Microplastics in the Galveston Bay Watershed: The Big Impacts of Tiny Pollution

Final Report

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Turtle Island Restoration Network
Fighting for a blue-green planet

Galveston Bay Estuary Program
A program of the TCEQ

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Abbreviations

˚C	Celsius
DI	Deionized Water
EPA	U.S. Environmental Protection Agency
EIH	Environmental Institute of Houston
gallon	gal
GBEP	Galveston Bay Estuary Program
km^2	kilometer squared
L	liter
m	meter
mg	milligram
µm	micrometer
mm	millimeter
mP/L	microplastics per liter
µs	microsiemens
psu	practical salinity units
TCEQ	Texas Commission on Environmental Quality
TIRN	Turtle Island Restoration Network
USGS	United States Geological Survey

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EXECUTIVE SUMMARY

Anthropogenic debris, primarily composed of plastics, is a pervasive and global environmental issue. Plastics are non-biodegradable by design. The very attributes that make plastics such a useful and transformative technology also make them particularly challenging pollutants. While plastics do not biodegrade, they do break apart and weather into smaller and smaller pieces through time. Microplastics are pieces of plastic that are less than 5 millimeters (mm) in diameter. While plastic pollution is ubiquitous across the globe, urban centers are the source for the majority of plastic pollution in marine ecosystems. Galveston Bay is home to the majority of the country's plastic manufacturers and major ports from which these commodities are shipped worldwide. Currently there is a lack of baseline data on plastics (particularly microplastics) within Galveston Bay.

The project was designed to provide a preliminary baseline characterization of the types, concentration, and distribution of microplastics within the Galveston Bay estuary. Ten sites were sampled during two events, approximately six months apart (March and September) in 2022. Sites were categorized into two types, open bay and shoreline. Three replicate water grabs, and sediment samples were collected at each site and event. Three replicate neuston tows were also completed at all open bay sites and events. Methods for processing the samples varied by sample type, but all samples were observed under a microscope with at least 20X magnification and scanned systematically. Each piece of microplastic was counted and placed into one of five categories (fragments, fibers, films, nurdles, and microbeads). Data were analyzed to determine if there were differences among sampling events, site types, and in the amount and types of microplastics collected.

The average number of days since last significant rainfall at the time of sampling for the March event was 34 days, while the average number of days since last significant rainfall at the September event was 5 days. While the salinity in the bay did not differ significantly between the March and September events, the Secchi (meter (m)) was significantly lower (meaning the water was more turbid) during the September event compared to the March event. Microplastics were identified in every sample collected throughout this study. The overall average density of microplastic pieces in water grab samples was 44.5 pieces of microplastics per liter (mP/L). There were significantly higher concentrations of microplastics in water collected during the September (72.2 mP/L) sampling event than the March (16.8 mP/L) event. There was a significant dissimilarity in the composition of microplastics by type observed in water grabs between events. Overall, there was not a significant difference in the number of microplastics collected at open bay versus shoreline sites or types of microplastics per L of water. The overall average density of pieces of microplastics collected in neuston samples was 7.43 mP/m^3 of water. There were on average more microplastics collected in the neuston net during the September (8.89 mP/m^3) sampling event than the March (5.88 mP/m^3) event. No statistically significant differences were detected in the total number of microplastics collected in neuston nets by type or event. When averaged across all events and sites, 692.68 mP/m^2 pieces of microplastics were collected in sediment samples. There were on average more microplastics collected in shoreline sediment samples (768.27 mP/m^2) compared to open bay samples (617.10 mP/m^2), but the difference was not statistically significant. The study failed to detect statistically significant differences in the number of each type of microplastic collected per m^2 of sediment by site type

(shoreline or open water). There was a significantly dissimilar composition of microplastics by type observed in sediments by event.

The first event (March 2022) occurred after a prolonged period with little rainfall in the watershed while the second event (September 2022) occurred during a period with more recent rainfall in the watershed. Unfortunately, with the limited data associated with this initial study the team is unable to determine the causation of the differences observed between these two events, but other studies have shown that microplastics in surface waters increase during increased inflows from stormwater events. The most common type of microplastics observed in both water and sediment samples in Galveston Bay were fragments followed by fibers. These are commonly the two most abundant types of microplastics observed in surface waters and sediments. Neuston samples resulted in lower than expected quantities of microplastics compared to the water grab samples. In waters with moderate to high microplastic concentrations, grab sampling has been shown to collect more microplastics per volume of water. Neuston nets, and other plankton nets can be helpful in sampling large volumes of water needed in areas with low microplastic concentrations such as open ocean or oligotrophic environments. Because of these challenges, the team does not recommend this method of sampling in Galveston Bay in future plastic monitoring projects.

The team encountered challenges in the procedures for processing our microplastic samples. The result of these challenges is a conservative evaluation of microplastic quantity. This study did not conduct organic digestion. As a result, some sediment samples with a high volume of small particle size materials required processing through the density separator twice. This is a labor and time intensive process. All microplastics reported in this study were visually enumerated using a high-powered dissecting microscope. This process is very time consuming and requires skill and consistency. When enumerating the microplastics under the microscope, only particles that the observer was “highly confident” in microplastic identity were included. There are a range of methods that can be used to quantify microplastics, each with their own pros and cons. The use of fluorescent dye or infrared microscopy to identify microplastics has shown promising results. Overall, there is a need for standardized methods for routine microplastic monitoring. Comparing the results of this study to other studies should be done with consideration to collection, processing, and enumeration techniques. Tampa Bay is a relatively large and industrialized bay within the northern Gulf of Mexico that has some baseline microplastic data available for comparison. The Tampa Bay study had an average water grab concentration of 0.94 mP/L while this study produced an average of 44.52 mP/ L of water. Assuming the average concentration of 44.52 mp/L in the surface waters, and an open water surface area of 1,530 kilometer squared (km^2), the team estimates that there could be over 20.4 trillion pieces of microplastics in just the top 0.3 m of water in Galveston Bay at any one time. This study was a first attempt to estimate microplastic quantity and types distributed throughout the Galveston Bay system’s waters and sediments. Continued monitoring is important to begin to document trends in microplastic sources, concentration, distribution, and changes through time to inform future best management practices to reduce microplastic pollution to Galveston Bay.

INTRODUCTION AND BACKGROUND

The Galveston Bay watershed is home to the majority of the United States petrochemical industry (Bridges 2019). Many of the facilities at these locations produce plastic, including plastic pellets, which are subsequently melted down and molded to form plastic products. A large amount of this plastic is also exported via shipping to distant ports. The Houston Ship Channel complex and its more than 200 public and private facilities is the nation's largest port for waterborne tonnage (Port of Houston 2024). Evidence of microplastics in offshore sediment in the Flower Garden Banks (FGB), located 120 miles southeast of Galveston, Texas was observed as early as 1980s (Guillen personal observation[1]). The FGB is adjacent to multiple shipping lanes leading from Galveston Bay to offshore routes (NOAA, 2024).

Past studies of coastal harbors documented the highest levels (up to 95% in surface area) nationally of floating plastic pellets and other debris in the Houston Ship Channel (Battelle Ocean Sciences 1992a and 1992b, Redford et al. 1992). The large urban area within the Galveston Bay watershed increases the likelihood of ongoing chronic plastic pollution including the loading of microplastics (i.e., plastic particles less than 5 millimeters (mm) in diameter).

Recent studies worldwide have drawn attention to the risks posed by microplastics to marine ecosystems (Vegter et al. 2014). As plastics in the marine environment are exposed to light over time, they break down into smaller fragments and are easily consumed by marine organisms. Plastics have been found in all trophic levels of marine organisms, from filter-feeding invertebrates all the way up to large pelagic fishes and mammals (Avio et al. 2017). Plastics and associated contaminants are amplified as they accumulate up the food chain through the process of biomagnification. To combat the problem of microplastics, we need to first understand the type and amount of microplastics entering the area through long-term monitoring. Unfortunately, there is a paucity of long-term monitoring data on microplastics in sediment, water, and biota within coastal regions of the United States (Barboza and Gimenez 2015). Recent efforts in the Gulf of Mexico have demonstrated the value of routine monitoring of shorelines by citizen scientists (Tunnell et al. 2020).

Currently there is a lack of long-term baseline data on plastics (particularly microplastics) within Galveston Bay watershed including upstream tributaries, and nearshore Gulf of Mexico (GOM) waters (GBF 2024, GBRMD 2024). A survey for microplastics was initiated by the United States Geological Survey (USGS) with funding from Galveston Bay Estuary Program (GBEP) during 2022 to assess the occurrence and abundance of microplastics (< 5mm in diameter in tributaries to Galveston Bay (USGS 2024).

Project Significance and Objectives

The project was designed to provide better understanding of the concentration, distribution and types of microplastics in the Galveston Bay watershed. The project also seeks to build general scientific literacy and environmental stewardship among Galveston Bay residents of all ages regarding microplastics; and increase public knowledge and utilization of the research capacity

[1] coauthor George Guillen found plastic pellets circa 1980-82 while sorting sediments for a benthic study of the Florida Garden Banks conducted by TERECO.

and conservation programs that exist throughout the Galveston Bay area. This effort supplemented and expanded upon shoreline surface water and sediment microplastics data collected by Turtle Island Restoration Network (TIRN) at sites in lower Galveston Bay and recent surface water samples collected by USGS in the tributaries and open bay waters of Galveston Bay (Lucena 2021a; Lucena 2021b).

The objectives of the study were to:

1) Classroom Education: provide in-classroom lessons for grades 4-12 to help students understand watershed science and the impacts of microplastics on the Galveston Bay ecosystem. (report provided in Appendix B)
2) Student Citizen Science Sampling: provide students with field applications of the lessons learned in the classroom setting by collecting and analyzing water samples for microplastics. (report provided in Appendix C)
3) Water and Sediment Sampling: Estimate microplastic densities for surface water and sediment samples at up to five sites along the shoreline and in open waters of Galveston Bay.
4) Public Outreach: Encourage public environmental stewardship and provide resources to reduce plastic pollution in the Galveston Bay Watershed and the Gulf of Mexico. (report provided in Appendix D)

METHODS

All project data collection was performed under an approved Quality Assurance Project Plan (QAPP): Microplastics in the Galveston Bay Watershed: The Big Impacts of Tiny Pollution QAPP Rev. 0, Q-Trak # 22-135.

Study Sites

Ten sites within Galveston Bay were sampled in 2022 (Table 1 and Figure 1). Sites were categorized into two types, open bay and shoreline. Sites were sampled during two events, approximately six months apart. Three replicate water grabs, and sediment samples were collected at each site and event. Three replicate neuston tows were also collected at each open bay site and event. Replicate results were used to document and assess the environmental variability in microplastic concentrations. Due to time requirement for processing and enumerating the sediment samples only two of the three replicates have been completed and are included in this report.

Table 1. Study sites by site type.

Site Type	Site ID	Site Description	Latitude	Longitude
Open Bay	B1 Trinity	Near the mouth of the Trinity River in Trinity Bay	29.71338	-94.72665
	B2 Channel	Houston Ship Channel near Morgan's Point (mouth of the San Jacinto River in Upper Bay)	29.67522	-94.97604
	B3 Center	Between Upper and Lower Galveston Bays, between Redfish and Smith Point	29.51170	-94.84272
	B4 TXC Dike	Lower Galveston Bay between the Texas City Dike and the Houston Ship Channel	29.39040	-94.84067
	B5 Bolivar	In the center of Bolivar Roads between Galveston Island and Bolivar Peninsula	29.35345	-94.74466
Shoreline	S1 Trinity	At the end of Detwiler Rd in Fort Anahuac Park near the Trinity River Delta	29.73011	-94.69632
	S2 Sylvan	The north beach at Sylvan Beach Park off of Bayshore Dr.	29.65474	-95.00799
	S3 El Jardin	The south beach at El Jardin Beach Park on El Jardin Dr.	29.59612	-94.98650
	S4 Moses	Beach at Dollar Point off of Beach Dr.	29.43294	-94.89194
	S5 TXC Dike	On the northeast side of the Texas City Dike approx. 1.1 km from the end of the dike	29.36904	-94.82021

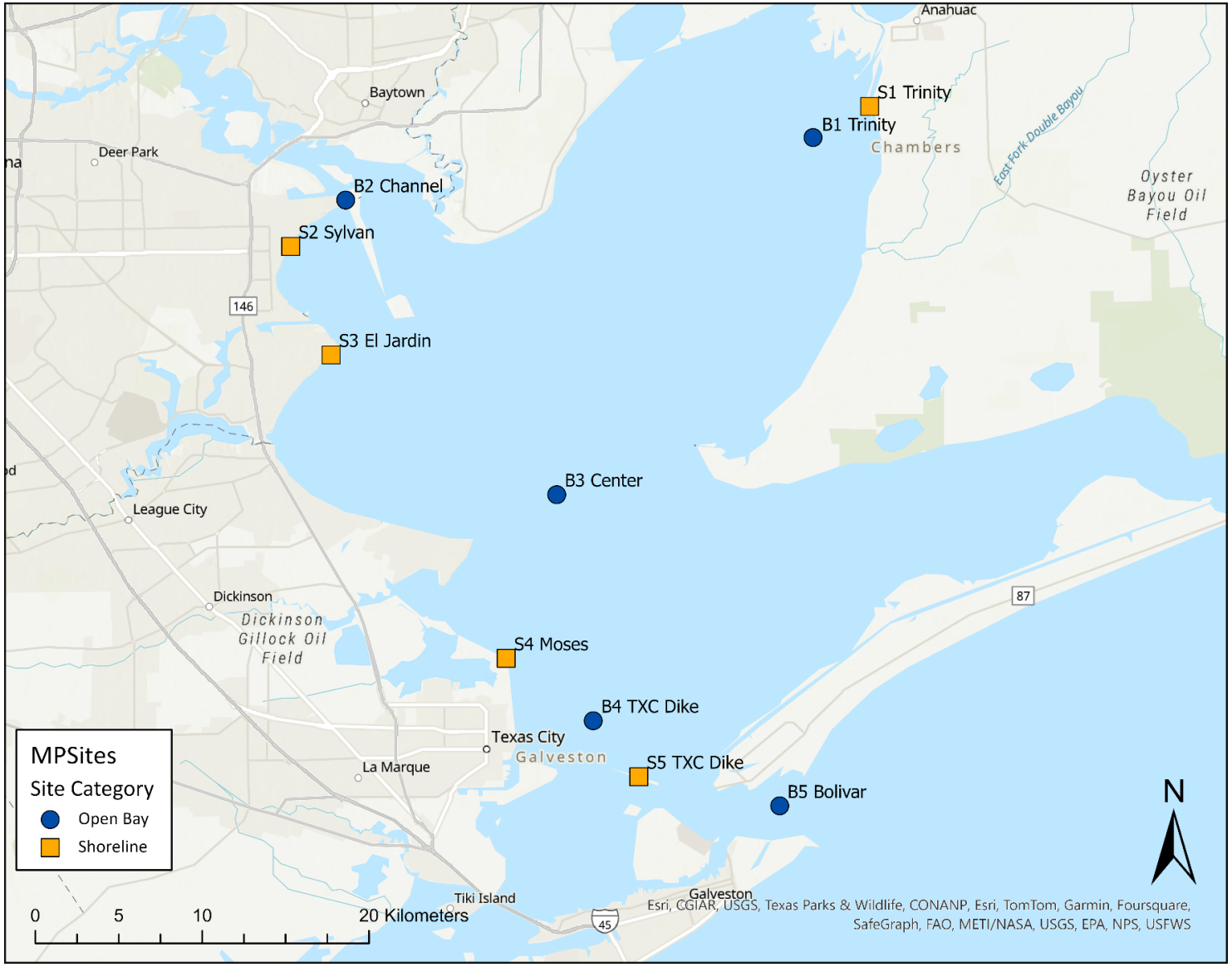

Figure 1. Map of study sites in Galveston Bay, Texas. Blue circles represent open bay sites and orange squares represent shoreline samples. Corresponds with Table 1.

Field Methods

Concurrent with microplastics sample collection, site variables were measured at open bay and shoreline sites at 0.3 meters (m) from the surface and 0.3 m from the bottom of the water column (e.g., water temperature (˚Celsius (˚C)), pH, dissolved oxygen (milligram (mg)/L), specific conductance (microsiemens (µS)), salinity (practical salinity units (psu)), and depth (m) of measurement) using a calibrated YSI multiprobe instrument, according to TCEQ SWQM published protocol (TCEQ 2012). Surface water transparency was measured using a Secchi tube according to protocol described by TCEQ (2012). The total depth to the nearest 0.1 m at the point of sampling was determined using a meter stick, or calibrated multiprobe instrument. In addition, weather and other physical data were observed and recorded. The geographical coordinates of each sampling site were determined a navigational grade GPS instrumentation and confirmed using a combination of navigational charts, and established georeferenced landmarks. During neuston net tows, the beginning and ending coordinates were recorded. To avoid contamination, sampling equipment was transported in a sealed container and all equipment was rinsed three times with deionized (DI) water and ambient water prior to sample collection to minimize contamination.

Open Bay Sample Collection

Water Grabs

Microplastic surface water grab samples were collected using methods consistent with the Florida Microplastic Awareness Project Volunteer Manual (FMAP 2017). Triplicate 1-L samples were collected using glass jars. Water grab samples were collected by hand from the side of the vessel. Before collecting each sample, the jars and lids were rinsed three times with seawater from the site. The sampler then moved to a nearby area that was not affected by the rinsing procedure and held the jar horizontally, lowering the jar into the water slowly to collect water from the surface until it was full. Samples were then placed on ice until filtering occurred.

Neuston Tows

To reduce the potential influence of floating microplastic patchiness associated with small sample grab volumes and low replication the study also utilized a Neuston Net (Sea-Gear Corporation) to sample the upper water layer. The frame was constructed of stainless steel and measured 0.5 m high by 1 m wide. The neuston net measured 5 m in length and was constructed of 335-micron nitex mesh. A detachable cod end constructed of hard polymer plastic containing a 335-micron stainless steel screen was attached to the net. The net was towed for a target of 15 minutes at a target speed of 1.5 knots. The net was towed alongside the boat using a boom which aided in keeping the net outside the propeller wash. The speed of the boat and time were recorded, and the amount of the net submerged (target 50%) was reported from five timed measurements throughout the tow and averaged to aid in calculating the volume filtered per tow. The cod end was removed from the net and the sample contents transferred to a 1 L glass jar and preserved with 70% ethanol due to the presence of biological bycatch (plankton) in the neuston net.

During the first round of sampling on March 10, 2022, a Sea-Gear MF 313 flow meter was used during three tows in Trinity Bay. For all subsequent sampling a General Oceanics Model M2030 was used as it was found to perform more reliably than the Sea-Gear MF-315. The actual effective distance towed with the neuston net was calculated using the flow meter manufacturers formula. The MF 315 uses the number of revolutions (end count - start count) multiplied by 0.245 to attain the effective distance (m) the net was pulled. For the model M2030 the number of revolutions multiplied by 0.027 provided the effective meters towed. The effective volume sampled using the neuston net tow was calculated using the area of the proportion of the mouth submerged multiplied by the effective tow length resulting in volume filtered (m^3).

Sediment

Sediments at open bay sites were collected using bottom dredges deployed from the sampling vessels according to TCEQ SWQM Procedures (TCEQ 2012). Basic sediment sampling equipment consists of either an Ekman or a Petite Ponar dredge. A total of three replicate bottom sediment grabs were collected approximately 50 m apart. If the bottom was composed mostly of soft sediment, then the Ekman dredge was the be best collection method. If instead the bottom was composed of hard substrate (e.g., shell hash), then the Petite Ponar dredge was the most efficient sampling method. The top five centimeters (cm) of sediment was retained. The sediment was visually classified into a size category using a modified Wentworth Classification system for estuaries (Bain, 1999; Spencer 2017).

Shoreline Sample Collection

Water Grabs

Microplastic surface water grab samples were collected using methods consistent with the Florida Microplastic Awareness Project Volunteer Manual (FMAP 2017). Triplicate 1-L samples were collected using glass jars. Water grab samples at shoreline sites were taken by hand by wading into the water past the wave break to minimize collecting re-suspended sediments. Before collecting each sample, the jars and lids were rinsed three times with seawater from the site. The sampler then moved to a nearby area that was not affected by the rinsing procedure and held the jar horizontally, lowering the jar into the water to collect water from the surface until it was full. Samples were then placed on ice until filtering occurred.

Sediment

Field methods for shoreline sediment sampling followed protocols by Wessel et al. (2016). The shoreline sampling area was adjacent to where the shoreline surface water grab samples were taken. Triplicate samples were collected along the wrack line on the shore and stored in 1-gal zipper-sealed bags. A location along the wrack line was randomly selected and a 0.25 m^2 quadrat was placed in the sand with the wrack line running through the middle. The sampler removed any large pieces of natural debris from the quadrat area and shook any loose sand off the debris into the quadrat. The sampler then scooped the top 3 cm of sand within the quadrat into a 5 mm sieve on top of a 5-gallon (gal) bucket. Anything that didn't pass through the sieve was discarded. Once the entire top layer of sand was scooped and sieved into the bucket, the sampler

poured the sand from the bucket into a 1-gal zipper-sealed bag. This procedure was repeated for two additional quadrats spaced approximately 100 m apart along the same wrack line to with a total of three replicate samples per site and event.

Laboratory Methods

Environmental Institute of Houston (EIH) staff analyzed the samples following methods described in the MSU Sampling and Processing Guidebook (Sartain et al. 2018) for processing the sediment samples and the Florida Microplastic Awareness Project Volunteer Manual (FMAP 2017) and NOAA's recommendations for analyzing microplastics in surface water samples (Masura et al. 2015). EIH also used the Guide to Microplastics Identification written by MERI (2015) as a reference while processing surface water and sediment microplastics samples. Laboratory sample analysis was based on visual microscopic methods and physical tests used by FMAP (2017), Sartain et al. (2018a), and MERI (2015). A microscope with digital camera and linear scales were used to document microplastics. The expected size of plastic debris analyzed ranged between 5 mm to 100 micrometers (µm) based on past studies (Baldwin et al. 2016; Wessel et al. 2016) and microscope power.

Water Grabs

When processing 1-L water grab samples, analysts closely followed the numbered steps with pictures that are available in the "Analyzing Water Samples for Microplastics" section of the Florida Microplastic Awareness Project Volunteer Manual (FMAP 2017) that are summarized below. Deionized water was used to rinse the filtering apparatus and accessories three times prior to use. A glass petri dish was used as a cover for the filter apparatus (only removed when adding more sample). This was done to minimize potential contamination of the sample (e.g., lint in the air). A small air gap between the petri dish and the top edge of the filter apparatus was left open during filtering. A 0.45 µm gridded filter was inserted into the filter apparatus. The sample was agitated and poured into the filter funnel and vacuum filtered until the filter is clogged or the sample has been entirely filtered. It was common to use multiple filters per 1L sample. The filter apparatus was rinsed with DI water. The filter was then removed and placed into a clean petri dish. The filter was stored until it was dry. Occasionally the filter would curl when drying and had to be glued to the petri dish for microscopic analysis.

The filters were analyzed for microplastics under a microscope with at least 20X magnification and scanned systematically, moving row by row to prevent double-counting or missing plastics. Each piece of microplastic were counted and placed into one of 5 categories (fragments, fibers, films, nurdles, and microbeads) (Figure 2). All data were written on laboratory data reporting forms immediately and entered into a digital database by EIH Research Staff. Each piece of microplastic was investigated using a variety of lighting adjustments and probing, and was counted only if the analyst was highly confident of plastic identification.

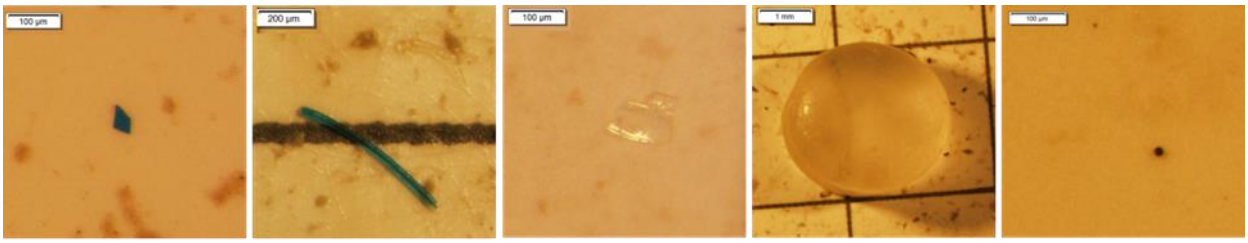

Figure 2. Examples of the five types of microplastics categorized in this study.

Neuston Tows

Neuston tow samples followed the same vacuum filtration procedures, but in order to remove large amounts of debris and organic matter caught in the net during towing, samples were first processed using a wet sieving method described in NOAA's Laboratory Methods for the Analysis of Microplastics in the Marine Environment (Masura et al., 2015). The preserved sample was rinsed into a stack of 4.5 mm, 2 mm, and 0.5 mm stainless steel mesh sieves using DI water. Material retained on the sieves were visually sorted/rinsed to minimize loss of microplastics during the sieving process, and organic material was discarded. The retained rinse water and sieved sample was then washed through a 335 µm mesh Nitex and the remaining sample was washed into a clean sample jar. Some samples containing large amounts detritus were sub-sampled using a Folsom plankton sample splitter. If the Folsom splitter was used, the sample was split in half and only one of the two samples were analyzed under the microscope. The final microplastic counts for those split samples were then doubled to represent the estimated amount in the whole sample. Finally, the contents of the sample jar following wet sieving was vacuum filtered, and the filter analyzed following the same procedures as for water grab samples. Even after splitting the neuston samples, it often required many (10+) filters to completely process the neuston samples.

Sediment

Sediment samples were analyzed following the methods described in the MSU Sampling and Processing Guidebook (Sartain et al. 2018a). The process of separating microplastics from the sediment was completed using a density separation where salt water and air bubbles were pumped through the sediment sample and fluidized to allow for the lower density plastics to separate from the higher density sediment. Steps for building a density separator are detailed in the Building a Density Separator Handbook written by Sartain et al. (2018b). Numbered steps with pictures are in the "Processing the Sediment Sample" section of the MSU Sampling and Processing Guidebook (Sartain et al. 2018a) and are summarized below.

The density separator was secured to a large reservoir filled with 10-20 gals of salt water (density separator volume is < 5 gals). The salt water was made from tap water mixed with aquarium Instant Ocean with a target salinity of 40-50 parts per thousand (measured with a refractometer) (Wessel et al., 2016; Frias et al., 2018). The most common plastic densities are between 0.8-1.4 gram (g)/cm^3 (Stock et al., 2019). Samples with particularly fine benthic sediment, typically containing high amounts of clay, were processed through the density separator twice to reduce the amount of sediment retained.

Prepared salt water was added to the density separator and then the sediment sample was added, allowing 10 minutes for settling before beginning processing. A 55 μm sieve was placed at the opening of the density separator to collect the microplastics. The 26-minute timer was started at 7 minutes, 10 minutes, 20 minutes, and 22 minutes the bubbler was turned off for 10 seconds and then turned back on. At 9 minutes and 21 minutes the water pump was unplugged for 10 seconds and then plugged back in. The air and pump breaks were taken to ensure that the fine sediment was well mixed and any buried microplastics were released into the density separator column.

Large and non-plastic debris (organic materials) were removed from the sieve and any remaining material caught in the sieve were rinsed using filtered water into a petri dish. The petri dish was allowed to dry and set on gridded paper to help with methodological counting. The petri dishes were analyzed for microplastics under a microscope at least 20X magnification and scanned systematically, moving row by row to prevent double counting or missing plastics.

Data Analyses

Prior to statistical analysis, data were transcribed from lab and field data sheets into digital Excel spreadsheets for archiving and manipulation. Data were imported into the native format of the software used for statistical, geospatial, and graphical analysis and plotting. Various data transformations were conducted to convert raw data into standard density units such as the total number of microplastic particles and the number within various categories (e.g. fragments, fibers, etc.) per unit volume. Total microplastics were calculated by gear type and are reported as average number of mP/volume ± 95% confidence interval.

Prior to statistical analysis, normality was tested, and when data were non-normal, non-parametric analyses were used. Replicate data were first tested for statistically significant differences, and since none were detected, replicates were averaged by data type, site, and event. Data were tested for an interaction between event and site type, since no statistically significant interaction were detected data were pooled for evaluation of these two variables on microplastic distribution and density.

Due to the low number of replicates, data analysis consisted of graphical and map plots and non-parametric statistical analyses in RStudio 2022.07.2 Kruskal-Wallis Rank Sum Test (Myles and Wolfe 1973) and Primer v7, ANOSIM (Clarke and Gorley 2015)) comparing event and site type to the composition, density, and distribution of microplastics in Galveston Bay. For all statistical tests, we used $\alpha = 0.05$ to determine statistical significance.

RESULTS

Sampling for the March event occurred between March 3 and 16, 2022 and for the September event between September 2 and 12, 2022 (Table 2). The average number of days since last significant rainfall at the time of sampling for the March event was 34 days, while the average number of days since last significant rainfall at the September event was five days. While the salinity in the bay did not differ significantly between the March and September events, the

Secchi (m) was significantly lower (meaning the water was more turbid) during the September event compared to the March event (Kruskal-Wallis chi-squared = 6.223, p-value = 0.0126). As expected, the average water temperature during the March event was lower (average 16 ˚C) than the September event (average 30 ˚C).

Water Grabs

A total of 2,671 pieces of microplastic were collected and enumerated from water grab samples throughout the study. Averaged across all events and sites we collected 44.52 ± 12.24 pieces of mP/L of water from water grab samples. The most common type of microplastic observed in water grab samples throughout the study was fragments accounting for 66.2% of the microplastics collected with an average of 29.5 fragments per L of water (Table 3). The second most common type of microplastic observed in water grabs was fibers accounting for 30.3% of the microplastics collected with an average of 13.5 fibers per L of water. An average of 1.3 microbeads, and 0.3 film pieces were collected per L of water. There were no nurdles collected in the water grab samples.

There were significantly more (Kruskal-Wallis chi-squared = 7.0053, p-value = 0.0081) microplastics collected during the September (72.2 mP/L) sampling event than the March (16.8 mP/L) event (Table 3, Figure 3). There were also significantly more fragments and fibers collected in water during the September event compared to the March event (Kruskal-Wallis chi-squared = 4.8057 and 10.095, p-value = 0.0284 and 0.0009 respectively) (Figure 4). There was a significantly dissimilar make up of microplastics by type observed in water grabs by event (Primer 7 ANOSIM R = 0.329, p-value = 0.004) (Figure 5). During the March event there were more microplastics per L collected at open bay sites (20.9 mP/L) compared to shoreline sites (12.7 mP/L). Conversely, during the September event there were more microplastics per L collected at shoreline sites (88.3 mP/L) compared to open bay sites (56.1 mP/L) (Table 3, Figure 3). We failed to detect a statistically significant difference in the total number of microplastics in water collected at open bay versus shoreline sites (Kruskal-Wallis chi-squared = 0.0701, p-value = 0.7913) or types of microplastics in water (Primer7 ANOSIM R=-0.092 and p-value = 0.955).

Table 2. Physicochemical conditions at each sampling event by site.

Event	Site Type	Site ID	Date	Total Depth (m)	Secchi (m)	Days Since Last Sig. Rainfall	Bottom (~ 0.3m from bottom)					Surface (~ 0.3m from surface)				
							Depth (m)	Temp (°C)	Salinity (psu)	DO (mg/L)	pH	Depth (m)	Temp (°C)	Salinity (psu)	DO (mg/L)	pH
March	Open Bay	B1 Trinity	3/10/2022	1.13	0.423	35	0.80	12.1	16.05	9.93	7.95	0.25	12.1	16.05	9.95	7.98
		B2 Channel	3/10/2022	2.41	0.387	35	2.11	15.9	20.21	8.51	8.06	0.40	16.0	20.20	8.52	8.06
		B3 Center	3/16/2022	3.36	0.672	41	3.01	15.8	21.91	9.45	8.23	0.25	17.1	19.25	9.90	8.25
		B4 TXC Dike	3/16/2022	3.02	0.532	41	2.63	16.7	23.34	9.55	8.28	0.31	16.8	23.34	9.95	8.29
		B5 Bolivar	3/16/2022	9.64	0.440	41	9.22	16.1	25.63	7.99	8.17	0.28	16.2	25.04	8.49	8.18
	Shoreline	S1 Trinity	3/3/2022	0.52	0.342	28	0.52	17.4	11.64	8.99	8.11	0.11	17.5	11.64	9.07	8.11
		S2 Sylvan	3/3/2022	0.54	0.386	28	0.54	18.1	20.62	10.40	8.14	0.11	19.0	20.81	10.33	8.16
		S3 El Jardin	3/4/2022	0.73	0.478	29	0.73	16.5	21.03	9.18	7.97	0.11	16.5	21.51	9.48	8.20
		S4 Moses	3/4/2022	0.49	0.516	29	0.49	18.3	21.95	8.47	8.07	0.12	18.3	22.09	8.74	8.13
		S5 TXC Dike	3/4/2022	0.53	0.226	29	0.53	16.6	24.26	9.42	8.16	0.10	16.7	24.41	9.44	8.15
September	Open Bay	B1 Trinity	9/2/2022	1.65	0.306	2	1.29	29.5	17.59	2.75	8.03	0.31	29.4	17.07	5.87	8.10
		B2 Channel	9/2/2022	2.84	0.360	4	2.58	30.0	21.20	4.40	8.13	0.34	30.6	19.01	4.91	7.87
		B3 Center	9/12/2022	3.87	0.310	9	3.63	29.3	23.39	5.87	8.15	0.33	29.4	23.38	6.43	8.37
		B4 TXC Dike	9/12/2022	3.01	0.236	5	2.84	29.7	25.19	6.41	8.40	0.35	30.0	24.93	6.94	8.47
		B5 Bolivar	9/12/2022	10.02	0.820	6	9.89	29.9	29.18	5.98	8.31	0.30	29.7	28.72	6.14	8.39
	Shoreline	S1 Trinity	9/6/2022	0.65	0.220	2	0.65	28.0	9.92	5.94	8.18	0.11	27.8	6.21	7.39	8.10
		S2 Sylvan	9/6/2022	0.78	0.338	3	0.78	29.5	17.44	8.30	8.18	0.12	29.4	17.68	8.20	7.84
		S3 El Jardin	9/6/2022	0.57	0.212	3	0.57	29.7	18.12	8.33	8.33	0.15	29.7	19.08	8.39	8.11
		S4 Moses	9/10/2022	0.64	0.165	12	0.64	29.1	19.50	6.00	8.25	0.16	29.2	22.41	6.06	7.94
		S5 TXC Dike	9/10/2022	0.97	0.239	4	0.97	31.5	26.64	6.73	8.27	0.24	31.7	28.16	6.64	8.00

Table 3 Summary table of microplastics observed in water grab samples reported in the average number of mP/L by event, site type, and site (replicates averaged). Aggregated total microplastics are calculated by site type and event as the average mP/L.

Sample type	Event	Site Type	Site	Date	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics	Aggregated Total Microplastics		
Water grabs (results presented in average mP/L)	March	Open Bay	B1 Trinity	3/10/2022	3.7	1.0	0.0	0.0	0.3	5.0			
			B2 Channel	3/10/2022	14.3	2.0	0.0	0.0	0.0	16.3			
			B3 Center	3/16/2022	19.7	6.3	0.7	0.0	0.0	26.7			
			B4 TXC Dike	3/16/2022	7.7	10.0	2.3	0.0	0.0	20.0			
			B5 Bolivar	3/16/2022	20.0	16.0	0.0	0.0	0.7	36.7	20.9		
		Shoreline	S1 Trinity	3/3/2022	3.3	5.0	0.0	0.0	0.3	8.7			
			S2 Sylvan	3/3/2022	14.7	2.3	0.0	0.0	0.3	17.3			
			S3 El Jardin	3/4/2022	3.0	1.0	0.0	0.0	0.0	4.0			
			S4 Moses	3/4/2022	11.0	2.7	0.0	0.0	0.0	13.7			
			S5 TXC Dike	3/4/2022	9.7	9.7	0.3	0.0	0.3	20.0	12.7	16.8	
	September	Open Bay	B1 Trinity	9/2/2022	5.3	8.7	0.3	0.0	0.3	14.7			
			B2 Channel	9/2/2022	27.7	41.3	0.0	0.0	0.7	69.7			
			B3 Center	9/12/2022	42.0	19.7	0.3	0.0	0.3	62.3			
			B4 TXC Dike	9/12/2022	2.3	10.7	0.0	0.0	0.0	13.0			
			B5 Bolivar	9/12/2022	102.3	17.0	1.0	0.0	0.3	120.7	56.1		
		Shoreline	S1 Trinity	9/6/2022	56.0	37.7	7.7	0.0	1.3	102.7			
			S2 Sylvan	9/6/2022	76.7	14.0	0.0	0.0	0.0	90.7			
			S3 El Jardin	9/6/2022	13.3	11.7	0.3	0.0	0.0	25.3			
			S4 Moses	9/10/2022	107.3	19.0	8.0	0.0	0.0	134.3			
			S5 TXC Dike	9/10/2022	49.3	34.3	4.7	0.0	0.3	88.7	88.3	72.2	44.5

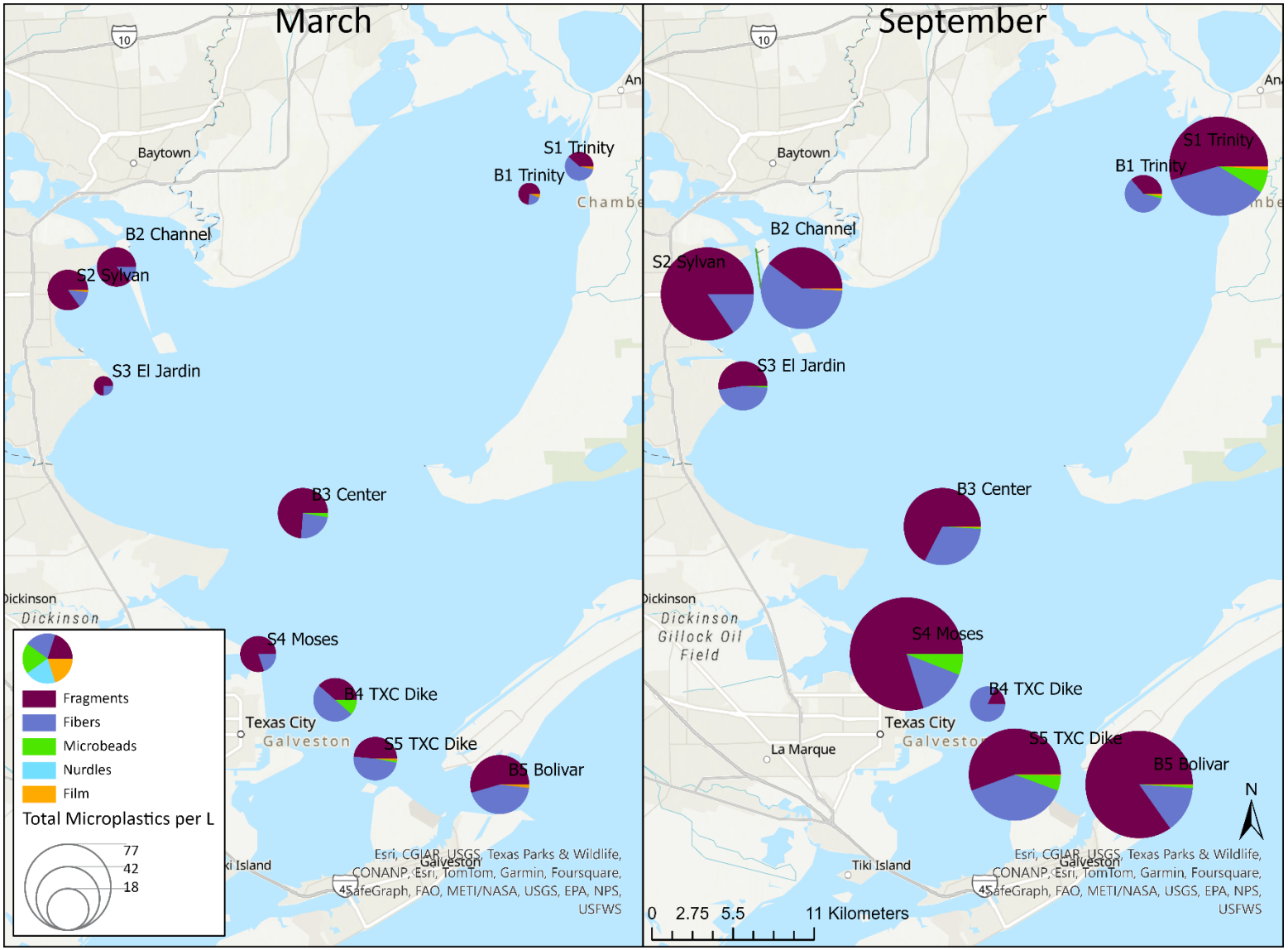

Figure 3. Map of average number and type of mP/L in water grab samples collected by site and season. The slices of the pie represent the proportion of the mP/L collected that were characterized into each microplastic type and the size of the pie chart represents the average number of all mP/L collected.

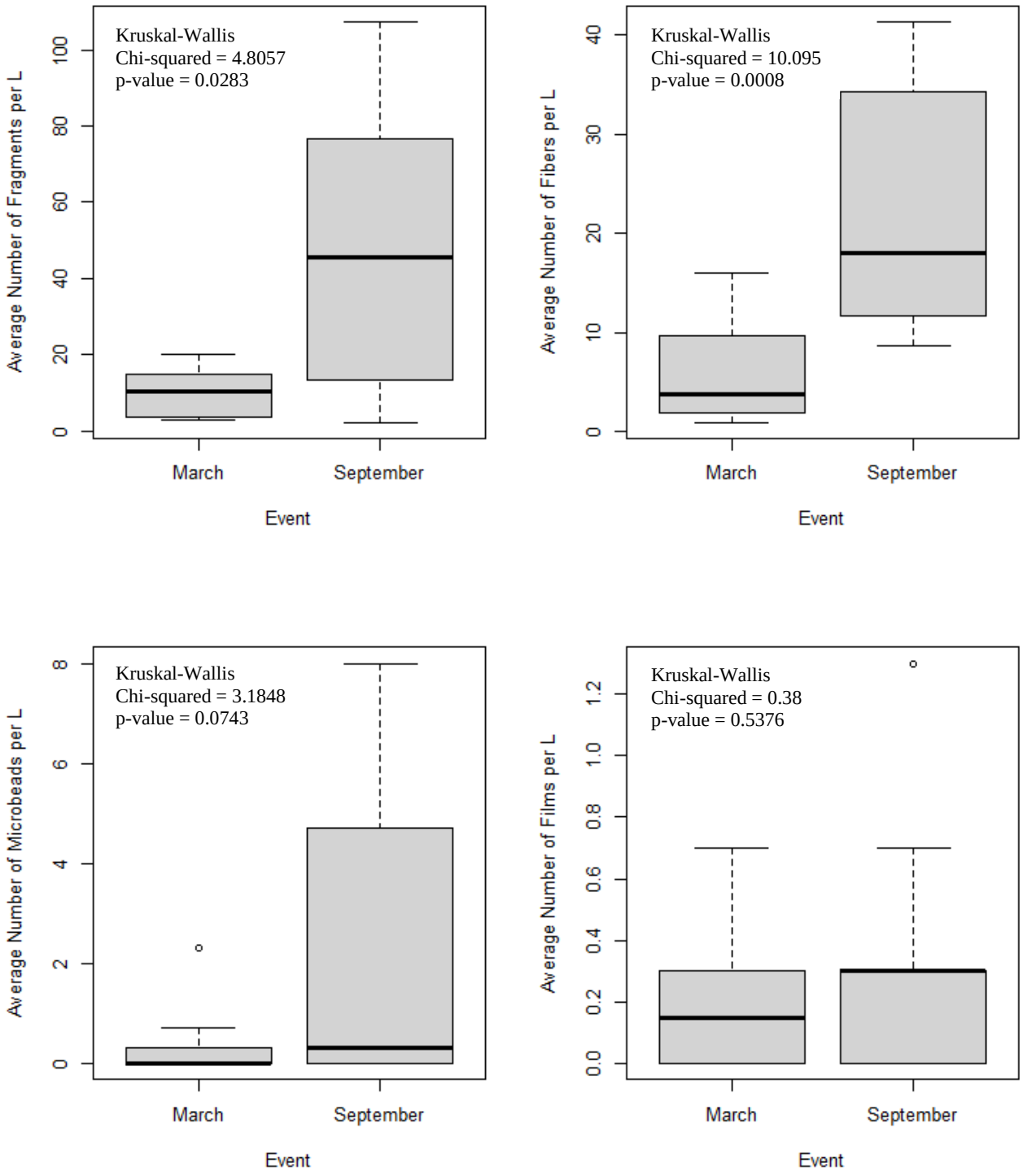

Figure 4. Boxplots of the number of microplastics in water grab samples per L by type and event. Statistical results of Kruskal-Wallis Rank Sum Test included in each figure by plastic type.

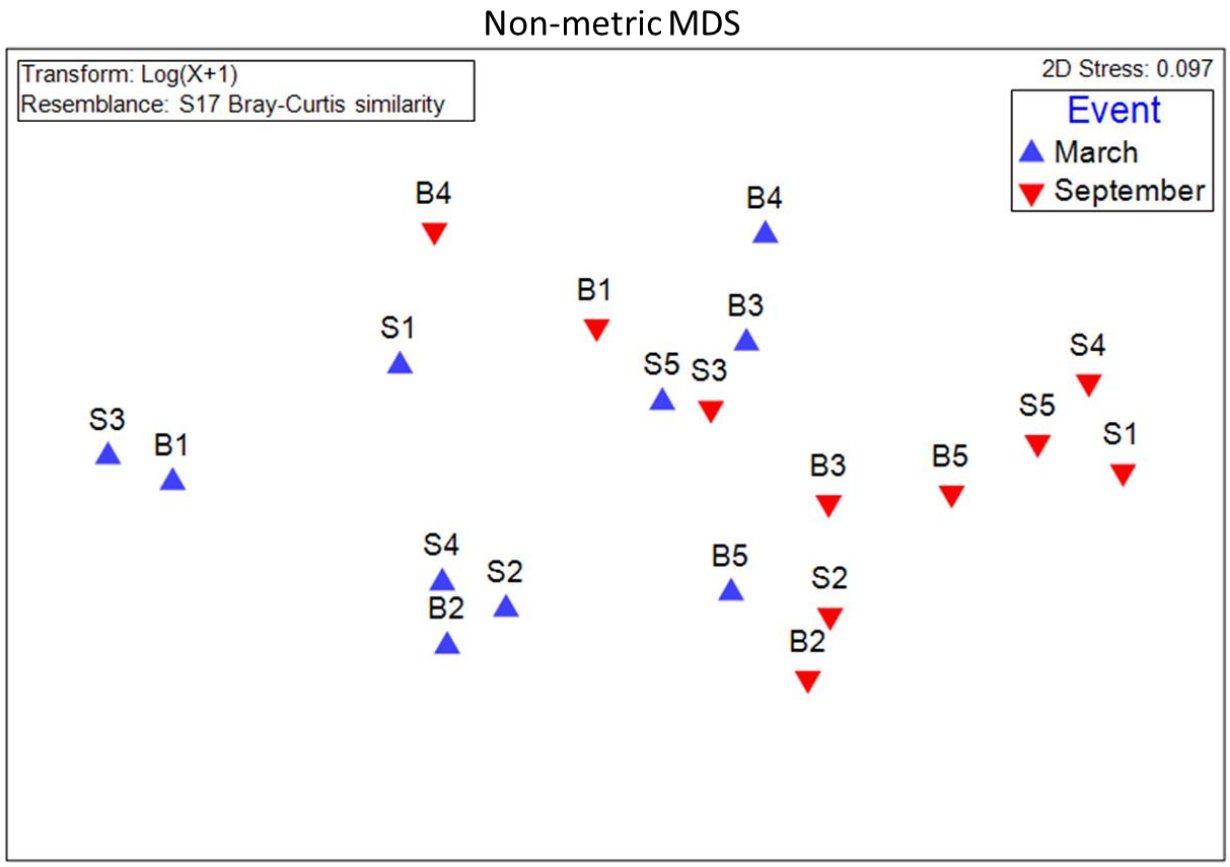

Figure 5. Non-metric MDS plot of the microplastic types collected in water grab samples by site and event. There were significant dissimilarities in the microplastic composition of samples by event per ANOSIM analysis (R = 0.329, p-value = 0.004).

Neuston Tows

A total of 26,891 pieces of microplastics were collected and enumerated from neuston tow samples throughout the study. When averaged across all events and sites we collected 7.43 ± 2.37 pieces of microplastics per m^3 (mP/m^3) of water from neuston samples (Table 4 and Figure 6). The most common type of microplastic observed in neuston samples throughout the study were fragments accounting for 44.2% of the microplastics collected with an average of 3.21 fragments per m^3 of water. The second most common type of microplastic observed in neuston tows were fibers accounting for 32.75% of the microplastics collected with an average of 2.39 fibers per m^3 of water. An average of 1.65 microbeads, 0.06 film pieces, and 0.02 nurdles were collected per m^3 of water in the neuston tows. There were on average more microplastics collected during the September (8.89 mP/m^3) sampling event than the March (5.88 mP/m^3) event. However, the team failed to detect any statistically significant difference in the number or composition of total microplastics or by type by event.

Table 4 Summary table of microplastics observed in neuston tow samples reported as the average number of mP/m^3 by event and site (replicates averaged). Aggregated total microplastics are calculated by site type and event as the average number of mP/m^3.

Sample type	Site Type	Event	Site	Date	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics	Aggregated Total Microplastics	
Neuston tow (results presented in average mP/m^3)	Open Bay	March	B1 Trinity	3/10/2022	0.2	0.2	0.0	0.0	0.0	0.5		
			B2 Channel	3/10/2022	0.4	2.2	0.1	0.0	0.1	2.7		
			B3 Center	3/16/2022	5.4	1.8	0.2	0.0	0.0	7.4		
			B4 TXC Dike	3/16/2022	5.9	2.8	0.3	0.0	0.1	9.1		
			B5 Bolivar	3/16/2022	4.5	4.0	0.1	0.0	0.1	8.6	5.9	
		September	B1 Trinity	9/2/2022	1.4	2.3	6.4	0.0	0.1	10.2		
			B2 Channel	9/2/2022	1.4	3.7	0.1	0.2	0.1	5.4		
			B3 Center	9/12/2022	2.4	2.6	0.0	0.0	0.0	5.1		
			B4 TXC Dike	9/12/2022	6.7	3.2	6.9	0.0	0.1	16.9		
			B5 Bolivar	9/12/2022	4.0	1.1	1.9	0.0	0.0	6.9	8.9	7.4

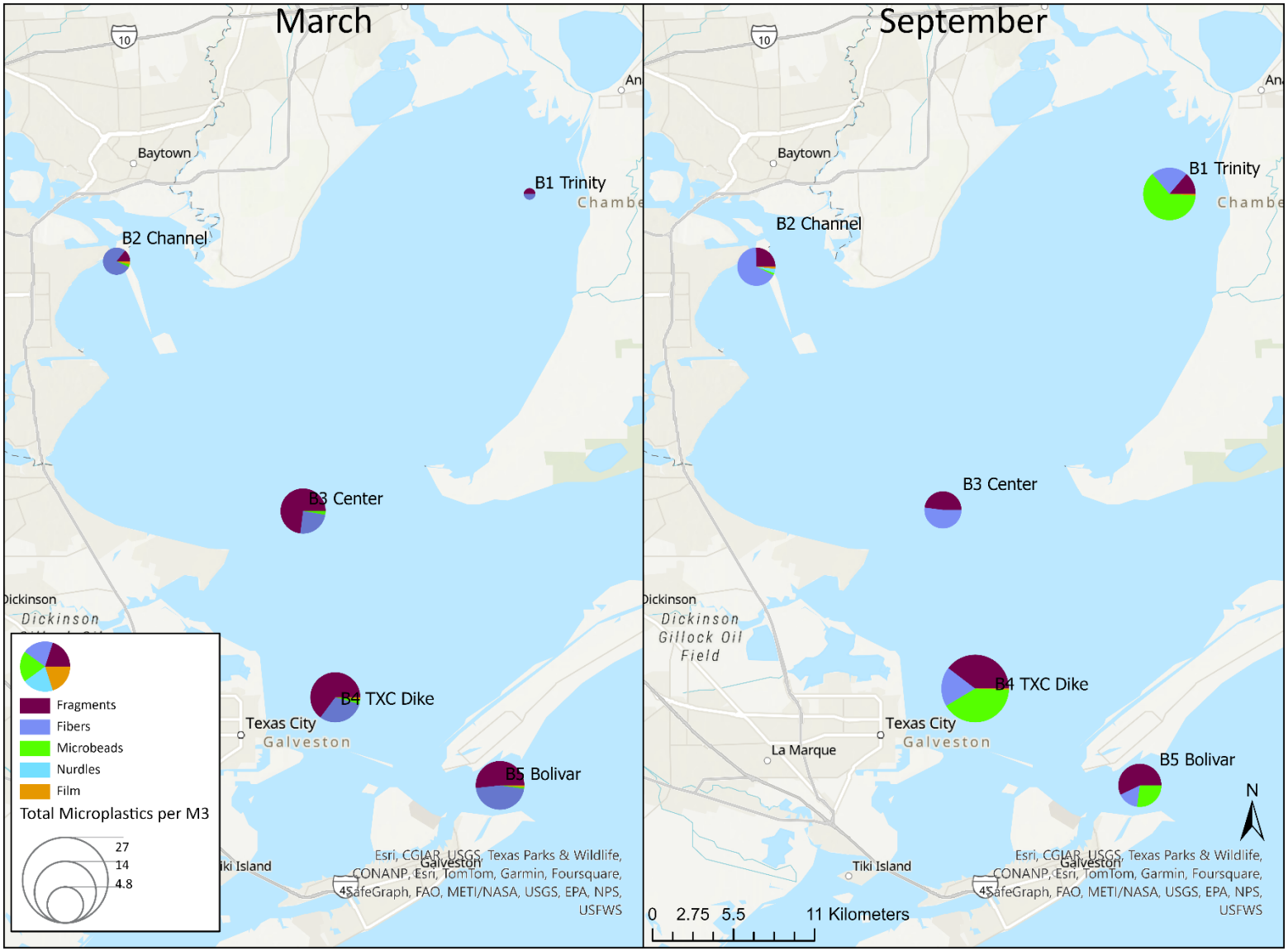

Figure 6 Map of average number and type of mP/m^3 in neuston samples collected by site and season. The slices of the pie represent the proportion of the mP/m^3 collected that were characterized into each microplastic type and the size of the pie chart represents the average number of all mP/m^3 collected.

Sediment

A total of 4,743 pieces of microplastics were collected and enumerated from sediment samples throughout the study. When averaged across all events and sites we collected 692.68 ± 161.80 pieces of mP/m^2 of sediment. The most common type of microplastic observed in sediment samples throughout the study were fragments which accounted for 69.8% of the microplastics collected, with an average of 502.6 fragments per m^2 of sediment (Table 5). The second most common type of microplastic observed in sediment were fibers accounting for 25.4% of the microplastics collected with an average of 164.4 fibers per m^2 of sediment. An average of 18.6 microbeads, 3.6 film pieces, and 3.5 nurdles were collected per m^2 of sediment.

The team failed to detect a significant difference in the number of microplastics collected at the March event versus the September event (total mP/m^2 of sediment, Kruskal-Wallis chi-squared = 0.1429, p-value = 0.7055). There were on average more microplastics collected in shoreline sediment samples (768.27 mP/m^2) compared to open bay sediment samples (617.10 mP/m^2), but the team failed to detect a statistically significant difference (Kruskal-Wallis chi-squared = 1.6514, p-value = 0.1988) (Table 5). The team also failed to detect a significant difference in the number of each type of microplastics in sediment by the site type (shoreline versus open water). There was a significantly dissimilar composition of microplastics by type observed in sediments by event (Primer 7 ANOSIM R = 0.134, p-value = 0.0450) (Figure 5) and by site type (Primer 7 ANOSIM R = 0.204, p-value = 0.0160) (Figure 9).

Table 5 Summary table of microplastics observed in sediment samples reported in the average number of mP/m^2 by event and site (replicates averaged). Aggregated total microplastics are calculated by site type and event as the average number of mP/m^2. Note: Shoreline sediment grabs were sampled to a depth of 3 cm and open bay sediment grabs were sampled to a depth of 5 cm.

Sample type	Event	Site Type	Site	Date	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics	Aggregated Total Microplastics		
Sediment grabs (results presented in average mP/m^2)	March	Open Bay	B1 Trinity	3/10/2022	642.6	164.7	0.0	0.0	0.0	807.3			
			B2 Channel	3/10/2022	523.1	38.8	3.2	0.0	0.0	565.1			
			B3 Center	3/16/2022	1537.1	64.6	32.3	0.0	0.0	1634.0			
			B4 TXC Dike	3/16/2022	319.7	19.4	6.5	0.0	0.0	345.5			
			B5 Bolivar	3/16/2022	155.0	61.4	0.0	0.0	3.2	219.6	714.3		
		Shoreline	S1 Trinity	3/3/2022	920.0	317.3	61.3	0.0	32.0	1330.7			
			S2 Sylvan	3/3/2022	597.3	405.3	2.7	0.0	2.7	1008.0			
			S3 El Jardin	3/4/2022	554.7	37.3	13.3	0.0	0.0	605.3			
			S4 Moses	3/4/2022	584.0	162.7	24.0	0.0	32.0	802.7			
			S5 TXC Dike	3/4/2022	138.7	24.0	0.0	34.7	0.0	197.3	788.8	751.5	
	September	Open Bay	B1 Trinity	9/2/2022	413.3	56.0	0.0	0.0	0.0	469.3			
			B2 Channel	9/2/2022	301.4	88.3	0.0	0.0	0.0	389.7			
			B3 Center	9/12/2022	477.9	649.1	0.0	0.0	0.0	1127.0			
			B4 TXC Dike	9/12/2022	390.7	16.1	0.0	0.0	0.0	406.9			
			B5 Bolivar	9/12/2022	171.1	35.5	0.0	0.0	0.0	206.7	519.9		
		Shoreline	S1 Trinity	9/6/2022	448.0	218.7	0.0	0.0	0.0	666.7			
			S2 Sylvan	9/6/2022	437.3	226.7	5.3	16.0	2.7	688.0			
			S3 El Jardin	9/6/2022	434.7	96.0	0.0	18.7	0.0	549.3			
			S4 Moses	9/10/2022	506.7	242.7	224.0	0.0	0.0	973.3			
			S5 TXC Dike	9/10/2022	498.7	362.7	0.0	0.0	0.0	861.3	747.7	633.8	692.7

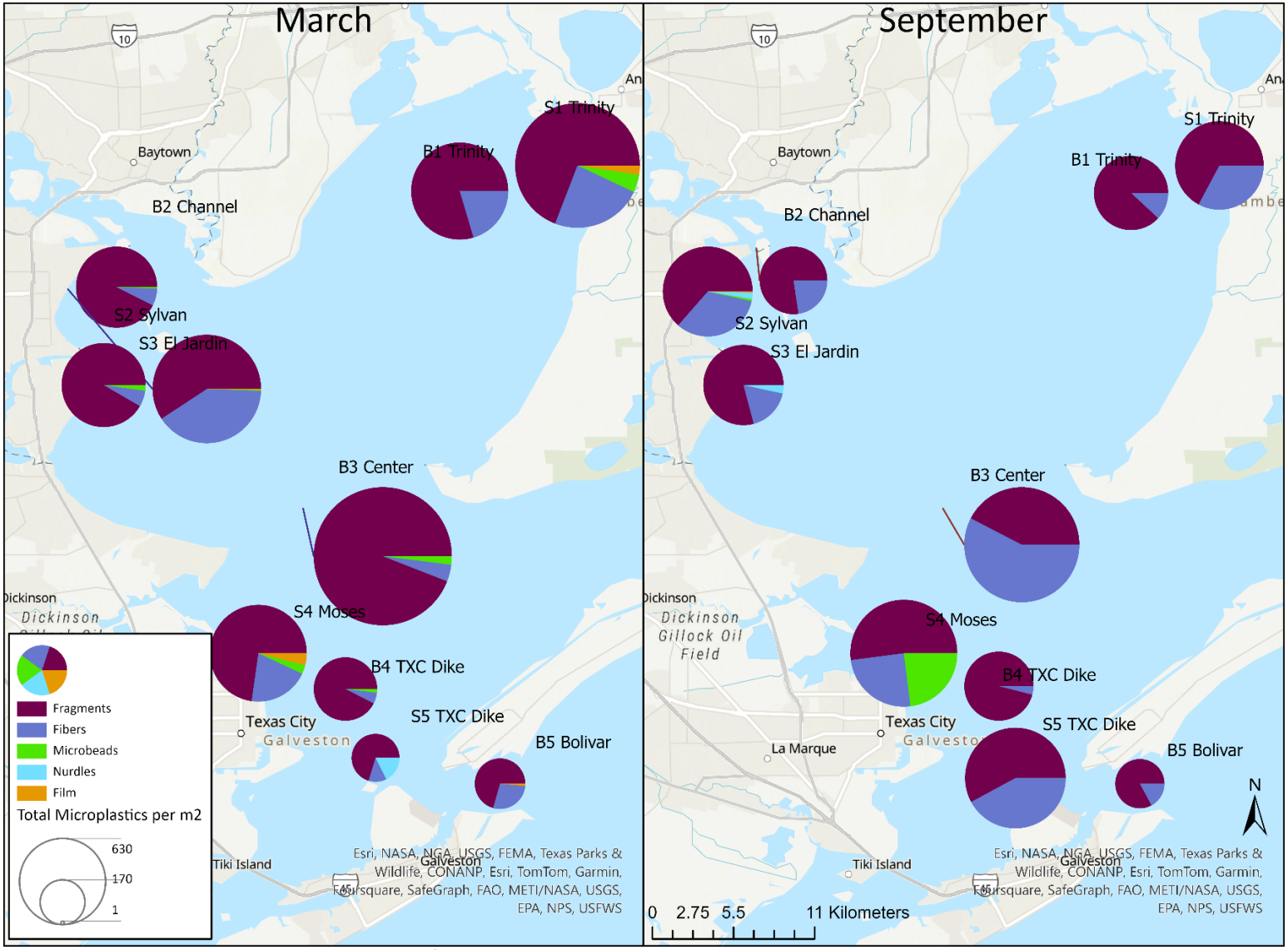

Figure 7 Map of average number and type of mP/m^2 in sediment samples collected by site and season. The slices of the pie represent the proportion of the mP/m^2 collected that were characterized into each microplastic type and the size of the pie chart represents the average number of all mP/m^2 collected.

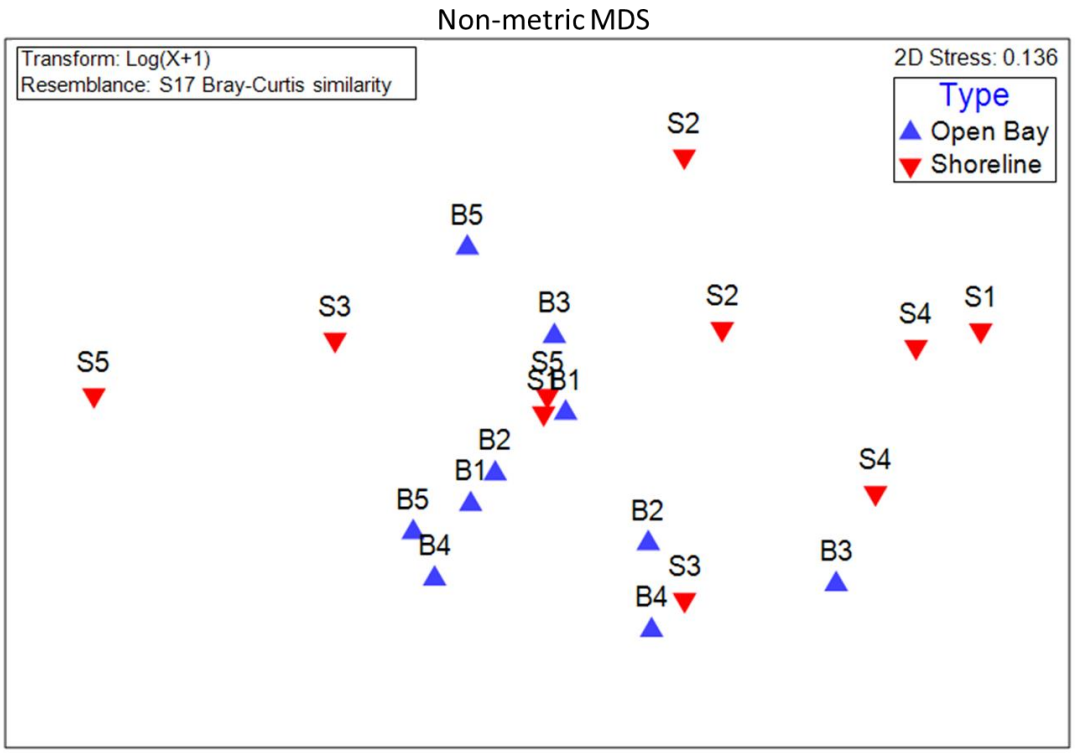

Figure 8. Non-metric MDS plot of the microplastic types collected in sediment samples by site and site type. There were significant dissimilarities in the microplastic make up of samples by site type per ANOSIM analysis (R = 0.204, p-value = 0.0160).

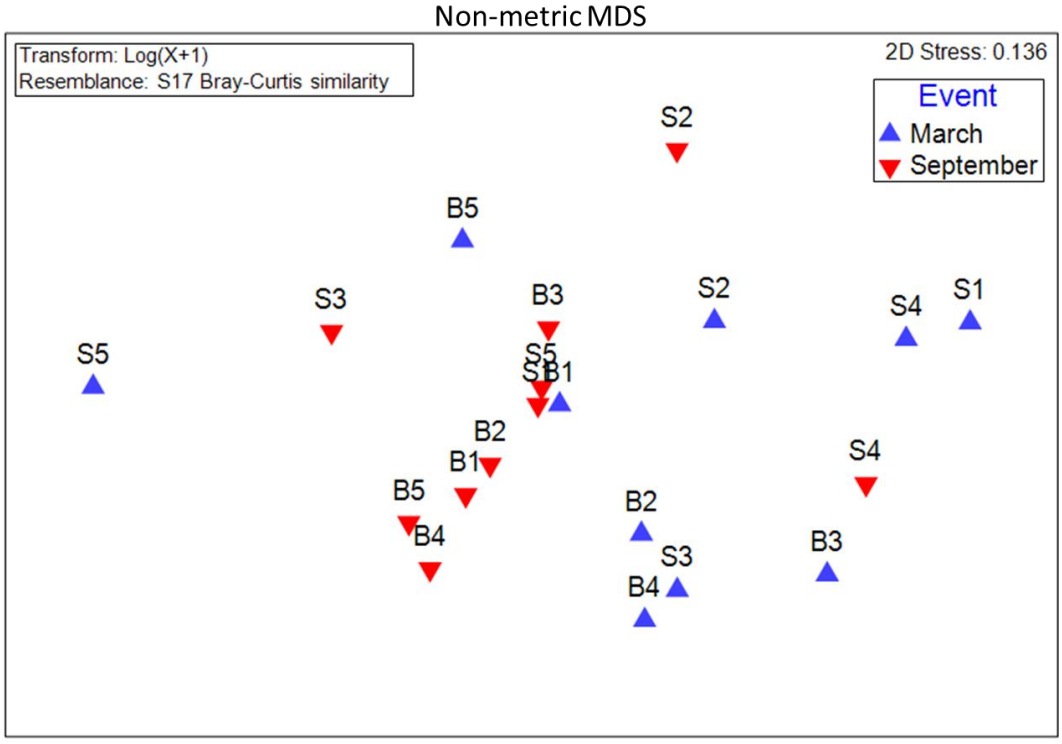

Figure 9. Non-metric MDS plot of the microplastic types collected in sediment samples by site and event. There were significant dissimilarities in the microplastic make up of samples by site type per ANOSIM analysis (R = 0.134, p-value = 0.0450).

DISCUSSION

This study represents a baseline assessment of the concentration, distribution, and types of microplastics found within Galveston Bay's waters and sediments. The two events sampled in this study provide a snapshot of the microplastics in Galveston Bay. Microplastics were identified in every sample collected throughout this study. The first event (March 2022) occurred after a prolonged period with little rainfall in the watershed while the second event (September 2022) occurred during a period with more recent rainfall in the watershed. Unfortunately, with the limited data associated with this initial study the team was unable to determine the causation of the differences we observed between these two events. It is likely, and supported by other studies (Busch et al. 2023, Hitchcock 2020, Masaya et al. 2021), that microplastics in surface waters increase during increased inflows from stormwater events. Additionally, physicochemical water variables such as salinity, temperature, and pH can affect the buoyancy and degradation of particles in water (Mendrik et al. 2023, Summers et al. 2023, Malli et al. 2022). It would require regular and long-term monitoring to begin to tease out influences of the water conditions within Galveston Bay on the microplastic distribution and composition.

The most common type of microplastics observed in both water and sediment samples in Galveston Bay were fragments followed by fibers. These are commonly the two most abundant types of microplastics observed in surface waters and sediments (Ramírez-Álvarez et al. 2020, Shruti et al. 2021). Fragments are typically pieces of larger plastic materials that break down into micro particles through various degradation pathways. Fibers may be introduced to the bay through wastewater pathways as a result of laundering clothing that is made up of synthetic fibers. They can also be from weathering synthetic fishing lines, nets, and ropes.

Neuston samples produced lower than expected quantities of microplastics (average 7.43 mP/m^3 = 0.00743 mP/L) compared to the water grab samples (26.74 mP/L). In waters with moderate to high microplastic concentrations, grab sampling has been shown to collect more microplastics per volume of water (Barrows et al. 2017, McEachern et al. 2019, Song et al. 2014). Like the water grab and sediment samples, fragments and fibers were the most numerous types of microplastic observed in the neuston samples but, there was an elevated proportion of microbeads collected during the September event at sites B1, B4, and B5 compared to all other samples and gear types. We are unsure what could have contributed to these elevated microbead counts, but hypothesize that microplastics, particularly fibers fragments, and films with irregular edges may catch on the net material reducing the number of microplastics that are washed down into the sample container. Additionally, there was a large amount of organic material collected in the net including plant material and comb jellyfish. As a result, samples were sieved to remove these larger particles, but microplastics could have adhered to their surface resulting in loss of microplastics. The smaller organic particles could have also obscured microplastics during visual enumeration. Even though the net was thoroughly rinsed after each pull, the net material can get clogged with plankton during a tow which reduces the efficiency of the net and the volume of the water that the net samples. Furthermore, the net material was composed of synthetic fibers, and specifically the binding of the seams of the net were made of blue and red synthetic fiber. The team quickly noticed that there were a number of red and blue fibers consistent with the coloration of the binding in our neuston samples. As a result, they were enumerated separately from the other fibers and excluded from the analyses. Neuston nets, and other plankton nets can

be helpful in sampling large volumes of water needed in areas with low microplastic concentrations such as open ocean or oligotrophic environments. Because of these challenges, the team does not recommend this method of sampling in Galveston Bay in future plastic monitoring projects.

The team encountered challenges in the procedures for processing our microplastic samples. The result of these challenges is a conservative evaluation of microplastic quantity. Organic digestion was not conducted in this study. As a result, some sediment samples with a high volume of small particle size sediments required processing through the density separator two times. This is a labor and time intensive process with the average time to complete a sample in the density separation procedure at approximately one hour. It is likely that the density separation process used for sediment samples was not successful at separating all microplastics from the sediment. In fact, there were instances where microplastics were observed with the naked eye when disposing of sediment after the density separation process.

All microplastics reported in this study were visually enumerated using a high-powered dissecting microscope. This process is considerably time consuming and requires skill and consistency. When enumerating the microplastics under the microscope we only included particles that the observer was "highly confident" in the microplastic identity. The enumerator regularly suspected that particles "could be" a microplastic, but did not count them because they were not certain. The result is a conservative estimate of microplastics in Galveston Bay waters and sediment. There are a range of methods that can be used to quantify microplastics, each with their own pros and cons. The use of fluorescent dye or infrared microscopy to identify microplastics has shown promising results (Maes et al. 2024, McEachern et al. 2019) and are recommended for consideration for future studies.

Overall, there is a need for standardized methods for microplastic monitoring (Lv et al. 2019). Comparing our results to other studies should be done with consideration to collection, processing, and enumeration techniques. Tampa Bay is a relatively large and industrialized bay that has some baseline microplastic data available for comparison. McEachern et al. (2019) had an average water grab concentration of 0.94 pieces of mP/L while we had 44.52 mP/L throughout this study. Assuming the average concentration of 44.52 ± 12.24 mP/L in the surface waters, and an open water surface area of 1,530 km2, the team estimates that there could be over 20.4 trillion ± 5.62 trillion pieces of microplastics in just the top 0.3m of water in Galveston Bay at any one time.

The comparison for plankton tow concentration for McEachern et al. (2019) was 4.5 pieces of mP/m^3 while this study had 7.4 mP/m^3 in the neuston net. The microplastic concentrations for the net-sampled water were more similar between the two waterbodies, however each study noted that the nets resulted in a substantial loss in microplastics. As a result, neuston or plankton nets are not a recommended gear type for future microplastic studies in Galveston Bay. However, to assure adequate characterization of the spatial distribution and potential for patchiness of microplastics, sufficient replication and spatial coverage are needed to properly design future studies. For example, a statistical power analysis using the data from this study could be conducted to guide sample size decisions in the future.

Recommendations and Lessons Learned

Regular monitoring of water and sediment microplastics should be continued to begin to understand temporal and spatial patterns of this pollutant type in Galveston Bay. The state and federal agencies charged with routine monitoring of water quality should adopt standardized methods to monitor microplastic concentration in water. Continued method development for more efficient and consistent sample analyses are needed. Methods used in this project required a considerable time commitment and for the sediment samples the amount of time it took to process and enumerate the sediment samples resulted in the decision to reduce the replication in the study design from three to two replicates per sampling event. Investigation of the use of fluorescent dye or infrared microscopy to identify and enumerate microplastics should be considered in future monitoring efforts (Maes et al. 2024, McEachern et al. 2019). Due to the turbidity and relatively high microplastic concentration in Galveston Bay water, neuston or plankton nets are currently not recommended for future monitoring projects in estuarine waters.

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Appendix A – Data Summary Table

Summary table of microplastics by unit of measure by event, site type, site, date, and replicate. Microplastic count unit of measure is specific to the sample type: Water grabs are number of microplastics per liter (mP/L). Sediment grabs are number of mP/m^2, and Neuston tow are number of mP/m^3. Note: Shoreline sediment grabs were sampled to a depth of 3cm and open bay sediment grabs were sampled to a depth of 5 cm. Totals by site type, event, and sample types are averaged.

Sample type	Event	Site Type	Site	Date	Rep	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics
Water grabs (results presented in mP/L)	March	Open Bay	B1 Trinity	3/10/2022	1	1	2	0	0	1	4
					2	5	1	0	0	0	6
					3	5	0	0	0	0	5
			B2 Channel	3/10/2022	1	23	4	0	0	0	27
					2	5	2	0	0	0	7
					3	15	0	0	0	0	15
			B3 Center	3/16/2022	1	15	6	1	0	0	22
					2	25	8	0	0	0	33
					3	19	5	1	0	0	25
			B4 TXC Dike	3/16/2022	1	8	20	4	0	0	32
					2	9	4	3	0	0	16
					3	6	6	0	0	0	12
			B5 Bolivar	3/16/2022	1	8	16	0	0	1	25
					2	19	9	0	0	1	29
					3	33	23	0	0	0	56
			Water-March-Open Bay Total			**13.1**	**7.1**	**0.6**	**0.0**	**0.2**	**20.9**
		Shoreline	S1 Trinity	3/3/2022	1	5	10	0	0	1	16
					2	2	5	0	0	0	7
					3	3	0	0	0	0	3
			S2 Sylvan	3/3/2022	1	11	0	0	0	1	12
					2	16	6	0	0	0	22
					3	17	1	0	0	0	18
			S3 El Jardin	3/4/2022	1	4	1	0	0	0	5
					2	2	1	0	0	0	3
					3	3	1	0	0	0	4
			S4 Moses	3/4/2022	1	4	4	0	0	0	8
					2	16	1	0	0	0	17
					3	13	3	0	0	0	16
			S5 TXC Dike	3/4/2022	1	8	6	1	0	0	15
					2	16	16	0	0	0	32
					3	5	7	0	0	1	13
			Water-March-Shoreline Total			**8.3**	**4.1**	**0.1**	**0.0**	**0.2**	**12.7**
		Water-March Total				**10.7**	**5.6**	**0.3**	**0.0**	**0.2**	**16.8**

Appendix A Cont.

Sample type	Event	Site Type	Site	Date	Rep	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics
Water grabs (results presented in mP/L)	September	Open Bay	B1 Trinity	3/10/2022	1	7	7	1	0	1	16
					2	6	12	0	0	0	18
					3	3	7	0	0	0	10
			B2 Channel	3/10/2022	1	16	22	0	0	0	38
					2	35	53	0	0	1	89
					3	32	49	0	0	1	82
			B3 Center	3/16/2022	1	29	14	0	0	1	44
					2	59	32	1	0	0	92
					3	38	13	0	0	0	51
			B4 TXC Dike	3/16/2022	1	3	10	0	0	0	13
					2	1	10	0	0	0	11
					3	3	12	0	0	0	15
			B5 Bolivar	3/16/2022	1	216	16	2	0	0	234
					2	59	17	0	0	0	76
					3	32	18	1	0	1	52
			Water-September-Open Bay Total			**35.9**	**19.5**	**0.3**	**0.0**	**0.3**	**56.1**
		Shoreline	S1 Trinity	3/3/2022	1	28	34	3	0	2	67
					2	101	47	0	0	0	148
					3	39	32	20	0	2	93
			S2 Sylvan	3/3/2022	1	73	17	0	0	0	90
					2	66	22	0	0	0	88
					3	91	3	0	0	0	94
			S3 El Jardin	3/4/2022	1	13	7	0	0	0	20
					2	17	10	1	0	0	28
					3	10	18	0	0	0	28
			S4 Moses	3/4/2022	1	66	20	4	0	0	90
					2	160	29	14	0	0	203
					3	96	8	6	0	0	110
			S5 TXC Dike	3/4/2022	1	18	21	0	0	0	39
					2	41	34	1	0	0	76
					3	89	48	13	0	1	151
			Water-September-Shoreline Total			**60.5**	**23.3**	**4.1**	**0.0**	**0.3**	**88.3**
		Water-September Total				**48.2**	**21.4**	**2.2**	**0.0**	**0.3**	**72.2**
	Water Total					**29.5**	**13.5**	**1.3**	**0.0**	**0.3**	**44.5**

Appendix A Cont.

Sample type	Event	Site Type	Site	Date	Rep	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics
Sediment grabs (results presented in mP/M^2)	March	Open Bay	B1 Trinity	3/10/2022	1	846.0	213.1	0.0	0.0	0.0	1059.2
					2	439.2	116.3	0.0	0.0	0.0	555.4
			B2 Channel	3/10/2022	1	303.5	32.3	6.5	0.0	0.0	342.3
					2	742.7	45.2	0.0	0.0	0.0	787.9
			B3 Center	3/16/2022	1	2635.0	96.9	32.3	0.0	0.0	2764.2
					2	439.2	32.3	32.3	0.0	0.0	503.8
			B4 TXC Dike	3/16/2022	1	355.2	32.3	0.0	0.0	0.0	387.5
					2	284.2	6.5	12.9	0.0	0.0	303.5
			B5 Bolivar	3/16/2022	1	251.9	58.1	0.0	0.0	0.0	310.0
					2	58.1	64.6	0.0	0.0	6.5	129.2
			Sediment-March-Open Bay Total			**635.5**	**69.8**	**8.4**	**0.0**	**0.7**	**714.3**
		Shoreline	S1 Trinity	3/3/2022	1	805.3	496.0	117.3	0.0	58.7	1477.3
					2	1034.7	138.7	5.3	0.0	5.3	1184.0
			S2 Sylvan	3/3/2022	1	629.3	442.7	5.3	0.0	5.3	1082.7
					2	565.3	368.0	0.0	0.0	0.0	933.3
			S3 El Jardin	3/4/2022	1	661.3	16.0	0.0	0.0	0.0	677.3
					2	448.0	58.7	26.7	0.0	0.0	533.3
			S4 Moses	3/4/2022	1	1002.7	256.0	48.0	0.0	64.0	1370.7
					2	165.3	69.3	0.0	0.0	0.0	234.7
			S5 TXC Dike	3/4/2022	1	144.0	26.7	0.0	42.7	0.0	213.3
					2	133.3	21.3	0.0	26.7	0.0	181.3
			Sediment-March-Shoreline Total			**558.9**	**189.3**	**20.3**	**6.9**	**13.3**	**788.8**
		Sediment-March Total				**597.2**	**129.5**	**14.3**	**3.5**	**7.0**	**751.5**

Appendix A Cont.

Sample type	Event	Site Type	Site	Date	Rep	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics
Sediment grabs (results presented in mP/M^2)	September	Open Bay	B1 Trinity	9/2/2022	1	327.2	77.5	0.0	0.0	0.0	404.7
					2	499.4	34.4	0.0	0.0	0.0	533.9
			B2 Channel	9/2/2022	1	361.7	90.4	0.0	0.0	0.0	452.1
					2	241.1	86.1	0.0	0.0	0.0	327.2
			B3 Center	9/12/2022	1	574.8	413.3	0.0	0.0	0.0	988.1
					2	381.0	884.8	0.0	0.0	0.0	1265.8
			B4 TXC Dike	9/12/2022	1	523.1	12.9	0.0	0.0	0.0	536.0
					2	258.3	19.4	0.0	0.0	0.0	277.7
			B5 Bolivar	9/12/2022	1	161.5	32.3	0.0	0.0	0.0	193.8
					2	180.8	38.8	0.0	0.0	0.0	219.6
		Sediment-September-Open Bay Total				**350.9**	**169.0**	**0.0**	**0.0**	**0.0**	**519.9**
		Shoreline	S1 Trinity	9/6/2022	1	266.7	144.0	0.0	0.0	0.0	410.7
					2	629.3	293.3	0.0	0.0	0.0	922.7
			S2 Sylvan	9/6/2022	1	650.7	282.7	10.7	0.0	5.3	949.3
					2	224.0	170.7	0.0	32.0	0.0	426.7
			S3 El Jardin	9/6/2022	1	570.7	26.7	0.0	0.0	0.0	597.3
					2	298.7	165.3	0.0	37.3	0.0	501.3
			S4 Moses	9/10/2022	1	912.0	410.7	448.0	0.0	0.0	1770.7
					2	101.3	74.7	0.0	0.0	0.0	176.0
			S5 TXC Dike	9/10/2022	1	261.3	330.7	0.0	0.0	0.0	592.0
					2	736.0	394.7	0.0	0.0	0.0	1130.7
		Sediment-September-Shoreline Total				**465.1**	**229.3**	**45.9**	**6.9**	**0.5**	**747.7**
		Sediment-September Total				**408.0**	**199.2**	**22.9**	**3.5**	**0.3**	**633.8**
	Sediment Total					**502.6**	**164.4**	**18.6**	**3.5**	**3.6**	**692.7**

Appendix A Cont.

Sample type	Event	Site Type	Site	Date	Rep	Fragments	Fibers	Microbeads	Nurdles	Film	Total Microplastics
Neuston tow (results presented in mP/M^3)	March	Open Bay	B1 Trinity	3/10/2022	1	0.04	0.09	0.00	0.00	0.00	0.14
					2	0.16	0.28	0.00	0.00	0.01	0.45
					3	0.51	0.23	0.02	0.00	0.01	0.78
			B2 Channel	3/10/2022	1	N/A	N/A	N/A	N/A	N/A	N/A
					2	0.33	2.16	0.00	0.00	0.16	2.66
					3	0.38	2.19	0.14	0.00	0.12	2.83
			B3 Center	3/16/2022	1	2.65	2.46	0.04	0.00	0.00	5.15
					2	7.59	1.22	0.23	0.00	0.02	9.06
					3	5.95	1.76	0.25	0.02	0.11	8.09
			B4 TXC Dike	3/16/2022	1	13.72	4.15	0.90	0.00	0.05	18.81
					2	1.32	2.27	0.02	0.00	0.06	3.67
					3	2.53	2.00	0.08	0.04	0.09	4.73
			B5 Bolivar	3/16/2022	1	1.58	2.23	0.03	0.00	0.05	3.89
					2	8.96	3.22	0.28	0.00	0.01	12.48
					3	2.98	6.48	0.00	0.00	0.09	9.55
			Neuston-March-Total			**3.5**	**2.2**	**0.1**	**0.0**	**0.1**	**5.9**
	September	Open Bay	B1 Trinity	9/2/2022	1	1.72	0.67	18.99	0.00	0.00	21.38
					2	1.46	1.33	0.28	0.01	0.15	3.22
					3	1.05	4.90	0.02	0.00	0.09	6.05
			B2 Channel	9/2/2022	1	1.31	1.26	0.13	0.46	0.00	3.16
					2	0.95	7.90	0.05	0.03	0.11	9.04
					3	1.79	1.92	0.11	0.00	0.07	3.88
			B3 Center	9/12/2022	1	1.97	1.14	0.06	0.03	0.00	3.20
					2	2.50	4.10	0.00	0.00	0.03	6.63
					3	2.58	2.53	0.09	0.03	0.12	5.36
			B4 TXC Dike	9/12/2022	1	7.35	6.60	0.03	0.00	0.03	14.02
					2	5.32	1.16	0.24	0.00	0.07	6.78
					3	7.41	1.89	20.29	0.07	0.11	29.76
			B5 Bolivar	9/12/2022	1	1.95	2.10	0.03	0.00	0.01	4.09
					2	4.80	0.41	0.37	0.00	0.00	5.58
					3	5.24	0.67	5.19	0.00	0.03	11.13
			Neuston-September-Total			**3.2**	**2.6**	**3.1**	**0.0**	**0.1**	**8.9**
	Neuston-Total					**3.3**	**2.4**	**1.6**	**0.0**	**0.1**	**7.4**

Appendix B – Classroom Education Final Report

Final Classroom Education Task Report
Date: 2/29/24

Project Title: Microplastics in the Galveston Bay Watershed: The Big Impacts of Tiny Pollution

TCEQ Contract #: 582-21-10096

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CLASSROOM EDUCATION OVERVIEW

The objective was to provide in-classroom lessons for grades 4-12 to help students understand watershed science and the impacts of microplastics on the Galveston Bay ecosystem. This will include research, data analysis, and the opportunity for students to present their findings to fellow students in their school and at local community events.

TASKS ACCOMPLISHED

Development of classroom curriculum was initiated and approved. The purchasing agreement with UHCL was finalized leading to the start of invoicing and purchasing materials. The kits were created and ready to be implemented in schools.

Meetings were held with Science Coordinators in GISD and other local school districts to schedule in classroom presentations. Classroom presentations and other outreach is listed in the Public Outreach Task Report.

A component of the education kits were used at beach cleanups since the creation of the kits. The portable density separator was used to demonstrate how we process sediment samples collected from our 6 six sites around Galveston Island. Data was not collected as it was a simplified explanation and demonstration of the larger density separator at the office.

During the waiting period in scheduling teacher workshops with schools, the kits were updated.
A meeting was held with GISD Staff, Sarah Hopkins and Jennifer Hart, about getting teacher kits in the classroom and completing other programs in the classroom. Communication and scheduling continued to be problematic.

The first teacher workshop was completed at Oppe Elementary during the spring of 2023. 3 of the 5 kits were left at the school for the teachers to use on their own time during the spring semester. The kits were not used during spring of 2023 due to testing and schedule conflicts within the school.

During the fall of 2023, a second teacher workshop was completed at Oppe Elementary for the 4th grade teachers. While the kits were intended to be left at the school and the curriculum to be led by the teachers, TIRN staff and interns led the kits due to

scheduling and teacher comfort. The kits were completed with all 4th grade classes in the classrooms at Oppe Elementary during October and November of 2023. The kits will be used by the Oppe 4th grade teachers again in the spring of 2024.

PROBLEMS OR OBSTACLES ENCOUNTERED

Most of the obstacles in completing the classroom education kits was getting dates set with the GISD schools. The primary school that we were involved with in getting the kits implemented was Oppe Elementary. Other schools in GISD were reached out to, but response was minimal.

At Oppe Elementary, teacher workshops were scheduled three times during the spring of 2022. The dates were moved by the school coordinator twice and finally canceled at the end of May. Numerous teachers in GISD resigned at the end of the 2021-2022 school year and did not return to school next year, so it was requested we wait until the 2022-2023 school year to complete training when new teachers are assigned to classrooms. During summer breaks there was no progress due to schools being out of session.

TIRN staff met with GISD staff, Sarah Hopkins and Jennifer Hart, about scheduling teacher workshops for education kits in the fall of 2022, but there were scheduling conflicts.

During the spring of 2023, TIRN Program Coordinator, Morgan Huette, conducted a teacher workshop for the 4th grade teachers at Oppe Elementary. 3 of the 5 kits were left at the school for the teachers to use on their own time during the spring semester. Due to unexpected STARR complications and scheduling, Oppe Elementary was not able to use the 3 kits during the spring.

Communicating with Oppe Elementary during fall of 2023 was difficult. The interest in implementing the kits was still present, but the correspondence to schedule a teacher workshop and implement the kit was lacking.

DELIVERABLE SUBMITTED

The education kits and classroom curriculum were submitted and approved by the Project Manager. Once kits and curriculum were approved, items were purchased and the education kits were created. The kits were implemented in Oppe Elementary in the fall of 2023.

Appendix C – Citizen Science Final Report

Final Citizen Science Sampling Task Report
Date: 2/29/24

Project Title: Microplastics in the Galveston Bay Watershed: The Big Impacts of Tiny Pollution

TCEQ Contract #: 582-21-10096

Grantee: University of Houston Clear Lake (UHCL)

Prepared by:

TIRN: Project Manager: Joanie Steinhaus

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STUDENT CITIZEN SCIENCE SAMPLING OVERVIEW

The objective was to provide students and community members with field applications of the lessons learned in the classroom setting by collecting and analyzing water samples for microplastics in accordance with procedures outlined in the QAPP developed in Task 2.

TASKS ACCOMPLISHED

Throughout the 3 years, volunteers and interns were recruited and trained in the citizen scientist microplastic sampling and analysis.

In July of 2021, the sampling methods were tested with UHEIL and citizen scientist (TIRN intern) for citizen science sampling. Water and sand samples were collected to practice with at TIRN's biannual sampling location. Analysis methods were tested with UH EIH Masters student.

New partnerships were developed with other organizations used our methods to sample for microplastics in sediments in Galveston Bay. The Galveston Bay Foundation sampled sediment at their Kemah facility's waterfront and Lee College sampled sediment at different living shoreline sites.

With the methods and analysis practiced, sand and water samples collection began at six sites around Galveston Island. The six sites of sample collection were:

1. Moody Gardens
2. Jamaica Beach
3. San Luis Pass
4. 53rd Street on Seawall
5. 39th Street on Seawall
6. Fort Point

Initially, students and volunteers were assigned a location to complete sampling, processing and enumeration. During the transition of TIRN Program Coordinators from Kimber D'Anderson to Morgan Huette, there was also a transition in volunteers and interns. Each site was no longer maintained by an individual volunteer, but the current TIRN interns would maintain all six sites. Prior, Ball

High School and Oppe Elementary students were trained as citizen scientists to assist during the project. A total of 3 rounds of samples were collected, processed and enumerated from each site.

During September of 2022, TIRN Program Coordinator, Morgan Huette, and TIRN Intern, Kory Barone, assisted in UHCL sample collection in upper Galveston Bay. Throughout sampling and analysis, meetings were held with UHCL staff (George Guillen, Jenny Oakley, Emily Cox) to discuss progress, problems, and future work.

In April of 2023, TIRN Program Coordinator, Morgan Huette, presented a poster over the work of this project at the Texas Plastic Pollution Symposium.

TIRN interns Brittany McWhorter and Alicia Arroyo assisted in creating visual data results after the third round of sample enumeration was complete.

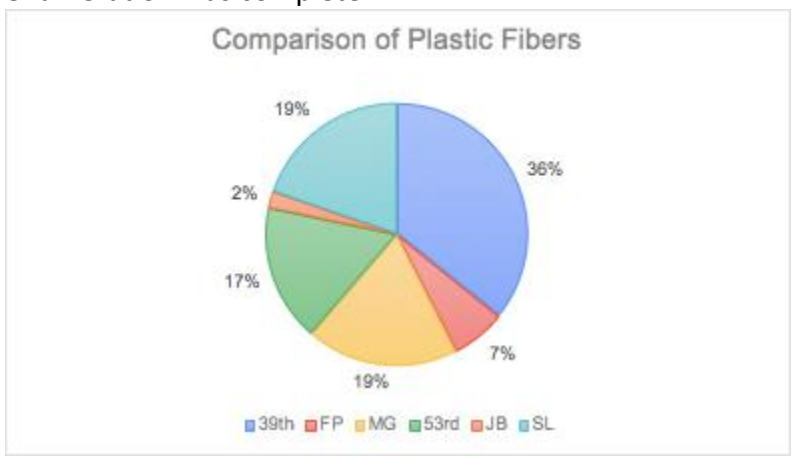

Figure 1. Comparing plastic fibers found in each site.

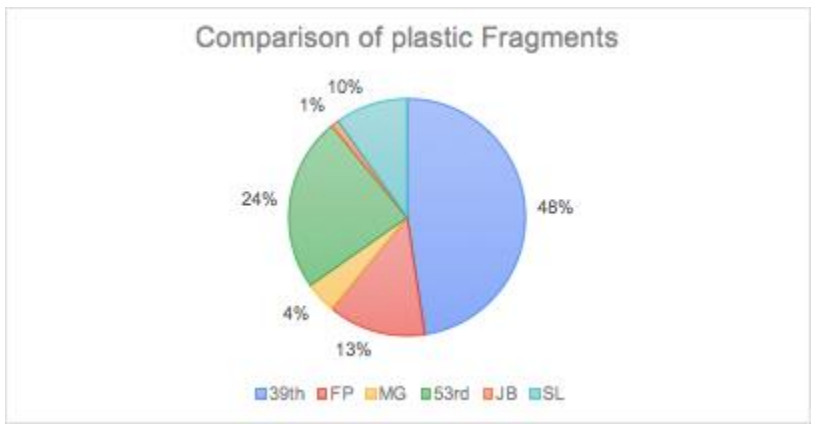

Figure 2. Comparing plastic fragments found in each site.

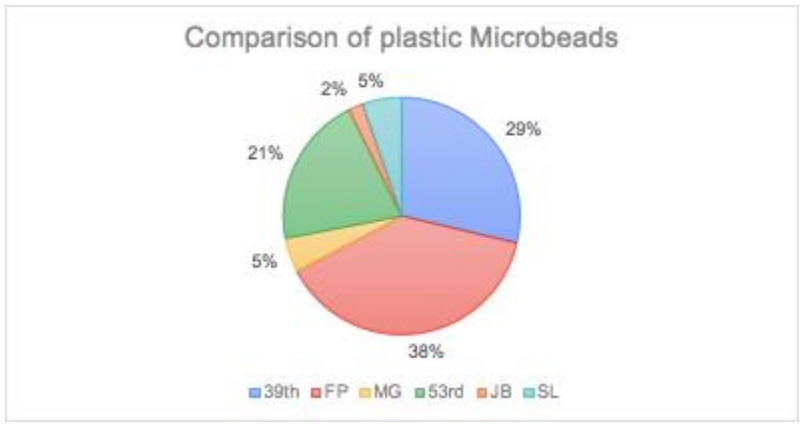

Figure 3. Comparing plastic microbeads found in each site.

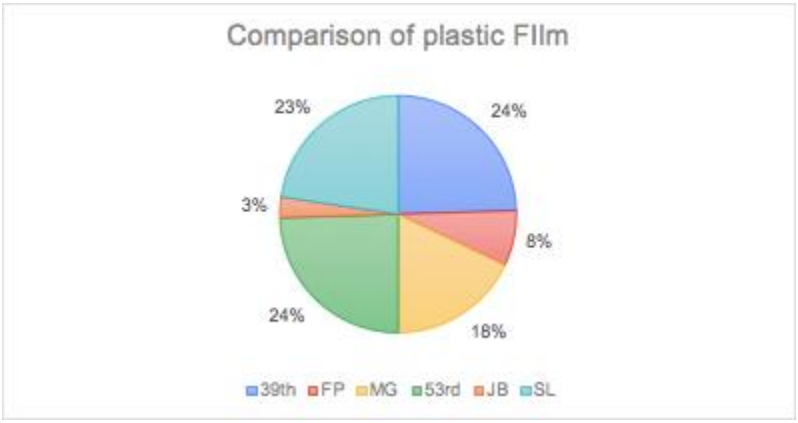

Figure 4. Comparing plastic film found in each site.

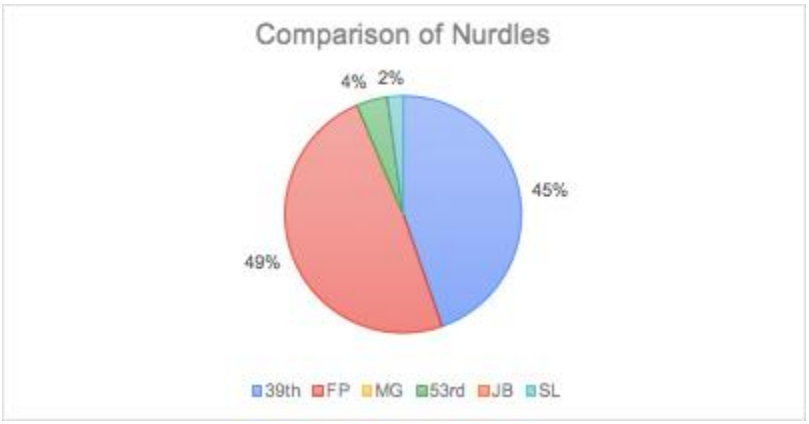

Figure 5. Comparing nurdles found in each site.

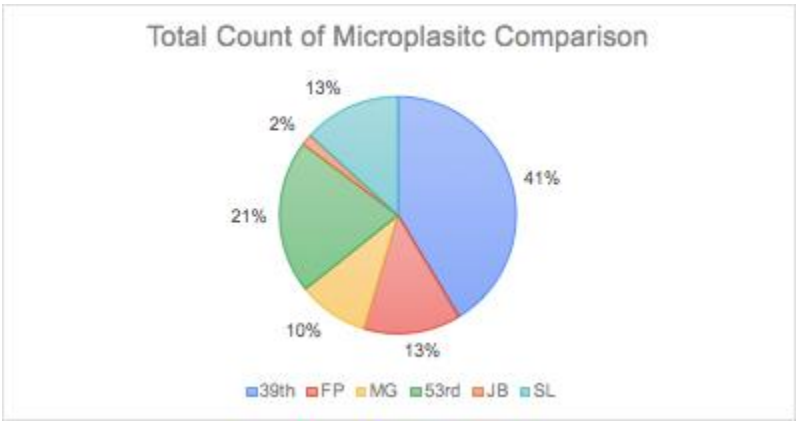

Figure 6. Comparing the total count of microplastics found in each site.

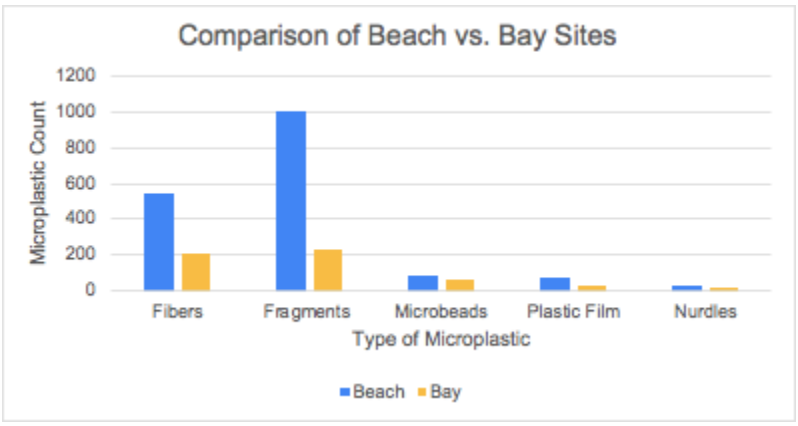

Figure 7. Comparing total count of microplastic found on beach sites versus bay site.

PROBLEMS OR OBSTACLES ENCOUNTERED

There were various obstacles that were encountered throughout the citizen science sampling, processing and enumeration. None of the problems required a CAR.

Towards the beginning of sample collection, sediment on the beaches had a lot more clay content than before due to ship channel dredge materials being placed on Galveston beaches. For heavy clay sediment, the density separator technique was adjusted because clay is less dense and does not sink as well as sand. The processing protocol as described in the QAPP was still being followed.

Citizen scientists were unable to participate at times due to schools canceling field experiences due to bus costs.

Sediment samples on the bay side were difficult to collect and process for varying reasons. The Jamaica Beach collection site had one small section of land area and the remaining area had bulkheads. Due to high clay content, rocks and vegetation present and safety for collection of samples, only water samples were collected at the Jamaica Beach site. The Moody Gardens collection site was located near the Colonel Paddleboat and faced similar problems. The site had high clay content, rocky shores with large areas of vegetation reaching the shoreline. Due to lack of sandy sediment, only water samples were collected from this site. There was also oil sheen present during some sample collections, most likely from the Colonel Paddleboat.

The vacuum pump used in processing of water samples broke. This prolonged the processing of the second round of samples. UH-CL loaned one of their pumps to us, allowing continuation of processing. The second collection of water samples at the Moody Garden location started to grow algae and become unusable. When attempting to process the algae filled water sample, the filter quickly got clogged. The algae water samples were discarded and new water samples were collected, finishing the second round of sampling. The reason for the delay in processing these samples was due to the vacuum pump breaking.

Large amounts of sediment were being collected in the sieves when processing sediment samples with the density separator. The problem has continued, but actions were taken to reduce the amount of sediment in the sieves. The portion of sand sample that was stuck on the wall of the density separator was washed further down into the density separator using a spray bottle. After the sediment samples were added to the density separator, the sediment settled for 10 minutes before turning the water pump on. If there was large amounts of sediment collected in the sieves at the conclusion of processing, the remaining sample from the sieves would be processed in the density separator again on a following day (after the sample dried).

Counting sediment samples in the petri dishes proved difficult. Graph paper templates were made to attach under the petri dish and were used as a guide when looking through the microscope. Samples that had a lot of sediment or organic content in the petri dish also proved difficult to enumerate. In these scenarios, forceps would be used to move the material around in the dish. Adding a step that would remove the organic debris would be beneficial in future studies. When enumerating with forceps in the lab and processing the sediment samples in the density separator outside in the garage, contamination chances were higher. Actions were taken to limit contamination, like enumerating with no fan on and processing sediment on a non-windy day. Many factors that could contribute to contamination could not be controlled.

Weather conditions and transition of interns prevented the completion of round 3 samples collections. During the winter season of 2022 into 2023, the cold weather, wind, and rough surf prevented sample collection at the remaining sites that needed the 3rd round of sample collection. The transition of interns also delayed sample collection due to the new training for the spring 2023 interns. 2 sites of round 3 have been collected and processed. The remaining 4 sites will be collected in the spring of 2023. The 3rd round of sample collection was completed later in the year when weather conditions were better.

DELIVERABLE SUBMITTED

In July of 2021, the sampling methods were tested with UHEIL and citizen scientist (TIRN intern) for citizen science sampling. Water and sand samples were collected to practice with at TIRN's biannual sampling location. In September of 2021, Moody Gardens staff assisted in analysis of method testing using the sediment samples collected on 7-26-21. UHCL, Galveston Bay Foundation, and Lee College also joined to learn the methods. The remainder of 2021 through 2023, acquisition of water and sediment samples were completed. Processing, enumeration and analysis were completed for all samples and the data sheets were submitted. The final data sheets, the final digital database and the data graphs are being submitted separately.

Appendix D – Public Outreach Final Report

Final Public Outreach Task Report
Date: 4/29/2024

Project Title: Microplastics in the Galveston Bay Watershed: The Big Impacts of Tiny Pollution

TCEQ Contract #: 582-21-10096

Grantee: University of Houston Clear Lake (UHCL)

Prepared by:

TIRN: Project Manager: Joanie Steinhaus

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PUBLIC OUTREACH OVERVIEW

The objective was to encourage public environmental stewardship and provide resources to reduce plastic pollution in the Galveston Bay Watershed and the Gulf of Mexico.

TASKS ACCOMPLISHED

Throughout the 3 years, volunteers and interns were recruited and trained to assist and lead educational outreach programs and events.

6,056 participants received a message regarding reduction of single use plastic products, microplastics, nurdles and trash in our watershed, bay and Gulf since June of 2021. Events and programs primarily included beach cleanups, presentations, school programs, vendor booths at festivals and community events, and Marine Debris Survey events.

Since June of 2021, a total of 2,838 pounds of trash, 313 balloons and 47,092 cigarette butts have been collected during cleanup events. As time permitted during our beach cleanups and programs, we ran a demonstration on sand processing for microplastics. Across all of the cleanups, 578 pieces of microplastics were found in our density separator demonstration. Nurdle surveys were completed at the beach cleanups if time permitted, and a total of 6,138 nurdle were collected.

PROBLEMS OR OBSTACLES ENCOUNTERED

There were delays in scheduling programs and events with schools due to Covid, teacher availability and scheduling conflicts. Transitions in GISD faculty also delayed scheduling programs with schools.

During the month of November through January of each year, there were fewer outreach events and beach cleanups due to winter weather and holidays.

DELIVERABLE SUBMITTED

The Public Outreach Plan was submitted and approved during April and May of 2021. The list of materials for all events was submitted and approved in July of 2021. Documentation of public event participation has been submitted with each quarterly progress report. The compiled public event participation is below.

FY21 Q3

- None

FY21 Q4

- June 2021
  - 6-18-21 Beach cleanup with Paul Mitchell the School Houston's Green Club. Collected 15.4 pounds and 10 nurdles (6 adults, 2 TIRN Interns, 1 TIRN Staff).
  - 6-24-21 Presentation to Hitchcock Public Library's youth program about sea turtles, estuaries, plastic pollution, and microplastics (97 viewers, 1 TIRN staff).
  - 6-25-21 Beach cleanup with Google Houston. Collected 22.94 pounds of trash and 159 nurdles (3 kids, 9 adults, 3 TIRN interns, 1 TIRN staff).
  - 6-26-21 Fishing line recycling tube installation and beach cleanup with a girl scout troop. Collected 8.36 pounds of trash, 350 cigarette butts, and 56 nurdles (8 kids, 4 adults, 3 TIRN interns, 1 TIRN staff).
- July 2021
  - 7-8-21 Presentation to UH Engineers Without Boarders for their upcoming cleanup to discuss sea turtles, marine debris, and microplastics (15 adults, 1 TIRN staff).
  - 7-10-21 Beach cleanup with UH Engineers Without Boarders. Collected 13 pounds of trash and found 7 nurdles (15 adults).
  - 7-15-21 Presentation to Hitchcock Public Library's youth program about sea turtles, oceans, plastic pollution, and microplastics (35 viewers, 1 TIRN staff).
  - 7-16-21 Beach cleanup with Inlanta Mortgage – The Legacy Group. Collected 15 pounds of trash, 78 nurdles, and 1200 cigarette butts (6 adults, 5 kids, 3 TIRN interns, 1 TIRN staff).
  - 7-23-21 Beach cleanup with Mt. Gay Rum. Collected 41 pounds of trash, 41 nurdles, and 1580 cigarette butts (40 adults, 2 TIRN interns, 1 TIRN staff).
  - 7-23-21 Beach cleanup with a girl scout troop. Collected 36 pounds of trash, 44 nurdles, and 15 cigarette butts (6 kids, 6 adults, 2 TIRN interns, 1 TIRN staff).
  - 7-31-21 Beach cleanup with cub scout troop. Collected 14.28 pounds, 23 nurdles, and 600 cigarette butts (8 adults, 11 kids, 2 TIRN interns).
- August 2021
  - 8-3-21 Presentation to Gulf Search and Rescue for their upcoming cleanup to discuss sea turtles, marine debris, and microplastics (20 adults, 5 kids, 1 TIRN staff).
  - 8-7-21 Beach cleanup with SOLAR-Caterpillar Latino Connection. Collected 17.42 pounds of trash, 27 nurdles, and 600 cigarettes (13 adults, 2 kids, 2 TIRN interns, 1 TIRN staff).
  - 8-12-21 Presentation to Harris County Evelyn Meador Branch Library about sea turtles, plastic pollution, and microplastics (6 viewers, 1 TIRN staff).
  - 8-14-21 Beach cleanup with Corona. Collected 47.01 pounds, 67 nurdles, and 3000 cigarette butts (37 adults, 2 TIRN interns, 1 TIRN staff)
  - 8-14-21 Beach cleanup with Gulf Search and Rescue. Collected 25.63 pounds of trash (20 adults, 5 kids).
  - 8-21-21 Beach cleanup with Girl Scout Troop 106035. Collected 5.52 pounds of trash, 185 nurdles, and 250 cigarette butts (7 adults, 10 kids, 3 TIRN interns).
  - 8-31-21 Attended Texas A&M Galveston – Galveston's Organization Night to recruit Fall semester interns to serve as citizen scientists (1 TIRN staff, 1 TIRN intern).

FY22 Q1 & Q2

- September 2021
  - 9-10-21 Microplastic Density Separator Training Day with partner organizations: Moody Gardens, Galveston Bay Foundation, UH EIH, and Lee College (1 TIRN staff, 1 TIRN intern, 6 adults)
  - 9-18-21 TX GLO Adopt-A-Beach Cleanup for World Cleanup Day. Collected xx pounds. (1 TIRN staff, 1 TIRN intern, xx adults, xx kids)

- 9-22-21 Holy Spirit Episcopal School Field Trip- Students conducted several activities including a beach cleanup, nurdle patrol survey, microplastics sampling and netting, and beach seining. Collected 7 pounds of trash, and 20 cigarette butts (43 students, 6 educators, 2 Moody Gardens staff, 2 TIRN staff).
- 9-24-21 Beach Cleanup with Dobie High School Environmental Science Classes. Collected 17 pounds of trash, 183 nurdles, 20 cigarette butts (4 educators, 33 students, 2 TIRN staff, 1 TIRN intern, 1 TIRN volunteer).
- 9-27-21 Hired 4 Fall semester interns
- 9-27-21 through 9-30-21 Teach a Kid to Fish

- October 2021
  - 10-1/14-21 School program for Oppe elementary students, Teach A Kid to Fish. (160 students, 8 educators, 2 TIRN staff)
  - 10-8-21 Curriculum planning meeting with Oppe Elementary and GISD Magnet Coordinator. Will use Microplastic Teacher kits this Fall (2 educators, 2 TIRN staff)
  - 10-9-21 Beach Cleanup – Step Up to Cleanup. Partner organizations include: Texas Brigades, Surfrider Galveston, SPLASh Texas, BACODA, Galveston Island Nature Tourism Council, Sea Tow, and Galveston Park Board of Trustees. Our booth focused on sea turtles, nurdles, and microplastics. Picked up 48 pounds of trash, 160 cigarette butts, and 142 nurdles (30 adults, 20 kids, 1 TIRN staff, 4 TIRN interns).
  - 10-14-21 Presentation to University of Houston's Engineers Without Boarders on how to conduct a beach cleanup and about microplastics (20 participants, 1 TIRN staff)
  - 10-30-21 Hosted a table at San Leon Day By The Bay where participants learned about microplastics, nurdles, turtles, single-use plastic and reusables (40 adults, 10 kids, 3 TIRN interns)
- November 2021
  - 11-10-21 Planning meeting with GISD staff to plan microplastics program at Oppe Elementary
  - 11-11-21 Cigarette pollution and plastics discussion with the Galveston Chapter of the Surfrider Foundation at Menard Park in Galveston (7 volunteers, 1 TIRN intern, 1 TIRN staff)
  - 11-30-21 Plastic Free Lunch program presentation for Oppe Elementary 4th Graders (34 students, 2 educators, 1 TIRN staff)
- December 2021
  - 12-1-21 Plastic Free Lunch program presentation for Oppe Elementary 4th Graders (32 students, 2 educators, 1 TIRN staff, 1 TIRN intern)
  - 12-2-21 Field trip at Moody Gardens with Dobie High School AP Environmental Class and UH Masters Student Emily. Students used the density separator to separate microplastics from sand, filtered sea water for microplastics, analyzed samples under microscopes, used an Enviroscape to learn about watersheds, toured the Animal Holding facility and aquarium (28 students, 5 educators, 2 TIRN staff, 1 TIRN intern, 1 UH Masters student).
  - 12-3-21 Plastic Free Lunch program presentation for Oppe Elementary 4th Graders (30 students, 2 educators, 1 TIRN staff, 1 TIRN intern)
  - 12-8-21 Presentation to 2nd Graders for Teach A Kid to fish where they talked about sustainable fishing practices, plastic pollution, and promises to sea turtles to help. (43 students, 2 educators, 1 TIRN staff, 2 TIRN interns)
  - 12-9-21 Presentation to 2nd Graders for Teach A Kid to fish where they talked about sustainable fishing practices, plastic pollution, and promises to sea turtles to help. (39 students, 2 educators, 1 TIRN staff, 2 TIRN interns)
  - 12-10-21 Presentation to 2nd Graders for Teach A Kid to fish where they talked about sustainable fishing practices, plastic pollution, and promises to sea turtles to help. (44 students, 2 educators, 1 TIRN staff)
  - 12-11-21 Beach cleanup with girl scout troop. Collected 1.6 pounds of trash, 2 balloons, 125 cigarettes, and 11 nurdles (9 kids, 3 adults, 1 TIRN staff, 3 TIRN interns)
  - 12-13-21 Beach cleanup with school. Collected 5.4 pounds of trash, 2 balloons, 500 cigarette butts, and 27 nurdles
- January 2022
  - 1-19-22 Presentation to rotary club about program and marine debri mitigation (xx adults, 1 TIRN staff)
- February 2022
  - 2-18-22 Microplastics Citizen Science Team training session (7 adult volunteers, 1 TIRN staff)
  - 2-22-22 Presentation to rotary club about program and marine debri mitigation (25 adults, 2 TIRN staff)
  - 2-23-22 Density separator methods practice and development with UH masters student (1 TIRN staff, 1 UH student)
  - 2-25-22 Beach cleanup with NCSY Relief Missions. Collected 1.92 pounds of trash, 200 cigarettes, 4 microplastics, 0.588 grams of microplastics, and 1 nurdle (14 students, 4 adults, 1 TIRN staff, 1 TIRN intern)

FY 22 Q3

- March 2022
    - 3-2-22 Beach Cleanup with Deutch Family Wine and Spirits. (21 adults and 2 children) 9.5 pounds of trash, 2 balloons, 150 cigarette butts.
    - 3-5-22 Beach cleanup with Roots and Shoots. (13 students and 6 adults) 2.34 pounds of trash, 30 cigarette butts.
    - 3-10-22 Beach Cleanup with Doane Univeristy, Nebraska. (10 students, 3 adults) 4.9 pounds of trash, 5 balloons, 600 cigarette butts.
    - 3-17-22 Beach cleanup Lamar University. (12 students, 2 adults) 2.3 pounds of trash, 300 cigarette butts.
    - 3-22-22 The Village School. (9 students, 2 adults) Zoom presentation on plastics/microplastics and processing
    - 3-25-22 San Jacinto College (17 students/1 adult) Presentation on plastics, micropastics and human health. Plus a beach cleanup. 21 pounds of trash, 1 balloon, 350 cigarette butts
    - 3-29-22 TAMUG Career Day. Recruited two interns for summer semester.
    - 3-31-22 Environmental Journalist Conference in Houston. Presentation to 42 journalists on project.
- April 2022
    - 4-2-22 Beach cleanup with Girl Scouts (10 Scouts, 8 adults) 10.3 pounds of trash, 1 balloon, 290 cigarette butts
    - 4-9-22 GLO Adopt a Beach. 800 participants in Galveston. Menard park to sign-in and sent to numerous locations in Galveston.
    - 4-9-22 Meadowlake Pet Resort (23 adults) Beach cleanup. 20.2 pounds of trash, 150 cigarette butts.
    - 4-9-22 Wings over Surfside. 42 participants. Booth staffed by TIRN interns. Reduction of single-use plastics.
    - 4-14-22 National Technical Honor Society. CCISD. (57 students, 5 adults) Programs with Moody Garden, American Bird Conservancy and TIRN staff. Beach cleanup, 23.96 pounds of trash, 1 balloon, 160 cigarette butts. Programs on nurdle patrol, microplastics and seine nets in the Gulf.
    - 4-15-22 Earth Day at UTMB. 69 adults visited our booth on reduction of single use plastics.
    - 4-18-22 Girl Scouts (16 Scouts, 2 adults) Beach cleanup. 4.25 pounds of trash, 4 balloons, 45 cigarette butts.
    - 4-22-22 Deer Park ISD HS. (19 students, 2 adults) Beach cleanup. 6.6 pounds of trash, 300 cigarettes.
    - 4-22-22 Wells Data Lab. Beach cleanup. 8.9 pounds of trash, 300 cigarette butts.
    - 4-23-22 Featherfest (bird event) 29 adults. Presentation on project, single use plastic, impacts to the environment and microplastics
    - 4-23-22 Artwalk, Family event. 15 participants. Made reusable T-shirt bags, and information on reduction of single use plastics.
    - 4-26-22 Alvin ISD. (22 students, 4 adults) Beach cleanup. 34.1 pounds of trash, 2 balloons, 400 cigarette butts.
    - 4-28-22 Friendswood HS (10 students, 1 adult) Beach cleanup. 22.3 pounds of trash, 2 balloons, 400 cigarette butts.
    - 4-30-22 Girl Scouts (10 Scouts, 2 adults) Beach cleanup. 5 pounds of trash, 75 cigarette butts.
- May 2022
    - 5-3-22 Klein HS (65 students, 5 adults) Programs with Moody Garden, American Bird Conservancy and TIRN staff at East Beach. Beach cleanup. 4 pounds of trash, 4 balloons and 250 cigarette butts. Density separator demo, microplastic lesson, nurdle patrol and seine netting.
    - 5-7-22 Friendswood FFA (32 students, 2 adults) Beach cleanup. 20.28 pounds of trash, 475 cigarette butts
    - 5-17-22 Acorn International. 6 adults. Beach cleanup. 4.1 pounds of trash, 4 balloons, 300 cigarette butts.
    - 5-21-22 Hambrick MS (29 students, 3 adults) Beach cleanup. 6.6 pounds of trash, 3 balloons, 250 cigarette butts

FY22 Q4

- June 2022
    - 6-1-22 Beach Cleanup with St. John Luteran Church Jr. High Program. Collected 22.22 pounds of trash, 42 balloons, 500 cigarette butts, 17 macroplastics, and 41 nurdles. (2 adults, 13 kids)
    - 6-3-22 Beach Cleanup with Girl Scout group. Collected 11.36 pounds of trash, 3 balloons, 200 cigarette butts, 19 macroplastics, and 15 nurdles. (2 adults, 5 kids)
    - 6-4-22 Beach Cleanup with the Omegas. Collected 7.3 pounds of trash, 1 balloon, 100 cigarette butts, 13 macroplastics, and 13 nurdles. (16 adult)
    - 6-4-22 World Ocean Day at East Beach. Booth with information about marine debris and ocean conservation. (155 people)
    - 6-4-22 Art Walk at Galveston Railroad Museum. Booth with information on microplastics and a demonstration with the portable density separator. (15 people)
    - 6-10-22 Beach Cleanup with Schlumberger. Collected 9.42 pounds of trash and 600 cigarette butts. (31 adults)

- 6-10-22 Beach Cleanup with Katy High School. Collected 14.3 pounds of trash, 2 balloons, 675 cigarette butts, 10 macroplastics, and 123 nurdles. (2 adults, 24 kids)
- 6-11-22 Corona/United by Blue Beach Cleanup Event. Collected 157 pounds of trash and 1200 cigarette butts. (56 people)
- 6-13-22 Beach Cleanup with Individual Family. Collected 45.68 pounds of trash, 300 cigarette butts, 3 macroplastics, and 73 nurdles. (3 adults, 11 kids)
- 6-16-22 BeachCleanup with St. Alban's Episcopal Church in Austin. Collected 11.78 pounds of trash, 2 balloons, 700 cigarette butts, and 2 macroplastics. (7 adults, 9 kids)
- 6-17-22 Beach Cleanup with Ball High School. Collected 2.5 balloons, 175 cigarette butts, 15 macroplastics, and 4 nurdles. (1 adults, 6 kids)

- July 2022
  - 7-8-22 Beach Cleanup with Control Risks. Collected 37.56 pounds of trash, 1100 cigarette butts, 23 macroplastics, and 2 nurdles. (17 adults, 7 kids)
  - 7-9-22 Beach Cleanup with AmeriCorps NCCC (Unit Yellowstone 2) and Scouts BSA Troop 1075. Collected 19.5 pounds of trash, 6 balloons, 1100 cigarette butts, and 256 nurdles. (2 adults, 18 kids)
  - 7-14-22 Sierra Club. everything. Zoom presentation on TIRN, microplastic project, single use plastic, impacts to the environment and microplastics. (27 people)
  - 7-18-22 Beach Cleanup with Familypoint Resources. Collected 14.82 pounds of trash, 27 balloons, and 1100 cigarette butts. (2 adults, 15 kids)
  - 7-26-22 Moody Garden SAVY program at TIRN office. Presentation on plastic pollution, single-use plastic and reusables, microplastics and human health. (9 kids, 2 adults)
- August 2022
  - 8-1-22 Beach Cleanup with the Trinity Classical School. Collected 15.45 pounds of trash, 700 cigarette butts, 3 macroplastics, and 52 nurdles. (4 adults, 20 kids)
  - 8-5-22 Beach Cleanup with Clear Creek ISD FFA. Collected 10.7 pounds of trash, 16 balloons, 1100 cigarette butts, 13 macroplastics, and 50 nurdles. (3 adults, 15 highschoolers)
  - 8-11-22 Beach Cleanup with Halle Jacobs and Family. Collected 5.8 pounds of trash, 7 balloons, 250 cigarette butts, 5 macroplastics, and 8 nurdles. (4 adults, 5 kids)
  - 8-20-22 Beach Cleanup with The Woodlands Community Presbyterian Church. Collected 21.62 pounds of trash, 4 balloons, 750 cigarette butts, 3 macroplastics, and 165 nurdles. (3 adults, 8 kids)
  - 8-20-22 Beach Cleanup with UH Hispanic Business Student Association. Collected 11.9 pounds of trash, 850 cigarette butts, 8 macroplastics, and 91 nurdles. (26 college students)
  - 8-25-22 Beach Cleanup with TRamontina USA. Collected 75.62 pounds of trash, 8 balloons, 2700 cigarette butts, 5 macroplastics. (54 adults)

FY23 Q1

- September 2022
  - 9-6-22 Beach Cleanup with Family Group. Collected 13.5 pounds of trash and 75 cigarette butts. (10 adults, 3 kids)
- October 2022
  - 10-1-22 Beach Cleanup with Family Group. Collected 5.16 pounds of trash, 350 cigarette butts, 11 macroplastics, and 130 nurdles. (6 adults)
  - 10-7-22 Beach Cleanup with Air Charter Services. Collected 4.08 pounds of trash, 350 cigarette butts, 3 macroplastics, and 45 nurdles. (12 adults)
  - 10-8-22 Surfside Nature Fest. Morgan Huette presented on Sea Turtles of the Gulf of Mexico. Hosted booth with Upcycle Your T-Shirt activity. (500 people)
  - 10-11-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (18 students)
  - 10-14-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (17 students)
  - 10-14-22 Beach Cleanup with American Marketing Association at UH. Collected 20.9 pounds of trash, 2 balloons, 850 cigarette butts, 5 macroplastics, and 18 nurdles. (16 adults)
  - 10-15-22 Beach Cleanup with UTMB Residents. Collected 20 pounds of trash, 2 balloons, 300 cigarette butts, 3 macroplastics, and 21 nurdles. (25 adults, 3 kids)
  - 10-18-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (19 students)
  - 10-18-22 Texas A&M University Galveston Career Fair. Informed college students about TIRN. Recruit new interns for Spring 2023. (400 students)

- 10-20-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (18 students)
- 10-21-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (19 students)
- 10-22-22 Beach Cleanup with Girl Scout Troop. Collected 4.34 pounds of trash, 900 cigarette butts, 17 macroplastics, and 25 nurdles. (8 adults, 14 kids)
- 10-22-22 Colleen's Beach Cleanup Memorial. Collected 13.63 pounds of trash and 300 cigarette butts. (28 adults and 3 kids)
- 10-26-22 Pasadena ISD Field Trip. Completed 3 stations (beach cleanup, microplastics, and seine net) at Stewarts Beach. Collected 10.34 pounds of trash, 100 cigarette butts, 3 macroplastics, and 8 nurdles. (3 adults, 42 students)
- 10-27-22 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (19 students)
- 10-29-22 Beach Cleanup with UH Engineers without Borders. Collected 7.4 pounds of trash, 30 cigarette butts, and 66 nurdles. (7 students)

- November 2022
  - 11-2-22 College of the Mainland presentation. Presentation focused primarily on microplastics and TIRN. (7 adults).
  - 11-3-22 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (18 students)
  - 11-4-22 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (20 students)
  - 11-7-22 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (17 students)
  - 11-8-22 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (15 students)
  - 11-8-22 Beach Cleanup with Friendswood HS Biomedical Innovation. Collected 8.32 pounds of trash, 5 balloons, 600 cigarette butts, 27 macroplastics, and 30 nurdles. (1 adult, 9 students)
  - 11-10-22 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (19 students)
  - 11-12-22 Beach Cleanup with Boy Scout Troop. Collected 47.24 pounds of trash, 150 cigarette butts, 35 macroplastics, and 26 nurdles. (6 adults, 10 students)

FY23 Q2

- December 2022
  - 12-2-22 Beach Cleanup with Post Oak School. Collected 5.76 pounds of trash, 400 cigarette butts, 10 macroplastics, and 51 nurdles. (22 students, 4 adults)
  - 12-3-22 Beach Cleanup with Beauer Honors Advisory Board. Collected 4.94 pounds of trash, 3 balloons, 350 cigarette butts, 8 macroplastics, and 159 nurdles. (8 students)
  - 12-5-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (18 students)
  - 12-6-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (16 students)
  - 12-7-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (17 students)
  - 12-9-22 Beach Cleanup with NHECHS. Collected 20.37 pounds of trash, 250 cigarette butts, and 5 macroplastics. (40 students, 3 adults)
  - 12-10-22 Beach Cleanup with Argus Media. Collected 6.26 pounds of trash, 3 balloons, 650 cigarette butts, 17 macroplastics, and 85 nurdles. (1 kid, 8 adults)
  - 12-13-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (15 students)
  - 12-14-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (18 students)
  - 12-15-22 CEER Listening Tour and Beach Cleanup. Collected 2.04 pounds of trash and 45 cigarette butts. (13 adults)
  - 12-16-22 Oppe Teach a Kid to Fish- 2nd Grade. Presentation and Sea Turtle Promises activity. (16 students)
- January 2023
  - 1-25-23 TAZE Conference. Microplastic presentation and demonstration at TIRN office. (10 adults)
  - 1-26-23 Winter Texas Office Visit. Sea Turtle and TIRN presentation, t-shirt bag activity, and microplastic microscope activity. (6 adults)
- February 2023
  - 2-3-23 Oppe Elementary Teacher Workshop. Introduce education kits and train teachers on program. (4 adult)
  - 2-4-23 Marine Debris Survey. Conduct training and survey. (8 adults)
  - 2-10-23 Beach Cleanup with Winter Texans. Collected 3.64 pounds of trash, 150 cigarette butts, and 130 nurdles. (2 adults)
  - 2-10-23 AWTY presentation. Zoom presentation on marine debris. (122 kids, 8 adults)
  - 2-25-23 Sea Turtle Saturday. Present about sea turtles and TIRN. Discuss TIRN projects at table. (72 adults)

FY23 Q3

- March 2023
  - 3-3-23 Beach Cleanup with Remy Cointreau USA. Collected 79.86 pounds of trash and 100 cigarette butts. (27 adults)

- 3-3-23 Beach Cleanup with Post Oak School. Collected 18.04 pounds of trash, 50 cigarette butts, and 13 nurdles. (26 students, 4 adults)
- 3-4-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (8 participants)
- 3-9-23 Crenshaw Career Day. Presentation about TIRN, plastic pollution, the marine biology field, and Morgan's career journey. (139 students)
- 3-16-23 OLLI Presentation over Microplastic. (23 adults)
- 3-23-23 TAMUG Career Fair. Recruit future interns and volunteers to aid in the microplastic project. (250 students)
- 3-25-23 Beach Cleanup with Girl Scout Troop 143155. Collected 23.74 pounds of trash, 62 cigarette butts, 24 macroplastics, and 123 nurdles. (13 kids, 14 adults)
- 3-29-23 Beach Cleanup with USCG Air Station Houston. Collected 27.74 pounds of trash, 325 cigarette butts, and 24 nurdles. (39 adults)
- 3-31-23 Beach Cleanup with Valaris. Collected 21.2 pounds of trash, 2 balloons, and 800 cigarette butts. (3 kids, 20 adults)

- April 2023
  - 4-1-23 Beach Cleanup with First Congregational Church of Houston-Youth. Collected 12.6 pounds of trash, 100 cigarette butts, 5 macroplastics, and 16 nurdles. (9 kids, 7 adults)
  - 4-1-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (8 participants)
  - 4-3-23 Beach Cleanup with Sunshine Center. Collected 9 pounds of trash and 50 cigarette butts. (6 clients, 2 adults)
  - 4-5-23 Texas Plastic Pollution Symposium. Network, collaborate, and learn more about research being done on plastic pollution. TIRN helped plan the symposium, presented a poster, and participated. (199 people)
  - 4-20-23 OLLI Program. Presentation on plastic pollution and make reusable t-shirt bags. (3 adults)
  - 4-21-23 Odyssey Academy Bay Area School Programs. Lead presentations and activities for students in grades kindergarten through 7th grade. (210 students)
  - 4-22-23 Beach Cleanup with Girl Scout Troop 129195. Collected 7.6 pounds of trash, 50 cigarette butts, and 2 macroplastics. (12 kids, 20 adults)
  - 4-22-23 Earth Day Event. Booth with information about TIRN, plastic pollution, and activity making reusable t-shirt bags. (200 people)
  - 4-28-23 Beach Cleanup with Texas Rising at UHD. Collected 4 pounds of trash, 5 balloons, 500 cigarette butts, 34 macroplastics, and 103 nurdles. (16 students)
- May 2023
  - 5-5-23 Beach Cleanup with Chinquapin Preparatory School 8th Grade. Collected 6.92 pounds of trash, 4 balloons, 300 cigarette butts, and 6 macroplastics. (19 students, 2 adults)
  - 5-6-23 Beach Cleanup with UTMB Resiterns. Collected 5.76 pounds of trash, 6 balloons, 150 cigarette butts, 5 macroplastics, and 9 nurdles. (2 kids, 9 adults)
  - 5-6-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (17 participants)
  - 5-9-23 Sea Center Texas Presentation. Presentation about TIRN and plastic pollution. (24 people)
  - 5-10-23 Foster Elementary Zoom Presentation. Presentation about TIRN, plastic pollution, and marine debris. (75 students)
  - 5-17-23 Beach Cleanup With Katy HS Student Council. Collected 25.72 pounds of trash, 2 balloons, 50 cigarette butts, and 6 macroplastics. (36 students, 3 adults)
  - 5-20-23 Beach Cleanup with Friendswood FFA. Collected 5.3 pounds of trash, 1 balloon, 200 cigarette butts, 10 macroplastics, and 138 nurdles. (3 kids, 15 adults)
  - 5-27-23 Beach Cleanup with Boy Scout Troop 446. Collected 10.28 pounds of trash, 52 balloons, 650 cigarette butts, 9 macroplastics, and 39 nurdles. (9 kids, 8 adults)

FY23 Q4

- June 2023
  - 6-2-23 Beach Cleanup with SLB. Collected 19.86 pounds of trash, 800 cigarette butts, 4 macroplastics, and 24 nurdles. (18 adults, 14 kids)
  - 6-10-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (22 participants)
  - 6-10-23 World Ocean Day. TIRN table with LUSH. (300 people)
  - 6-12-23 YMCA Zoom Presentation. Presentation over TIRN and sea turtles. (21 people)
  - 6-16-23 World Sea Turtle Day Beach Cleanup. Collected 226.57 pounds of trash and 2,800 cigarette butts.(112 people)

- 6-26-23 Beach Cleanup with Ralph Lauren. Collected 13.32 pounds of trash, 2 balloons, 500 cigarette butts, and 3 macroplastics. (10 adults)
- 6-30-23 Beach Cleanup with Wolff Center for Entrepreneurship at UH. Collected 6.54 pounds of trash, 1 balloon, 400 cigarette butts, and 3 macroplastics. (10 students)

- July 2023
  - 7-8-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (9 participants)
  - 7-19-23 Beach Cleanup with Iberia Parish 4-H. Collected 7.86 pounds of trash, 8 balloons, 580 cigarette butts, and 4 macroplastics. (13 students, 1 adult)
  - 7-21-23 Beach Cleanup with Individual Group. Collected 19.50 pounds of trash, 2 balloons, 400 cigarette butts, and 1 macroplastics. (7 kids, 10 adults)
  - 7-22-23 Better Brazoria Bash. TIRN table. (50 people)
  - 7-27-23 SAVY Program and Beach Cleanup. Microplastic presentation and beach cleanup. Collected 13.97 pounds of trash, 7 balloons, 300 cigarette butts, 6 macroplastics, and 12 nurdles. (11 kids, 1 adult)
  - 7-29-23 Beach Cleanup with Girl Scouts. Collected 9.9 pounds of trash, 4 balloons, 250 cigarette butts, 7 macroplastics, and 12 nurdles. (6 adults, 6 kids, 1 baby)
- August 2023
  - 8-3-23 Beach Cleanup with Clear Creek ISD FFA. Collected 32.82 pounds of trash, 500 cigarette butts, 11 macroplastics, and 7 nurdles. (8 students, 3 adults)
  - 8-5-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (18 participants)
  - 8-8-23 Zoom program with HHS TWRC Wildlife Center. Presentation about turtles, plastic, TIRN, and career path. (7 people)
  - 8-11-23 Beach Cleanup with Hispanic Business Student Association. Collected 10.32 pounds of trash, 7 balloons, 500 cigarette butts, 3 macroplastics, and 11 nurdles. (17 students)
  - 8-18-23 Beach Cleanup with Alpha Epsilon Delta Texas Chapter. Collected 15.92 pounds of trash, 1 balloon, 200 cigarette butts, and 2 macroplastics. (11 students)
  - 8-26-23 Beach Cleanup with Woodlands Community Presbyterian Church. Collected 7.14 pounds of trash, 800 cigarette butts, 9 macroplastics, and 239 nurdles. (14 kids, 4 adults)

FY24 Q1

- September 2023
  - 9-6-23 Reusable Foodware Presentation for Kiwanis. (47 people)
  - 9-9-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (18 people)
  - 9-21-23 Art in the Gardens. Complete art and craft activities with special needs students. (200 people)
  - 9-23-23 Beach Cleanup with Girl Scout Group. Collected 18.94 pounds of trash, 5 balloons, 100 cigarette butts, and 12 macroplastics. (9 kids, 8 adults)
- October 2023
  - 10-4-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (17 kids)
  - 10-5-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (17 kids)
  - 10-6-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (17 kids)
  - 10-7-23 DaVinci Day. Work TIRN table with t-shirt bag activity. (143 people)
  - 10-7-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (10 people)
  - 10-10-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (19 kids)
  - 10-10-23 Clear Creek Community Church -Rob the Ridley. Read story to kids and take pictures with Rob the Ridley. (100 kids)
  - 10-11-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (16 kids)
  - 10-12-23 Oppe Teach a Kid to Fish- 3rd Grade. Presentation and marine debris timeline activity. (18 kids)
  - 10-13-23 Beach Cleanup with Society of Hispanic Professional Engineers. Collected 20 pounds of trash, 4 balloon, 650 cigarette butts, 12 macroplastics, and 137 nurdles. (35 people)
  - 10-14-23 Fish for Kids Sake. TIRN table highlighting the monofilament tubes around the island. (20 people)
  - 10-20-23 Clear Creek Community Church- Field Trip. Families rotated between beach cleanup, microplastic, and seine net stations. Collected 5.12 pounds of trash and 100 cigarette butts. (135 people)
  - 10-20-23 Beach Cleanup with Alcon. Collected 29.36 pounds of trash, 400 cigarette butts, and 6 macroplastics. (32 people)
  - 10-24-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (20 kids)

- 10-25-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (21 kids)
- 10-26-23 Oppe Teacher Workshop. Teach Oppe 4th grade teacher how to complete and use the microplastic kits. (6 adults)
- 10-27-23 Beach Cleanup with Texas Rising at UHD. Collected 7.04 pounds of trash, 350 cigarette butts, 5 macroplastics, and 28 nurdles. (19 people)
- 10-27-23 Beach Cleanup with Sphera. Collected 15.42 pounds of trash, 1 balloon, 500 cigarette butts, 7 macroplastics, and 47 nurdles. (14 people)
- 10-30-23 Oppe 4th Grade Microplastic Kits. Lead class in microplastic kit program. (105 kids)

- November 2023
  - 11-1-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (20 kids)
  - 11-2-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (18 kids)
  - 11-2-23 Texas A&M University Galveston Career Fair. Informed college students about TIRN. Recruit new interns for Spring 2024. (50 people)
  - 11-4-23 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (8 people)
  - 11-6-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (20 kids)
  - 11-6-23 Oppe 4th Grade Microplastic Kits. Lead class in microplastic kit program. (20 kids)
  - 11-7-23 Oppe Teach a Kid to Fish- 4th Grade. Presentation and Sort Me Recycling activity. (17 kids)
  - 11-29-23 Present to TAMUG Circle K International group about microplastics and TIRN.(16 students)

FY24 Q2

- December 2023
  - 12-2-23 Beach Cleanup with Texas A&M University ASSIST group. Collected 448.64 pounds of trash and 30 balloons (51 people)
  - 12-5-23 Awty International School Marine Debris Presentation. (102 students, 6 adults)
  - 12-12-23 Coastal Community Church surveys about reusable foodware. (45 people)
- January 2024
  - 1-6-24 Marine Debris Survey. Collect and record trash at our designated site at East Beach. (19 people)
  - 1-27-24 Beach Cleanup with Girl Scout Troop 142142. 244.61 pounds of trash collected, 70 nurdles found, and 3 macroplastics found. (18 people)
- February 2024
  - 2-7-24 Lemonade Day Kickoff at Central Middle School. (Approximately 250 people in attendance)
  - 2-17-24 Beach Cleanup with Marine Science Club from Sugarland ISD. 61.36 pounds of trash collected. (9 people)
  - 2-19-24 through 2-22-24 Gulf of Mexico Conference in Tampa, FL. Presentation of Reusable Foodware System through partner organization and discussed programs with other organizations. (1100 people in attendance)
  - 2-26-24 Beach Cleanup with Austin Middle School. Collected 21.04 pounds of trash. (19 people)

FY24 Q3

- March 2024
  - 3-2-24 Marine Debris Survey. Collect and record trash at our designated site at East Beach (18 people)
  - 3-18-24 Houston Festival for the People and the Planet. Outreach with participants at the festival, booth set up. (150 people)
  - 3-19-24 Beach Cleanup with Pearland ISD. 23.9 pounds of trash collected. (28 people)
  - 3-19-24 Beach Cleanup with Galveston Homeschool Performing Arts Co-op. 16.64 pounds of trash collected. (9 people)
  - 3-28-24 Texas A&M University Galveston Career Fair. Informed college students about TIRN. Recruit new interns for Summer 2024. (50 people)
  - 3-29-24 Beach Cleanup with Field Elementary National Honor Society. Collected 4.54 pounds of Marine Debris and 2 balloons. (4 participants)
- April 2024
  - 4-4-24 Galveston ISD Powerful Learning Innovators program at TIRN Education Center. 2nd grade students learned about microplastics in the Gulf of Mexico and Galveston Bay (50 students)
  - 4-5-24 Beach Cleanup with Milby High School NHS at East Beach. Picked up 27.9 Pounds of marine debris, found 2 balloons. (32 participants)
  - 4-6-24 Marine Debris Survey. Collect and record trash at designated site at East Beach. (14 volunteers)

- 4-9-24 Beach Cleanup with Disney Cruise Line. 21.98 pounds of marine debris removed between 2 sites. (10 participants)
- 4-10-24 Beach Cleanup with US Coast Guard Air Station Houston. Removed 283.31 pounds of debris. (29 participants)
- 4-11-24 Teach A Kid To Fish program at Crenshaw Environmental Magnet Elementary and Middle School. 3rd-8th grade levels: Sort-Me Recycling, Watersheds, Litter vs Trash, Upcycle your T-Shirt, Microplastic and Food Web Interactions, and Plastic Free Lunch. (90 students)
- 4-12-24 Beach Cleanup with Sunshine Renewable Solutions. Removed 45.58 pounds of marine debris. (23 participants)
- 4-18-24 PLI Program GISD at TIRN. 1st grade and Pre-K Recycling program at TIRN Education Center. Students learned about microplastics and recycling. (40 students)
- 4-18-24 Beach Cleanup with Briarwood School. Removed 18.84 pounds of marine debris and 5 nurdles. (38 participants)
- 4-19-24 Beach Cleanup with UH AMA and MISSO clubs. Removed 15.32 pounds of trash and 88 nurdles. (22 participants)
- 4-22-24 Beach Cleanup with Rhythm Energy. Removed 11.76 pounds of marine debris and 37 nurdles. (13 participants)
- 4-22-24 Beach Cleanup with Friendswood High School. Removed 15.5 pounds of marine debris and 41 nurdles. (13 participants)
- 4-23-24 Beach Cleanup with Bush High School. Removed 7.24 pounds of marine debris (29 participants)
- 4-24-24 Beach Cleanup with St. Paul's Christian Day School. Removed 10.81 pounds of marine debris and 13 nurdles. (13 participants)
- 4-25-24 Lab Presentation with St Paul's Christian Day School. Students learned about watersheds and practiced collecting data on microplastics by analyzing samples. (13 participants)
- 4-25-24 TAKTF Sea Turtle Promises Program at Sunshine Center Inc. Participants learned about our watershed, marine debris and pollution, and caring for marine species environments. (19 participants)
- 4-26-24 Beach Cleanup with University of Houston Downtown Texans Rising Club. Removed 9.81 pounds of marine debris and 2 nurdles. (15 participants)
- 4-27-24 Beach Cleanup with St. Agnes Academy. Removed 15.12 pounds of marine debris and 81 nurdles. (24 participants)

- May 2024
  - 5-8-24 TAKTF Marine Debris and Microplastic Program at Ball High School. Aquatic Science class, 10th-12th grader. (98 students)
  - 5-9-24 Tourism Talks Event with Visit Galveston. Shared information about TIRN programs and research. (about 250 attendees)
  - 5-9-24 Beach Cleanup with EnSafe Inc. Removed 54.96 pounds of marine debris. (11 participants)
  - 5-13-24 Virtual Presentation with Foster Elementary School 4th grade class. Program about watersheds, marine debris, and microplastics. (24 students).
  - 5-17-24 Beach Cleanup with Omega Phi Gamma. Removed 19.36 pounds of Marine Debris. (14 participants)
  - 5-18-24 Beach Cleanup with Friendswood High School FFA. Removed 8.9 pounds of marine debris and 278 nurdles. (20 participants)
  - 5-23-24 Beach Cleanup with InnOvation Church. Removed 31.96 pounds of marine debris and 12 nurdles. (16 participants)
  - 5-24-24 Beach Cleanup with St. Catherine's Montessori High School. Removed 18.52 pounds of marine debris. (23 participants)
  - 5-24-24 TAKTF presentation on marine debris and microplastics at Mark Twain Elementary. (98 students)
  - 5-25-24 Beach Cleanup with Hambrick Middle School. Removed 14.5 pounds of marine debris. (19 participants)
  - 5-25-24 Beach Cleanup with Cypress High School Speech and Debate Team. Removed 15.36 pounds of marine debris. (18 participants)
  - 5-28-24 Field Trip with Roberts Elementary School. Students participated in a beach cleanup station, and a microplastics and nurdles station. Removed 49.98 pounds of marine debris and 7 nurdles. (96 students and 20 chaperones)