Plastic Pollution in Marine Environments is Here to Stay

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English 1100.08

November 28, 2018

Plastics are used in a high percentage of everyday products including cars, clothing, packaging, toothpaste, cosmetics and so much more, it is a fundamental ingredient for almost every industry.[1] People love plastic because "... [it] is versatile, lightweight, flexible, moisture resistant, strong, and relatively inexpensive".[2] With the overconsumption of plastic comes the disposal issue, where should it all go? The Environmental Protection Agency has reported that all plastic ever produced is still on the planet in one form or another.[3] Different types plastic pollution ends up collecting inside of our oceans gyres, and inside of the stomachs of our marine life. All different kinds of toxins get absorbed by the plastic that floats in the open oceans and works its way up the food chain, all the way to people that eat seafood and causes a plethora of negative health effects on the human body. Plastic pollution is causing irreversible damage to the oceans, all marine life, and human beings.

The global production and consumption of plastics continues to rise with society's ever increasing population and a lot of waste continues to end up in the oceans and cause great harm to the environment. In 2015 a staggering 300 million tons of plastic was produced worldwide[4] and scientists estimate that up to 10% of that ended up in the oceans.[5] A study performed in 2014 found that there were an estimated 5.25 trillion plastic particles floating around the ocean at the time of the study, weighing at over 260,000 tons.[6] Additionally, plastic is very durable and has a very long degradation process, some scientists estimate it could take centuries.[7] Ultraviolet

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[1] Wood, Stephanie F. "Move over Diamonds - Plastics Are Forever: How the Rise of Plastic Pollution in Water Can Be Regulated." *Villanova Environmental Law Journal,* 29, no. 1 (2018): 155-76.
[2] Guern, Claire L. "When the Mermaids Cry: The Great Plastic Tide." Coastal Care. November 2009. http://coastalcare.org/2009/11/plastic-pollution/#education.
[3] *Ibid. 1*
[4] *Ibid. 2*
[5] Lusher, Amy. "Microplastics in the Marine Environment: Distribution, Interactions and Effects." *Marine Anthropogenic Litter*, June 2, 2015, 245-307. doi:https://doi.org/10.1007/978-3-319-16510-3_10.
[6] *Ibid. 1*
[7] *Ibid. 1*

radiation from the sun causes large pieces of plastic such as single use plastic bags or disposable water bottles to break down into smaller and smaller pieces until they are eventually singular polymer molecules, these are called microplastic.[8] Massive amounts of plastic waste is being produced which is going to be around long after those who manufacture it, and with nowhere to be disposed it will continue to accumulate inside of our oceans.

Both regular plastic litter and microplastics get pushed around by wind currents and tend to end up in the 5 major subtropical ocean gyres. These gyres are essentially "massive rotating current systems" that are comprised of the earth's rotation and ocean currents, basically giant vortex's in the ocean that pulls anything in proximity towards itself.[9] The 5 Gyres Institutes has found plastic particles have not been found only in the North Pacific gyre, but all 5 of the subtropical gyres in addition. As well as the accumulation of microplastic particles they have also found several garbage patches that have accumulated inside of these gyres, meaning that plastic is being littered into the oceans by every continent in the world.[10] It is extremely impractical and expensive to retrieve plastic waste from inside of these gyres so generally plastic is not collected and disposed of properly until it washed up onto shorelines.[11] There is no way to know how long that process could take, plastic from the North Pacific gyre can take 10 years to make the rotation from California to Japan and back.[12]

Microplastic does not exclusively come from degraded plastic pieces, many manufacturers add microplastic to the products to use as a filler. Some of these items include

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[8] Azzarello, Marie Y., and Edward S. Van Vleet. "Marine Birds and Plastic Pollution." *Marine Ecology* 37, no. 1 (May 6, 1987): 295-303.
[9] *Ocean Heroes: What Is a Gyre?* 5 Gyres Institute. January 12, 2012. https://www.youtube.com/watch?v=h6i16CrI8ss.
[10] *Ibid. 9*
[11] *Ibid. 9*
[12] *Ibid. 9*

toothpaste, cosmetics, body wash and so many more everyday household products.[13] The issue with microplastic is that the world's filtration systems are not able to filter out such miniscule pieces, so when toothpaste for example goes down the drain and into water filtration facilities, the microplastic is released straight back into our water sources.[14] As these microplastics are pushed along the oceans they will absorb all of the agricultural and industrial toxins they come across like a sponge.[15]

Plastic has many adverse effects on marine life and species that inhabit ocean environments. The Convention on Biological Diversity has estimated that approximately 663 marine species have ingested, become entangled or have been smothered by plastic pollution.[16] This results in approximately 100,000 deaths of marine mammals, as well as millions of birds and fish each year.[17] The most heavily impacted of all the marine animals are sea turtles, seals, sea lions, seabirds, fish, whales and dolphins.[18] Marine inhabitants often mistake plastic such as pellets, bottle caps, pieces of toys, cigarette lighters, and plastic packaging for food and will either ingest it themselves or feed it to their young. This can result in blockage of the digestive tract and internal wounding which can ultimately impair feeding abilities and often results in starvation.[19] When marine life as well as small organisms such as plankton and mollusks ingest these plastics they are in turn passed along all levels of the food chain.[20]

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[13] *Ibid. 1*
[14] *Ibid. 1*
[15] *Ibid. 5*
[16] *Ibid. 1*
[17] *Ibid. 2*
[18] Henn, Corrine. "These 5 Marine Animals Are Dying Because of Our Plastic Trash … Here's How We Can Help." One Green Planet. 2016. https://www.onegreenplanet.org/animalsandnature/marine-animals-are-dying-because-of-our-plastic-trash/.
[19] *Ibid. 1*
[20] *Ibid. 5*

When humans consume fish, as many do, all of the toxins that have deposited inside of the cells are absorbed into the digestive tract and causes many alarming effects. Humankind is quite literally eating its own waste. Research has found that many chemicals that are used in the production of plastic are harmful to the human body and can cause many adverse effects if exposed to enough of the substances.[21] One class of chemicals they use in many everyday plastics are called Endocrine-disrupting compounds (EDCs) and some studies have shown EDCs can cause the development of different types of cancer, reproductive issues in both males and females, type 2 diabetes and cardiovascular disease.[22] Two examples of some very commonly used EDCs are phthalates and bisphenol A (BPA), they are used in the production of softer plastics like disposable beverage bottles and food containers.[23] They have been proven to slowly seep out of the plastic and potentially into food products that are sold to be consumed by the general public. This includes packaging advertised as microwavable safe, while heat is known to cause the phthalates to seep out at a much quicker rate.[24]

Many scientists have made predictions on what the future will hold if plastic production and disposal continues on the same trajectory and it is not favourable for any species. "Plastic production increased dramatically worldwide over the last [sixty] years, passing from 0.5 million tons [per year] in 1960 to almost 300 million tons in 2013".[25] Scientists estimate that by the year 2050 when the population is suspected to skyrocket to 10 billion people plastic production is

[21] *Ibid. 1*
[22] *Ibid. 2*
[23] *Ibid. 1*
[24] *Ibid. 1*
[25] *Ibid. 1 p 157*

estimated to triple; consequently, there will be as much plastic as fish in the oceans.[26] The crowding of garbage in marine habitats is already causing habitat alteration, which is a change in the ecosystem that has a significant impact on the plants and animals living in the area.[27] By the year 2050 when there is increasingly less room in the ocean for life there could eventually be an extinction of certain larger species.

Although we have undeniably done irreversible damage to our marine ecosystems, there are sustainable and more environmentally friendly options that future generations will have to adopt if we wish to clean up the oceans and protect our marine life. The most obvious step is banning the manufacturing of single use plastic items such as straws, shopping bags and water bottles. Single use plastics on average make up 49% of beach litter in which many of these items have more environmentally friendly alternatives, some places such as Italy, Ireland and Bangladesh have already banned the use of non-biodegradable shopping bags.[28] Recycling as much of the plastic material that we can and therefore sending less to the landfill would exponentially improve our pollution situation, although recycling is encouraged virtually everywhere the percentage of people who actively recycle plastic products is low compared to neighbouring countries.[29] Lastly and most importantly we need to provide more education on this ever increasing issue as most people are ignorant of the significance of the problem that plastic pollution poses to our environment, as well as demand government policies to regulate the production and sale of single use plastics.

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[26] *Plastic Ocean*. United Nations. May 24, 2017. https://www.youtube.com/watch?v=ju_2NuK5O-E&vl=en.
[27] "Habitat Alteration." Encyclopedia.com. 2009. https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/habitat-alteration.
[28] “Single-Use Plastics and the Marine Environment”. Seas at Risk. June 2017.
[29] *Ibid. 28*

Plastic is everywhere, everybody uses it. Global production continues to rise and many companies continue to use microplastic as an additive to products which cannot be filtered out of the water. The plastics that float along the oceans absorb all the toxins nearby causing it turn into conglomerates of toxic plastic particles which are collecting inside of the world's oceans and ocean gyres. Thousands marine mammals each year will mistakenly ingest the plastic and endure a slow and painful death and often with a stomach completely full of plastic. The toxins work its way up to food chain and cause a plethora of medical issues for humans. Since plastic has such a long degradation process things will need to change dramatically if the oceans are going to be preserved. The responsibility of current generations is to fight for regulations put on manufacturing companies to limit plastic production and to educate future generations of the impending destruction of marine environments everywhere. The oceans are a beautiful, home to millions of marine creatures and largely unexplored. At the rate that pollution is accumulating inside of them, future generations will never get the chance to uncover the mysteries that lie within.

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