64	60	4	23	NA	60
<b>White shrimp</b>	NA	60	60	3	60	60	60
<b>Eastern oyster</b>	NA	63	85	60	67	NA	60

Mercury analysis is ongoing. The species at each site which have been analyzed are shown in Table 2.

**Table 2:** Fishes and shellfishes that have undergone Hg analysis at each collection location. Y = all samples have been analyzed. ND = not determined because could not be sampled.

	<b>Austwell</b>	<b>Seadrift</b>	<b>Port Lavaca</b>	<b>Point Comfort</b>	<b>Palacios</b>	<b>Port O'Connor</b>	<b>Matagorda</b>
<b>Red drum</b>		Y				Y	Y
<b>Black drum</b>		Y				Y	Y
<b>Spotted seatrout</b>		Y				Y	Y
<b>Southern flounder</b>		Y				Y	Y
<b>Sheepshead</b>	ND	Y				Y	Y
<b>Hardhead catfish</b>	Y	Y				Y	Y
<b>Striped mullet</b>		Y	Y		Y	Y	Y
<b>Atlantic croaker</b>		Y	Y		Y	Y	Y
<b>Blue crab</b>	ND	Y	Y		Y	ND	Y
<b>White shrimp</b>	ND	Y	Y		Y	Y	Y
<b>Eastern oyster</b>	ND	Y	Y		Y	ND	Y

Selenium analysis has started, and we have made significant progress. The species at each site which have been analyzed are shown in Table 3.

**Table 3:** Fishes and shellfishes that have undergone Se analysis at each collection location. Y = all samples have been analyzed. ND = not determined because could not be sampled.

	<b>Austwell</b>	<b>Seadrift</b>	<b>Port Lavaca</b>	<b>Point Comfort</b>	<b>Palacios</b>	<b>Port O'Connor</b>	<b>Matagorda</b>
<b>Red drum</b>							
<b>Black drum</b>		Y				Y	Y
<b>Spotted seatrout</b>							
<b>Southern flounder</b>		Y				Y	Y
<b>Sheepshead</b>		Y				Y	Y
<b>Hardhead catfish</b>						Y	Y
<b>Striped mullet</b>		Y	Y		Y		Y
<b>Atlantic croaker</b>		Y	Y		Y		Y
<b>Blue crab</b>		Y	Y		Y	ND	Y
<b>White shrimp</b>		Y	Y		Y	Y	Y
<b>Eastern oyster</b>						ND	

The Hg and Se data for the Matagorda samples was presented at the Society of Environmental Toxicology and Chemistry (SETAC) South Central Annual Meeting in late March 2023.

Daniels, JL, McInerney, BJ, and Dutton, J. (2023). Selenium:mercury molar ratios in commercially and recreationally important fish and shellfish species in southeastern Matagorda Bay, Texas. Society of Environmental Toxicology and Chemistry South-Central Regional Meeting. Denton, TX.

Plastic data was presented at the Society of Environmental Toxicology and Chemistry (SETAC) South Central Annual Meeting in late March 2023 and Texas Plastics Pollution Symposium in early April in Houston.

Fadare, OO, Lascelles, N, Myers, JT, Conkle, JL, Dutton, J, and Hussain, AA (2023). Plastics, Polycyclic Aromatic Hydrocarbons, and Mercury Interactions within the Matagorda Bay System: Does this pose a risk to fish health? Society of Environmental Toxicology and Chemistry South-Central Regional Meeting. Denton, TX.

Fadare, OO, Martin, L, Lascelles, N, Myers, JT, Kaiser, K, Xu, W, Conkle, JL and Hussain, AA (2023). A Novel Method for Micro(nano)plastics extraction in Particulate Organic Matter from Lavaca Bay System. Society of Environmental Toxicology and Chemistry South-Central Regional Meeting. Denton, TX.

Gallagher, C, Fadare, OO, Conkle, JL, and Hussain, AA (2023). Towards long-term monitoring of Plastic pollution in the Matagorda Bay Systems: Quantitative Analysis and FTIR Characterization of Macroplastics. Texas Plastics Pollution Symposium. Houston, TX.

Fadare, OO, Lascelles, N, Conkle, JL, 2023. <https://www.youtube.com/watch?v=zEc-RnzAwDM>

Goals for the next quarter:

- Finish sample collection
- Finish Hg analysis
- Continue the Se analysis
- Continue Plastics data processing
- Move the plastic samples to Dr. Dutton's lab for Hg Analysis