Jeri Tyler- 4 Page Introduction- Microplastics in the Chesapeake Bay

INTRODUCTION

Plastic is the most dominant type of marine debris found in our ocean (National Ocean Service 2018). Over 5 trillion plastic debris are afloat worldwide (Antão Barbozaabc et al. 2018). Many people like to use plastic since it is so durable. Consequently, these particles can stay in the environment for extended periods of time. Microplastics are very small plastic particles that are less than 5 millimeters in length with no lower limit established. They are a contaminant in aquatic environments and in human health (Akdogan and Guven 2019). These tiny particles cannot be seen by the naked eye, but they pose a huge threat to the ecosystem (Yonkos et al. 2014). Scientists are concerned about the accumulation of microplastics because they have the potential to cause harm to aquatic animals.

Plastic production has increased since the 1960s by about 8.7% annually (Smith et al. 2018). 8 million metric tons of plastic enter the ocean annually and conservative estimates say that 5.25 trillion plastic particles are currently circulating in the surface water of our oceans. Plastics are considered municipal solid waste (Plastics: Material… 2019). The most plastic tonnage is from the containers and packing category at over 14 million tons in 2015. This category contains bags, wraps, sacks, bottles, etc (Plastics: Material… 2019). Plastics are also found in nondurable products such as diapers and trash bags. The amount of plastic entering the ocean from land is unknown. It is estimated that the amount is somewhere around 4.8 to 12.7 million metric tons entered the ocean in 2010 (Jambeck et al. 2015). It is also estimated that around 80% of debris in our oceans originates from land. This is due to the amount of disposable plastic products that are circulating through our world today, like grocery bags. The market for plastics has grown significantly since their development in the 1930s. Global plastic resin production has significantly increased about 620% since 1975, due to various factors such as being cheap and convenient (Jambeck et al. 2015).

There are two main categories of microplastics: primary microplastics which are manufactured in the correct size range of microplastics, such as plastic pellets, and secondary microplastics which are formed by degradation of macroplastics or other materials, such as fibers and plastic fragments (Fiella 2015). The direct release of micro particles, such as scrubs

and abrasives in household care, causes microplastics to accumulate. Some industrial raw materials are accidentally lost during transport at sea which leads to microplastics getting released. Sewage sludge also causes microplastic problems in the oceans especially when the sewage is just released into the oceans without going through treatment (Green Facts 2019). The particles can be laundered from nylon clothing and they can wash down the drain with many toothpastes and cosmetics (Adventure Scientists). Bigger plastic that degrades into smaller sizes also causes microplastics to accumulate. Weathering degradation of the plastic on beaches results in the surface embrittlement of them, yielding wind or wave action that will carry these particles into the water (Andrady, Anthony L.). Mechanisms like sedimentation and weather have to be investigated too since these two processes influence transportation of particles in the ocean which affects the potential of the particles to harm different organisms (Barbozaabc *et al*). Since the particles continue to reduce in size, surface area of these particles increases and also the possibility of chemical transport, the absorption of chemicals into microparticles, increases (Green Facts 2019).

Not a lot is known about the impacts of microplastics, but the ones that are known are all negative (National Ocean Service 2018). Researchers are not able to do non-lethal sampling biopsies to test for chemical tracers in endangered species because of the risk ("Microplastics: No small problem for filter-feeding ocean giants. Pollutants, such as pesticides and manufacturing chemicals, can attach to microplastic particles and bioaccumulate in aquatic life (Adventure Scientists). They are known to affect predator avoidance as well as cell function in fish (Adventure Scientists). Plastic litter was first reported in the oceans in the 1970s. It drew little to no attention from people in the scientific community. Since then, accumulating data has increased the interest on the topic. The studies mostly focus on the direct impacts of plastic on marine animals (Laist 1997). Aquatic life and marina birds often mistake microplastics for food (National Ocean Service 2018). Ingestion of plastics by birds and turtles is significantly documented globally. At least 44% of the marine bird species are known to ingest plastics (Andrady, Anthony L.). There has been some research that suggests that microplastics are transferred into the circulatory system (Barbozaabc *et al*). Filter feeders at the bottom of the food chain will be primarily affected since they live in some of the most polluted waters.

Microplastics pose a huge threat since these organisms need to swallow hundreds to thousands of cubic meters of water daily to capture plankton ("Microplastics: No small problem for filter-feeding ocean giants"). Filtering this indigestible plastic can block nutrient absorption and cause damage to their digestive tract. Also, the chemicals can lead to altered growth, development, and reproduction. It is also important that we understand the effects of microplastic pollution on these giants because nearly half of the mobuild rays and two-thirds of the filter-feeding sharks are globally threatened species. To keep ecosystems alive and as healthy as possible, scientists need to know exactly what is causing health conditions in these animals and how microplastics are affecting their health.

There have also been studies that show microplastics impacting humans. They are compromising human food security, health, and food safety (Antão Barbozaabc et al. 2018). Some studies have shown that microplastics are now in our drinking water, sea food, and a number of other food items. The knowledge on the different effects on human health is still limited since it is difficult to assess and highly controversial. Research has shown that shellfish and a large amount of commercial fish are contaminated with microplastics, exposing humans to particles and chemicals these plastics contain (Antão Barbozaabc et al. 2018). The only animals that pose a huge threat to humans are the ones we eat whole since we are also eating the stomach, like oysters. Human health is a major concern since the effects aren't certain. Many people have wondered how many imported fish pass inspections since we cannot be for sure they have microplastics in them. If animal health is not a priority, human health definitely should be.

Microplastics in the oceans have been accumulating for over the last four decades. Field methods for collecting sand, surface-water, and sediment microplastic samples have been established and are currently undergoing testing (National Ocean Service 2018). Eventually, scientists will be able to compare the amounts of microplastics released into the environment globally due to the rapid increase of technology. 74% of samples taken around the world have included microplastics (Adventure Scientists). It is very likely that the amount of microplastic waste in the ocean will continue to increase due to plastic consumption (Green Facts 2019). Many efforts have been taken to try and reduce the plastic use, such as the use of reusable bags

and metal straws, but not all Americans are on board. They do not think they will make an impact on the environment. If our research can show people that they are impacting the Bay and the oceans in more ways than they think, then our research has succeeded.

Not much research has been done focusing on the Chesapeake Bay and its microplastic levels. Only one article in the Web of Science contains actual information regarding the Bay and it found that microplastic in all but one of their 60 samples (Yonkos *et al*). Scientists want to see how it directly impacts the Bay since it is such a huge watershed that gives many people jobs and homes. They predict that the amount of microplastics will be higher when closer to the shore due to the houses around the Bay as well as people's tendencies to litter. It will be lesser in the middle of the Bay because of the volume of water the particles are in as well as its distance from human life. This project is important because we care about the Bay and its health as well as the health of the organisms that live in and around it. Although some people might not care about the animals, people can be directly affected by this problem. Our drinking water could possibly be affected by this problem which could cause a number of health issues in humans. Just like it could harm us, animals are hurt as well. They are not able to feed or breath without consuming some sort of microplastic material. The amount of damage this causes is still fully unknown. We are hopeful that our experiment will encourage more scientists to look at the effects microplastics are having on the Bay and its ecosystem. Once effects have been established, it will make for a stronger campaign to lessen the use of plastic since people will know they are actually harming the environment. This project is important to scientists because they want the world to know that they are killing the environment in more ways than they think they are. This research will help show individuals of all sorts of backgrounds that people need to be caring more for the Bay since humans are responsible for its possible death.

For this experiment, scientists are hypothesizing that the abundance of microplastics will increase as proximity to shorelines in the Chesapeake Bay increases. They are looking at the levels of microplastics in the Chesapeake Bay from different points in the Bay. Scientists will be using the data previously collected from two different spots in the Bay, close to shoreline and in the middle of the Bay.

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