

## **Quarterly Progress Report**

**(March 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 periodic sampling will continue after logistics delay and unfavorable weather with the most recent sampling to be carried out between March 24 and 25, 2023. Samples will be collected from all 12 locations in San Antonio (SA) and Matagorda Bay (MB) (please see Table 4) 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 will be appropriately documented. Processing of collected plastic litter continues at TAMU-CC. Polymer identification for two batches of samples have been completed and awaits data cleaning and analysis. The samples collected from previous surveys await mercury quantification and data analysis.

**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

Recruited a M.S. student, Jordan Daniels, who will complete this objective for her thesis. Experiments will start Spring 2023.

Determined which types of plastic to use for the experiments – PVC powder, PE nurdles, and aerated polystyrene.

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

A pilot sampling was conducted between October 5-26, 2022 to predict possible challenges during our major sampling which is expected to start in Spring 2023 (Figure 2). The materials needed for this study have been approved and we await supply from various vendors.

**Objective 4.** Tried to continue sampling throughout this quarter, but all except one trip was canceled due to high winds. We managed to increase the sample size for some species in Austwell and Port Lavaca. We have a three day sampling trip scheduled to Port Lavaca and Point Comfort for the first week of April; hopefully, the weather will cooperate. This sampling delay is beyond our control. The current sample size for each species and collection location is shown in Table 1.

**Table 1:** Fish and shellfish sample sizes to date at each collection location. NA = not available (could not be found).

	<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>	3	82	6	32	27	63	86
<b>Black drum</b>	19	53	10	31		17	53
<b>Spotted seatrout</b>	29	62	26	11	20	122	90
<b>Southern flounder</b>		25	1	8	4	52	52
<b>Sheepshead</b>		2	1	7		3	4
<b>Hardhead catfish</b>	54	67	12	47	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>		64	60	4	23	NA	60
<b>White shrimp</b>		60	60	3	60	60	60
<b>Eastern oyster</b>		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					
<b>Southern flounder</b>		Y				Y	Y
<b>Sheepshead</b>		Y				Y	Y
<b>Hardhead catfish</b>		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>		Y	Y		Y	NS	Y
<b>White shrimp</b>		Y	Y		Y	Y	Y
<b>Eastern oyster</b>						NS	

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.

	Austwell	Seadrift	Port Lavaca	Point Comfort	Palacios	Port O'Connor	Matagorda
<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
<b>Striped mullet</b>					Y		
<b>Atlantic croaker</b>							Y
<b>Blue crab</b>		Y	Y		Y	ND	
<b>White shrimp</b>		Y	Y		Y	Y	Y
<b>Eastern oyster</b>						ND	

Goals for the next quarter:

- Continue sample collection (aim is to at least finish Point Comfort and Port Lavaca)
- Finish Hg analysis of all species at each collection location that have reached the required sample size
- Continue the Se analysis
- Present the Hg and Se data for the Matagorda samples at the Society of Environmental Toxicology and Chemistry (SETAC) South Central Annual Meeting in late March 2023.



**Figure 1:** Pilot Sampling to determine environmental rates of Hg sorption to new plastics conducted between October 5-26, 2022.

**Table 4:** GPS of the sampling sites with few observations during sampling.

Bay	Sites (n=13)	Name	Coordinates	Remarks
SA	Austwell	AU	28 23'24"N 96 50'15"W	Typically high debris content, mostly fishing line.
MB	Point Comfort	PC	28 40'00"N 96 34'27"W	This site is on the site of the road with the food truck. It's imperative to hit this site with low tides or weak tides to get a larger space. We did not sample past the barbed wire. Very high debris, broken glass and hooks inclusive.
MB	Point Comfort - Cross Road	CR	28.667278 - 96.575641	This site is across the causeway from the site above. There is a steep incline from road to the beach.
MB	Boggy Creek National Park	BC	28 27'35"N 96 24'46"W	Lots of glass at this site. High clay content and many burrowed crabs.
MB	Palacios	PA	28 41'53"N 96 12'54"W	A lot of fishing line and other debris. Located right next to the pier. Fairly heavy foot traffic. High amounts of cigarette Butts.
MB	Bayfront Peninsula Park (Port Lavaca Harbour)	BP	28 36'59"N 96 37'19"W	High oyster shell content, it was difficult to get the full bag for all samples because of the sediment type.
MB	6 Mile	SM	28 41'37"N 96 39'45"W	A lot of organic matter on the beach, not too much litter.
MB	Texas Parks & Wildlife Beach	TP	28 38'30"N 96 19'23"W	This was a <i>very</i> dirty beach.
MB	Lighthouse Beach RV Park	LH	28 38'21"N 96 36'39"W	Easy beach to access, lots of people using it, high debris (mostly kids toys)
MB	Magnolia Beach	MG	28 33'36"N 96 32'14"W	No visible debris.
MB	Holiday Inn	HI	28 38'24"N 96 36'56"W	The sediment was not too bad. There is a small creek running into the bay from this area.
MB	Port Lavaca - "Corner Beach"	CB	28.612329, - 96.620149	Very high amount of large debris.