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Plastic Pollution Effects on Pacific Marine Life

You hear the sound of the waves crashing into the shore, the sun is starting to set, and you can see baby turtles breaching their nests to make their way to the horizon. You're simply at peace and assume that all the creatures in the blue sea in front of you are too, only to look down and see plastic bags, bottles, and garbage starting to swell around your feet. This trash accounts for 100 million marine life deaths and causes more than 100,000 animals to die yearly from getting entangled in plastic waste, yet "this is just the creatures that we've found" (CondorFerries, 2021). The marine life in the Pacific Ocean alone is slowly perishing due to the lack of action taken on humans' part, with the Great Pacific Garbage Patch being a significant blame. Plastic takes anywhere from 500 to 1000 years to degrade completely, and currently, almost 80% is being sent to the ocean; Only 9% is getting recycled (CondorFerries, 2021). However, if we all work together, we can stop this ongoing issue affecting our oceans, change those numbers, and work towards a cleaner, safer Earth. The effects of plastic waste in the Pacific Ocean are major issues in regard to marine life and need to be stopped.

There is plastic all around us. America's "recycling infrastructure was not designed to collect the many types of packaging we use today," it is a rapidly growing factor of municipal solid waste, MSW, and found in all the major categories of the disposal of this kind of waste (America's Plastic Makers, 2020). In 2018, the category

that had the most plastic weight, at over 14.5 million tons, was the containers and packaging category that encompasses many different elements. It includes "bags, sacks and wraps; other packaging; polyethylene terephthalate (PET) bottles and jars; high-density polyethylene (HDPE) natural bottles; and other containers" (U.S. EPA, 2018). There is also plastic in durable and nondurable goods that we do not normally consider, like furniture, appliances, casings of lead-acid batteries, trash bags, disposable diapers, kitchen utensils, medical devices, and shower curtains. This data is not even including plastic resins that are used in a wide variety of container and packaging products as well, "such as PET beverage bottles, HDPE bottles for liquids like milk or water, and other plastic containers, bags, sacks, wraps, and lids" (U.S. EPA, 2018).

Plastic contamination is also in the single use packaging we discard, the consumer goods that fill our stores, and in our clothing, which sheds microplastic fibers in the wash and ends up following the paths of pollution into our oceans (Center for Biological Diversity, 2021). Single-use plastic products, or SUPs, are plastics that are only used once or for a short period of time before being thrown away and greatly contribute to the statistical impacts of plastic waste in aquatic environments. Three hundred million tons of plastic are produced yearly, with 50% being single use only. In 2018 specifically, using data from the American Chemistry Council, the National Association for PET Container Resources, and the Association of Plastic Recyclers, it was validly determined that 35.7 million tons of plastic were generated throughout the year. One single year. From 2000 through 2010, there was more plastic produced than that of all the years in history up to the year of 2000, and each year billions of pounds more of plastic end up in the oceans adding to the statistical contamination amounts.

Not to mention, the fossil fuel industry plans to "increase their plastic production by forty percent over the next decade" instead of trying to take preventative steps to slow the manufacturing due to its benefits from an economic standpoint (Center for Biological Diversity, 2021). Plastic products like food containers, packaging, and plastic bags are the largest component of marine waste. Unfortunately, plastic is so long-lasting, taking between five hundred to one thousand years to degrade; the EPA reports "every bit of plastic ever made still exists" to some extent, and that is a terrifying thought to consider (Center for Biological Diversity, 2021). There have been animals, architectural builds, ocean bodies, and many other aspects of this Earth, both natural and man-made, around for centuries that have come and gone because of varying disasters, but every ounce of plastic produced has made it through that all. Due to all this pollution, "we now have over 500 locations recorded as dead zones where marine life cannot exist," and the surface area is only going to grow if proper action is not taken (CondorFerries, 2021).

However, humans are not immune to the threat of pollution in the depths and on the surface of the oceans either. While we may not face the fatal possibility of swallowing a plastic bag, getting caught in debris, or drifting away from our homes on a bundle of garbage, the plastic particles that are breaking down in the ocean end up in the seafood that we consume. "A recent study found that a quarter of fish at markets in California contained plastic in their guts, mostly in the form of plastic microfibers," which would have later ended up on someone's plate and in their bloodstream (Center for Biological Diversity, 2021). Also, there is currently only nine percent of plastics getting recycled, and over eighty percent is being sent to landfills or burned, leading to pollution

of the air, which takes an effect on our lungs (CondorFerries, 2021). These pollutant matters are going to be what ends up coming back and impacting us much more than we realize now.

Though in 2018, there were three million tons of plastic recycled, it was only an 8.7 percent total recycling rate for the year. The individual recycling rate for bottles and jars was 29.1 percent, and the rate for natural bottles was 29.3 percent. Unfortunately, the rate of all municipal solid waste combusted with energy recovery that year was only 16.3 percent, while 18.5 percent went to landfills (U.S. EPA, 2018). To further use this data from the United States EPA from 2018, 35,680 tons of plastic were generated, and only 3,090 tons were recycled, whereas 26,970 tons were landfilled (U.S. EPA, 2018). With this much recyclable material being sent to landfills instead of recycling centers, it is going to remain as difficult as it is now to change these numbers since the most basic step is not even being taken by those that cause the deathly harm to our ocean's ecosystems.

The Great Pacific Garbage Patch is the largest trash site on the planet. It is in the North-Central Pacific Ocean and is twice the surface area of Texas. It also outnumbers sea life in the region six to one (CondorFerries, 2021). This phenomenon is the name for a mass of debris that has accumulated over time due to intersecting ocean currents that move in a swirling motion leaving all the plastic waste that is trapped in the more stable middle section of the currents, therefore creating the Great Pacific Garbage Patch. In this patch, it is almost entirely composed of microplastics, which are "small pieces of plastic that measure less than five millimeters long - and discarded fishing gear floating at the water's surface," as well as other materials that get collected along

the ocean's surface to mix with these fibers and grow the surface area of the patch (National Marine Sanctuary Foundation, 2020). With all these discarded products having a resistant, buoyant nature, they are able to float around in the ocean for years without breaking down, further adding to the accumulation of trash in the Garbage Patch. However, there is also an abundance of trash that is heavier, less buoyant, and sinks to the bottom of the ocean, adding to the density of the patch instead of to the surface spread of it. "In fact, scientists recently found that about seventy percent of all marine debris eventually sinks to the ocean floor" (National Marine Sanctuary Foundation, 2020). There are "5.25 trillion pieces of plastic waste estimated" to be in the oceans with 269,000 tons floating and "4 billion microfibers per kilometer squared below the surface" that all contribute to the numbers of contamination in the Pacific (CondorFerries, 2021).

Because of the location of the Great Pacific Garbage Patch, encompassed between Mexico, California, and Japan, over half of the percentage of the debris moving through the patch comes from the California and Asia side of the patch. Another twenty percent comes from aquatic transportation and offshore oil rigs that both intentionally and unintentionally discard trash into the ocean around them. Once it is in the Pacific, it will swirl around through the currents until it ends up trapped in the patch, waiting for its time to decompose. However, thanks to data that has been reported from aircraft and multi-vessel surveys, it is predicted that there is "at least 79 thousand tons of ocean plastic floating inside an area of 1.6 million kilometers squared; a figure four to sixteen times higher than previously reported" which shows this rapid accumulation of growth that does not seem to be slowing down (Lebreton, 2018). One of the main problems

with this is that almost fifty percent of this trash, and the main source of debris capture, is due to fishing nets, which in turn is harming the wildlife more by allowing sea creatures that should not be captured in the nets, to get entangled. While this does not discount the technological advances in the marine environment that comes with synthetic fibers in fishing and aquaculture gear, the loss and disintegration of this gear will do more harm than good. This breakdown is a major concern yielding direct negative impacts on the economy and marine habitats worldwide (Lebreton, 2018).

Even though this debris is unpleasant to look at in our beautiful oceans, it is even more harmful to those that rely on the ocean to survive. Marine plastic pollution has impacted over 267 species worldwide, "86% of that being sea turtle species, 44% of seabird species and 43% of marine mammal species" (Clean Water Action, 2017). According to the United Nations, "at least eight hundred species worldwide are currently affected by marine debris, and as much as eighty percent of that litter is plastic alone" (Reddy, 2018). The plants and animals that need the ocean to survive endure physical and sometimes fatal harm due to the ever-growing amounts of garbage that invade their home by causing issues ranging from the entangling of "large, migratory animals like whales, to being mistaken for food by sea turtles, fish, and sea birds" (National Marine Sanctuary Foundation, 2020). The marine life can also ingest this toxic debris and suffocate, starve, or drown because of it. There was a gray whale that died after being stranded near Seattle with more than "twenty plastic bags, a golf ball, and other garbage" in its stomach back in 2010 when the situation has only gotten worse since then with "research indicating that half of the sea turtles worldwide have also ingested plastic" (Reddy, 2018). Reproduction rates are being affected as well due to pollution

altering the temperature of the beaches where incubations need to occur. At the rate of demise from marine animals now, scientists worry that the reproduction rates will not be able to stabilize, let alone rise, to where they need to be to avoid possibly losing another specie that we value and love.

When it comes to plants that grow and thrive in the ocean, these microplastics and trash harm the plankton and algae around it by “blocking the sunlight they need to be able to undergo photosynthesis and produce energy for themselves,” which in turn, can cause harm further in the marine food web (National Marine Sanctuary Foundation, 2020). Plastic waste also encourages the growth of pathogens in the oceans, leading to an even more intense problem that is harder to visualize, stabilize, and control.

“Scientists concluded that corals that come into contact with plastic have an 89 percent chance of contracting disease” compared to the four percent contraction rate for corals that do not come into contact (Reddy, 2018). These pieces of trash can also serve as a mode of transportation for sea life small enough to carry them to far-off domains and cause them to settle into new ecosystems forcefully. While this is bad solely for the fact that not all species can survive in different habitats, it can also spread invasive species throughout the ocean, causing a long-lasting problem that won’t be able to be stopped at the hand of one effort. Also, “because persistent organic pollutants in the marine environment attach to the surface of plastic debris, floating plastics in the oceans have been found to accumulate pollutants,” causing them to be transported through ocean currents as well (Clean Water Action, 2017). Now with all this toxic debris floating through the ocean, there is research that shows that marine life that “ingests plastics

coated with pollutants can absorb these pollutants into their bodies” and perish as a result (Clean Water Action, 2017).

While our knowledge on ocean plastics and all their true effects are not as great or complete as scientists could have desired, if there is going to be an increasing mismanagement and negligence of fossil fuel-derived plastics, FFP's, it is estimated that within the next five years, there will end up being a one-to-three-ton ratio of trash to fish in the ocean (Forrest, 2021). With all this plastic swimming through the seas with the animals, plants, and other life that inhabit it, these species are inevitably subject to starving, dying, and in extreme cases, going extinct. Some people choose not to take on social issues that they cannot directly see or do not directly impact them, but the most visible impact from these pollution efforts are not small ones. The harm to marine megafauna, including turtles, aquatic birds, mammals, and sharks, is just the spark of contributions to the statistical data offered right now; it will only grow once smaller, more elusive organisms are examined and added to data counts as well.

The world needs to work as one to slow these detrimental effects on our aquatic life, and one of the best prevention methods for keeping this trash out of marine life's way is to work to prevent the Great Pacific Garbage Patch from growing even more. To do this, we need to work together at home by reducing our utilization of single-use plastic products from day to day, helping with trash clean-ups in our local communities, upcycling items that we already have handy, and encouraging local officials to put more policies into place with focuses on preventing marine pollution and raise funds to work towards removing the plastic products that are already swimming through our oceans. We need to collect this plastic for it to be processed and reused to make new products

in a sustainable way. Not only are “bigger, visible” plastic items contributing to the scales of oceanic pollution either, it is all the fishing gear, containers, microplastics, and nano plastics that are not as easily detectable and need to be looked out for. These products are also not entirely manufactured and spread on their own. While segments of these particles are released directly into the environment, others are created by the fragmentation of larger goods that have already made their way into the Pacific and degraded or broke down (Forrest, 2021). Being able to recognize that not all the pollution in the Great Pacific Garbage Patch or in the Pacific as a whole comes straight from landfills in its largest form or from our garbage cans around the world, we will be able to come up with more sustainable and inventive ways too slow the root of plastics failing to end up in the proper recycling centers and in the oceans instead.

While companies are trying to enhance traditional machinery used for recycling, new technologies are being created to work with plastics in more innovative ways; one of those being "advanced plastic recycling." Advanced Plastic Recycling is a chemical breakdown approach to a method of recycling and breaks down plastics into molecular building blocks to be turned into new plastic, industrial chemicals, transportation fuels, and other products (America's Plastic Makers, 2020). This plan also encompasses the act of keeping plastic out of the ocean before it even gets there while expanding the market for used plastic in a productive manner. There is also a more advanced, scientific route that can potentially be taken to lessen the effects of plastic on the Earth overall. "Scientists have identified bacteria, worms, and caterpillars that can digest plastic and might be used as alternatives to burning or burying" all the plastics we use daily to avoid landfills (Kugiya, 2020).

Businesses and large corporations are also doing what they can to try and start making a difference. For example, in the world of hospitality, "by the end of this year, Marriott International has promised to eliminate single-use plastic bottles of shampoo and conditioner in most of its 7,000 hotels, [while the] Hyatt Hotels said it will do the same at 900 properties by mid-2021" (Kugiya, 2020). However, we do not need to completely ban plastic to help the Earth and its oceans. What if we were able to use plastic as a valuable resource instead of categorizing it as waste and trash? There is an emerging technology that is allowing us to make that possible. We can use plastic for new and useful products, energy to fuel transportation, and even wax to create crayons (America's Plastic Makers, 2020). With this technology, it is now possible to create a more sustainable, annular model where we can recover and reuse our plastic.

"Companies that make and use plastic are transitioning to a circular economy... by investing in the infrastructure needed to collect used plastic and in the advanced technologies that reuse it," which is a giant step towards the lessening of plastic that ends up in the oceans instead of recycling centers (America's Plastic Makers, 2020).

Of the multiple efforts underway to try and use plastic for more recycling-type purposes, three of them stand for distinctive elements: the Recycling Partnership, the Wrap Recycling Action Program, and Materials Recovery for the Future. All of these programs focus on the recovery and collection of plastic manufactured goods, but they all accentuate different steps in the process. The Recycling Partnership is the basic step in gathering the plastic products for recycling actions to be taken. They are doing this by "investing in local communities to make curbside recycling more accessible and effective to expand the types of plastics that are collected and repurposed" (America's

Plastic Makers, 2020). The Wrap Recycling Action Program "supports the recycling of plastic bags and wraps at more than 18,000 grocery and retail stores across the nation," also touching upon the idea that along with places like the Marriott and the Hyatt, if more businesses get involved, that alone would be a major step in the right direction for plastic collection (America's Plastic Makers, 2020). Lastly, the Materials Recovery for the Future is a pilot program in Pennsylvania that demonstrates how "flexible plastic packaging, such as pouches, liners, and wraps, can be collected in curbside bins and recycled," but it is not yet effective and is still in its testing phase (America's Plastic Makers, 2020).

Though the main factors of pollution involve our over usage of single-use plastic and lack of commitment to finding better products to utilize, if we take the initiative and pursue the next steps to slow and hopefully stop pollution in not only the west coast and the Pacific Ocean, but everywhere, the marine life in our oceans can prevail and continue to be a part of our Earth for centuries to come. We would also be able to maintain a better environment for ourselves and those to come as well. However, this issue is a dire one, and we need to act fast; "Unless action is taken soon to address this urgent problem, scientists predict that the weight of ocean plastics will exceed the combined weight of all of the fish in the seas by 2050" (Reddy, 2018) and not one square mile of surface ocean anywhere on Earth will be free of plastic pollution (Center for Biological Diversity, 2021). Doing things like recycling or switching plastic products to more sustainable options are only the first steps to slowing this devastating matter.

More than anything, it is in our hands. In the Cleanwater article, it says, "The plastics industry, through the leadership of the American Chemical Council (ACC),

spends millions of dollars each year to convince policymakers and Californians that solutions to plastic pollution lie in anti-litter campaigns that attribute the responsibility for marine debris on individual behavior. Yet they have devoted little funding to public education and much more on promoting policies that support increased use of plastics" (Clean Water Action, 2017). In order to take the necessary measures to end this pollution, we need to make sure that more than this is being done. While it is nearly impossible to ban the production of plastics or pull all plastic products out of the market, actions are needed in place of the words that we are given from those in charge of these suppliers and manufacturers. The result of chemical pollution of the waters is a worldwide crisis, with over one hundred million marine animals' lives lost every year and the slow decay of the ocean's ecosystem (CondorFerries, 2021).

Taking the lead in recycling and being informed of the ecological statuses around our communities can help us manage what is working and what we need to go back and revise. There are new technologies being produced that can help guide these future efforts that are so detrimental. Small changes need to be made everywhere. With the enhancement of traditional recycling and advanced recycling technologies, there will be a greater guidance to improve the reuse, recycling, or recovery of all plastic packaging in the United States by 2040 (America's Plastic Makers, 2020). The costs of these efforts are going to continue to sway society's output of notice and awareness even with all the good it would initially do. Plastic waste is a persistent form of pollution in aquatic environments, and contamination levels are continuously rising in a drastic manner. Starting at higher platforms and focusing on the new technological, chemical, and

communal steps forward are going to be key in stopping the plastic from compromising our delicate environments.

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