# Microplastics Report August 2018

*1. Introduction*

Plastic pollution is a global issue that has recently emerged as an area of concern for the health and well being of humans, animals, and the environment. In the world's oceans, plastics enter from primarily land-based sources, such as rivers beaches, and wastewater treatment plants, though there are maritime sources as well (Cole et al., 2011). Plastics are highly durable in the marine environment. Different estimates predict they can persist for anywhere from hundreds to thousands of years. They are, however not immune to degradation. Over time, ultraviolet radiation and other weathering processes cause larger plastics to degrade into microplastics, or plastic particles <5mm in diameter (Barnes et al., 2009). Microplastics were first reported in the open ocean in the 1970s (Carpenter and Smith, 1972) and since then they have been discovered in all types of marine environments (Wright et al., 2013). A 2014 study conducted by 5 Gyres Institute estimates that there are more than five trillion pieces of plastic in the ocean, weighing more than 250,000 tons (Eriksen et al., 2014).

Plastic pollution poses a substantial threat to marine wildlife, causing entanglements as well as choking and starvation upon ingestion. This phenomenon has been well documented around the globe for many types of species, from marine mammals to sea turtles and other marine megafauna (Adimey et al., 2014; Butterworth, 2017; Gregory, 2009; Stelfox et al., 2016). These incidents are often either fatal for the animals or the cause of a severe reduction in fitness. The Manta Mexico Caribe research team has also witnessed, first hand, the entanglement of plastic fishing gear around the cephalic fin of a manta ray during August of 2018 (see below). The conditions of the entanglement would have most likely proved fatal for the individual. Fortunately, the line was removed before the injury could worsen; others are not so lucky.


Marine plastics and microplastics are also hazardous in a more unexpected way, as they harbor the potential to poison marine wildlife upon ingestion (Simmonds, 2017). Plastic readily absorbs what are known as persistent organic pollutants (POPs). These are chemicals that do not naturally occur in the environment and are resistant to degradation. They include pesticides such as dichlorodiphenyltrichloroethane (DDT) and industrial compounds known as polychlorinated biphenyls (PCBs). When microplastics are ingested, they act as vectors for POPs, which are fat-soluble and accumulate in the fatty tissues of marine animals. When released into the blood stream, they have been shown to cause health problems in a variety of animal species. These problems potentially have population level implications, such as increased rates of cancer and decreased reproductive success (Simmonds et al., 2017). POPs are also known to bioaccumulate and biomagnify up the food chain, which means that predators accumulate the toxins of all of their prey before them, with top predators containing the highest levels in their tissues. Considering humans are top predators and regular consumers of seafood, this is potentially a human health issue as well as a conservation issue (Barboza et al., 2018).



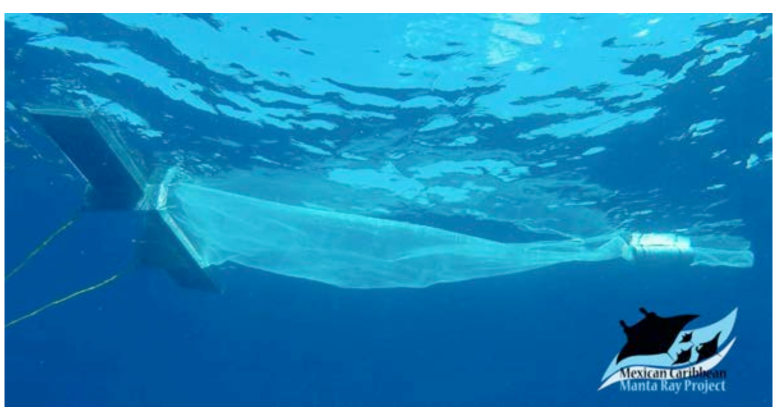
*Plastic bottle found in the water and collected plastic while taking manta ID´s*

For endangered or vulnerable species, microplastics pose an imminent threat to the success of wild populations. This includes the giant oceanic manta ray (*Mobula cf. birostris*) (Marshall et al., 2009; Hinojosa et al., 2016), a charismatic species present in the Mexican Caribbean and classified as 'vulnerable' by the International Union for the Conservation of Nature (IUCN) (Marshall et al., 2018). Oceanic manta rays are filter feeders that primarily consume zooplankton (Germanov et al., 2018). Their small prey and large body size means they must consume large quantities of plankton to survive. This feeding strategy means that microplastics pose a substantial threat to manta ray health because they may filter hundreds of thousands of cubic meters of water daily, which could lead to microplastic ingestion, either directly or through the ingestion of contaminated plankton (Germanov et al., 2018). Currently, the amount of microplastic in the Mexican Caribbean manta ray feeding range is unknown. It is the primary focus of Manta Mexico Caribe’s microplastic project to sample this environment and generate counts of microplastics in manta habitats and further inform the state of this emerging conservation issue.


*Filter feeders and plastic*

*2. Methods*

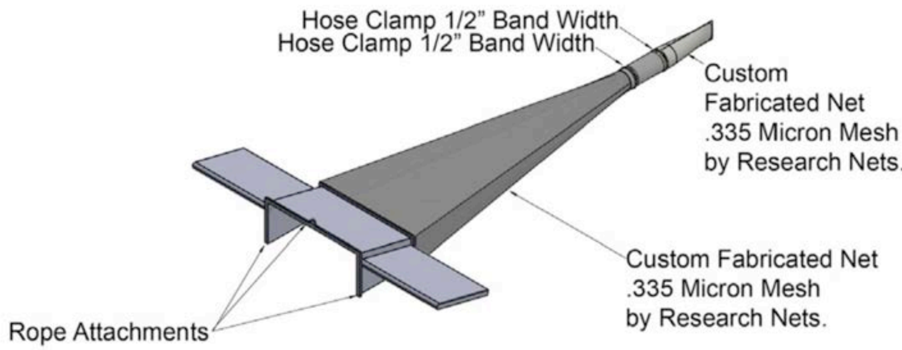
During August of 2018, eight samples were collected near manta feeding sites using a manta trawl, as part of the 5 Gyres TrawlShare Program. Samples were then processed in the laboratory using the protocol of the National Oceanic and Atmospheric Association (NOAA) Marine Debris Program (Masura et al., 2015). Microplastics were identified and counted using microscopy. Of the eight samples collected, three have so far been processed and the remaining five are to be processed January 2019.




*Manta trawl in water*

*2.1. Trawling*

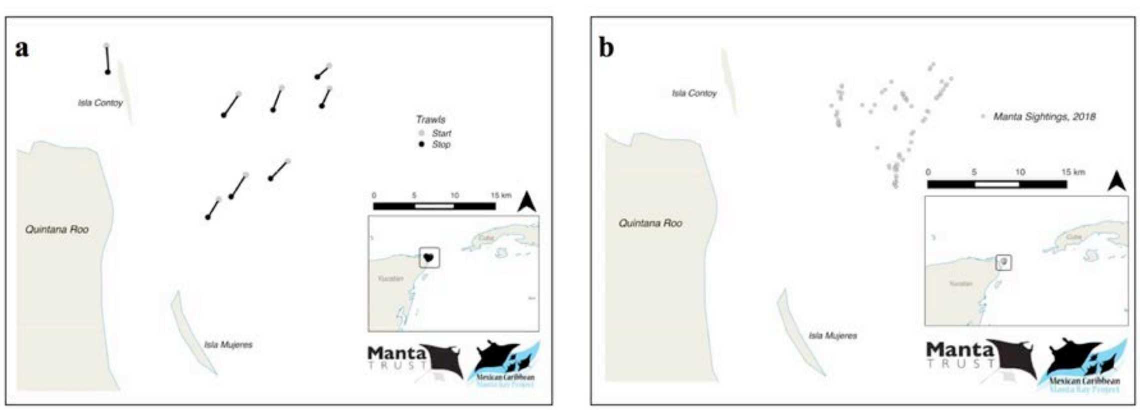
Samples were collected using a manta trawl. It has a rectangular aperture that is 16cm high by 61cm wide. The net is 3m long and captures particles greater than 335µm into a collection bag of the same material that is 30cm x 10cm (Eriksen et al., 2018). The manta trawl was pulled behind the boat between distances of 10m and 15m. Trawls lasted for 30 minutes at an average speed of 3 knots.




*Schematic drawing of a manta trawl (Eriksen et al., 2018)*

*2.2. Sampling Locations*

Trawl locations were determined with the aim to sample near manta feeding sites within the Mexican Caribbean Biosphere Reserve, but far enough away as to not endanger any animals with the trawl net. Following each field expedition, the team travelled 0.5-1km away from each feeding site until no animals were observed and began the trawl. As seen in below, trawl sites generally overlap with manta sightings, with the exception of one trawl near the national park of Isla Contoy.




*Manta trawl locations (a) and manta sightings (b) during August 2018*

Another factor taken into consideration while deciding trawl locations was the presence of *Sargassum* spp. (*S. fluitans* and *S. natans*). *Sargassum* spp. is an invasive floating macroalgae that began to arrive in the Mexican Caribbean in 2011, with unusually large quantities arriving in 2014 (Tussenbroek et al., 2017). Historically, *Sargassum* spp. would occasionally drift into the Mexican Caribbean from the Sargasso Sea, but infrequently and in small quantities. The *Sargassum* spp. currently observed, however, is thought to originate off the coast of Brazil as a result of increased ocean temperatures due to climate change and nutrient runoff from the Amazon River Basin (Gavio et al., 2014).



*Sargassum within the Mexican Caribbean Biosphere Reserve*

*Sargassum* spp. presence was considered in the determination of trawl sites in order to understand the relationship between *Sargassum* spp. and microplastic. Anecdotal observations from the Manta Mexico Caribe research team noted a possible positive relationship between Sargassum spp. and marine plastic litter. Therefore, some trawls were in areas where *Sargassum* spp. was present and some were in areas where *Sargassum* spp. was absent, in order to determine if such a relationship exists.

*2.3. Isolation and Extraction of Microplastics*

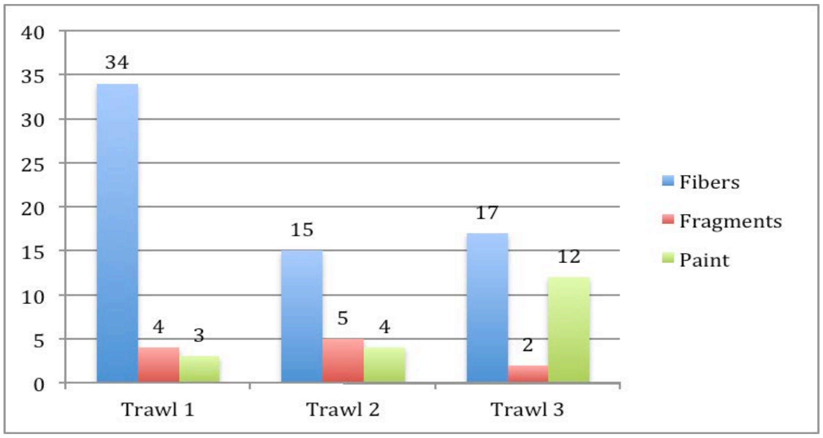
Following collection, each sample was rinsed thoroughly through a stacked arrangement of three stainless steel mesh sieves (2mm, 1mm, 0.3mm). All solids less than 2mm and greater than 0.3mm were retained and kept in a drying oven at 70˚C until dry. Then, all organic material was dissolved using wet peroxide oxidation. Finally, microplastics were extracted using density separation. The plastics were visually identified and extracted with tweezers. They were confirmed under a dissecting microscope and total counts were taken.

*Analysis of microplastic samples by Brittany from Tufts University in the laboratory of Dr. Luis Mejia (Universidad de Quintana Roo)*

*3. Results and Discussion*

Of the eight trawls taken during August of 2018, three have been analyzed in the lab so far. Microplastic types were broken down into the three categories of ‘fiber’, ‘fragment’ and ‘paint’. Fibers are defined as long, filamentous particles that are equally thick throughout their entire length, as with clothing fibers, fishing line or synthetic ropes (Qui et al., 2016). Fragments are secondary microplastics that have fragmented from their larger primary source, as opposed to primary microplastics that are manufactured as microbeads. They can be identified by their irregular shape (Hidalgo-Ruz et al., 2012). Paint fragments most likely made it into the manta trawl during the process of deploying and recovering the trawl from the boat. They were identified by their texture and their consistency with research boat colors.

For all three trawls, fibers were the most abundant of all microplastic types with Trawl 1 containing 34 fibers, Trawl 2 containing 15 fibers and Trawl 3 containing 17 fibers. The fragments counted in each trawl were 4, 5 and 2, respectively. Paint Fragments were 3, 4, and 12, respectively. Trawl 3 notably had a higher number of paint fragments than the previous 2 trawls. This may have been due to the difficulty of deploying the trawl on this particular trip, resulting in the trawl scraping the side of the boat many times. Total counts can be seen in the graph below.




*Total microplastic counts for Trawls 1, 2, and 3 of August 2018*

As of this point in our project the sample size of 3 trawls is too small to draw any definitive conclusions about microplastics, or their relationship with *Sargassum* spp. in the Mexican Caribbean. This project, however, is a continued effort through 2019 and beyond, and with more data we will be able to have a greater understanding of the problem. Manta Mexico Caribe is dedicated to increasing our knowledge of environmental conditions, whether natural or anthropogenic, in the Mexican Caribbean so we can better protect manta rays and all marine life of the region.

*4. Acknowledgments*

We would like to thank 5 Gyres Institute for allowing the use of their manta trawl, la Universidad de Quintana Roo and Dr. Luis Mejia for allowing the use of his laboratory and the National Commission for Natural Resources (CONANP) for granting the permits needed for this research within the Mexican Caribbean Biosphere Reserve.

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