



THE GREAT PACIFIC GARBAGE PATCH: THE PLASTIC OCEAN

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ABSTRACT:

The plastic that has ended up in oceans can persist in the sea surface waters, floating and eventually end up in the most remote areas of the world's oceans. One such large accumulation that drew public attention is the Great Pacific Garbage Patch, which was discovered by Charles Moore in the year 1997, when he found himself in the mish mash of plastic surrounding him on his return journey home. This garbage patch is present in the subtropical waters of between North America and Japan. The article shows the current state of the Pacific Ocean and the conditions of its pollution including plastic and other marine debris. It specifically indicates the various threats and dangers the plastic debris possesses for the human and the marine ecosystem in biological, chemical, economic ways. The article further surveys the various national and international laws and agreements that are related to it. Even though there are several treaties and agreements focusing on this issue, they are only as strong as the people for whom it is enforced. Thus, the proper tackling of the issue at local, national and international levels might help in the prevention, reduction and the recycling of these materials.

INTRODUCTION:

“Only humans make wastes that the nature cannot digest.”

- Charles Moore

The term “Garbage Patch” is often used for areas where floating waste collects in the middle of the giant circulating current system of the oceans called “Gyres”. These gyres define the various patterns of surface movements in the global oceans. Plastic, that is the main component present in this garbage, paves its way into the ocean by floating down drains of rivers and off beaches, and sometimes may be dumped intentionally from ships. The Global annual plastic consumption has now crossed over 320mn tones with more plastic produced in the recent ten years than ever before.

Plastic and synthetic debris in the environment have a profound negative effect on the various organisms and ultimately humans. This plastic that has been floating over the years has become a major threat; through the entanglement of the oceanic life into lost fishing nets and six pack rings; through the ingestion of plastic including lighters, bottle caps and smaller fragments like food packaging, even the tiniest “micro-plastic” pieces have a tendency to reach chemicals and concentrate toxins from the surrounding sea water.

Ocean plastic can persist in sea surface waters, eventually accumulating in most remote areas of the world's oceans. There are potentially five garbage patches scattered globally, located in the North and South Pacific Ocean; North and South Atlantic Ocean; and Indian Ocean. Here we are characterizing and quantifying one of the major plastic accumulation zones formed in the subtropical waters between California and Hawaii; the great Pacific Garbage Patch which is a large expanse of garbage.

According to the UNEP sources this largest garbage patch consists of eastern and western zones; which extends between Hawaii and California while the second one is a smaller “recirculation gyre” between Japan and Hawaii.

Thus, the garbage patch can be stated not to be a stable entity anchored with coordinates and facts while it is a tangled trajectory of all kinds of moving materials. Only in the last decade has these garbage patches become the stuff of national headlines and international discussion, and eventually of great environmental concerns.

WHAT IS THE GREAT PACIFIC GARBAGE PATCH?

The Great Pacific Garbage Patch drew the public attention only after the year 1997, when yachtsmen Charles Moore was returning home after participating in the biennial Transpacific race, when he chose a route that took him through this north



pacific sub-tropical gyre. As the fuel reserves began dwindling, the boat slowed to crawl, this is when he found himself traversing through a mish mash of floating plastic bottles and other debris. Shocked by his discovery, he started the Algalita foundation in 1999 with the sole purpose of studying the garbage patch in its research vessel, the Algalita; and to improve the water quality along the Californian coast. The researchers of this foundation took samples to further analyze them for plastic content and plastic toxicity thus, their research shows the increase in plastic content steadily. The patch was later named by Curtis Ebbesmeyer, a Seattle oceanographer.

This notorious mess now known as the Great Pacific Garbage Patch, behaves as a swirling oceanic graveyard is surrounded and controlled by the North subtropical Gyre, formed by ocean currents as result of the rotation of the earth. The area is classified into two main regions: The Western and Eastern Garbage Patch. These areas of spinning debris are in turn linked together by the North Pacific Subtropical Convergence Zone, located a few hundred kilometers north of Hawaii. This is where the warm water meets up with cooler water, acting as a highway between the two patches.



Forbes Magazine

This garbage patch comprises of trash from countries surrounding the Pacific Rim, including nations in Asia and North and South America. The six main countries responsible for the ocean garbage include China, Indonesia, Philippines, Vietnam, Sri Lanka and Thailand.

Earlier the wastes comprised of natural wastes than would eventually break down into carbon dioxide and water through biodegradation, but now our goods include a class of products that challenge even the most creative and insidious bacteria, Plastics. These wastes do not readily biodegrade and are accumulating in the Pacific at an alarming rate.

Plastics are nothing but synthetic organic polymers that have been popularized around the world in just over a century. Its various features such as lightness, durability, strength, relative low cost of production and versatile uses have contributed to it entering into our everyday aspects of life. While on the other hand, the same characteristics are responsible for the rapid increase in plastic pollution, making it a serious hazard for the environment. The stronger and more buoyant plastics show persistence in the marine environment, allowing them to be transported over large distances. They persevere at the sea surface, being transported by the ocean currents and in the end up hoarded in the patch.

Rather than breaking down into smaller and simpler chemical constituents, most plastics eventually break down into smaller pieces forming individual polymer molecules. This breakdown usually occurs by photodegradation, which is a process that involves the action of the sun rays on tons of plastic to dry them to the point that they shatter. These plastic bits formed by photodegradation are also known as mermaid tears or nurdles.



Though the complete biodegradation of these plastics requires an unknown amount of time. However, these invisible microplastics pose a larger threat to the environment. The surface of these plastics absorbs the harmful toxins present in the water due to industrial run-offs and since they are so small that they are easily consumed by various marine organisms, leading to the consumption of not only the plastic bits but also the harmful toxins and are much harder to remove from the oceans.

The sources of this plastic debris can either be land-based (estimated at eighty percent) or ocean-based, forming four main categories: sewage, tourism, fishing, and waste from ships and boats. It includes trash that comes from storm water discharges, combine sewer overflows, and solid waste disposal and landfills; that eventually makes its way into the oceans. Trash discarded in the streets, sidewalks, gutters and elsewhere is carried by water flow or wind and eventually ends up in the ocean. Furthermore, industrial products can become marine debris if not properly disposed of. Tourist littering is one of the major causes of beach pollution that eventually leads to the formation of marine debris. All the boats and ships and off-shore industrial platforms are potential sources of ocean pollution, as they can generate trash, which could dispose it off either intentionally or accidentally.

The plastics can be classified into four classes based on their size into:

- Microplastics (0.05 -0.5 cm)
- Mesoplastics (0.5 – 5 cm)
- Macroplastics (5 – 50 cm)
- Megoplastics (above 50 cm)

These plastics can be further classified into four main types based on their sources into:

- Type H - hard plastic, sheet or films
- Type N - plastic lines, ropes and fishing nets
- Type P - pre-production plastics
- Type F - fragments made of foams materials

Thus, we can state that there are four main dimensions to the problem of this plastic trash patch - plastic is extremely easy to diffuse in the oceans, it does not biodegrade, it affects the ecosystem, and it is a global issue – which can be related to how effective the various national policies on waste minimization in developed and near developed countries are; how operative the municipal, industrial, commercial and recreational solid waste management services and programs actually are; and how well stakeholders will respond and contribute to their implementations.

ENVIRONMENTAL IMPACTS:

From interfering with food webs, ghost fishing and transfer of various toxins up the food chain the marine debris present in the garbage patch is of great significance with many ecosystem, human and socioeconomic impacts.

EFFECT ON THE BIODIVERSITY:

Marine debris ingestion and entanglement has direct impacts on marine life. Additionally, even the mere occurrence of this marine debris can upset an entire food web through its indirect impacts. Studies show – the presence of plastic samples in dead and captured birds and marine animals, indicating that these plastic bits are mistaken to be food. Ingestion of this plastic has various effects that include “reduction in the absorption of nutrients by the gut, reducing the amount of space for actual food particles, ulceration of tissues, starvation, ruptured organs and mechanical blockages in the digestive system.”



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Mercury is found to be the leading toxin found in the pollution of garbage patches released by many different companies and machines, which is eventually caught onto the plastic bits entering the body of the organisms and humans causing various kinds of diseases. Beside the consumption of plastic particles, the organisms are known to get entangled in the debris particularly in the derelict fishing gear which leads to “ghost fishing”.

The other indirect effects of these small plastic particles include the combining of these particles on the surface of the water that blocks the sunlight to all the autotrophs such as phytoplankton which require the sunlight to feed of it and provide food to the bottom of the food chain. Once the productive capacity of these phytoplankton collapses the entire food chain below will eventually collapse. Studies show that about 700 species have been encountered with marine debris. Out of these, 17 percent of the species affected b plastic are on the IUCN Red List of Threatened Species.

The main species to be affected include the loggerhead sea turtles which are often known to mistake plastic bags for jelly fish, Albatrosses that mistake plastic resin pellets for fish eggs and seals that are known to get entangled in abandoned plastic fishing nets.

EFFECT ON HUMANS:

While the effects of plastic on the marine ecosystem are arguably worthy of attention, parallelly the dangers imposed to human health caused by this plastic debris is also very important to consider. While humans are exposed to many man-made chemicals one of the relevant ones include the endocrine disrupting chemicals or the acronym EDC's, which is used in the manufacturing of plastic, largely affects the metabolism or synthesis of the endogenous hormones leading to the disruption of the endocrine system. Studies show that these EDC's also contribute towards the development of cancer, reduce human sperms, causes abnormalities in the male reproductive tract and premature onset of puberty in females.

The plastics are also known to absorb harmful contaminants such as polychlorinated biphenyls(PCB's) and dichlorodiphenyltrichloroethane (DDT), which are considered to be persistent organic pollutants which are passed on from one species to another in the food chain, and are often linked with “ reproductive, developmental, behavioral, neurologic, endocrine, and immunological health effects” in humans. The accumulation of these pollutants in the debris of the garbage patch is helping them (PCB's and DDT) build up rapidly in the oceanic environment.



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Thus, it can be stated that the plastic being a persistent material has several ecological, economic and toxicological effects in the long term, which include:

- Physical impact on marine life by entanglement, ingestion, starvation
- Chemical impact by the build up of organic pollutants such as DDT and PCB's
- Ecological impact by the transportation of invasive species and pollutants from polluted rivers to the remote areas of the ocean
- Economic impact by the damage to fisheries, shipping and tourism

LEGISLATION AND ORGANIZATIONS INVOLVED:

Recognizing the pollution occurring in the oceans in not a new phenomenon in the society neither are the attempts to prevent and aid to it. However, the various methods, sources and types of solutions used to combat this plastic pollution has differed over the last 40 years.

Among the various agreements relating to this kind of pollution some of the major international ones include – the Convention on the Prevention of Marine Pollution by Dumping of wastes and other matter of 1972, the International Convention for the Prevention of Pollution from Ships of 1973, and the United Nations Convention of the Law of the Sea. In December 2017, nearly 200 countries signed a U.N. resolution to eliminate plastic pollution from the sea, beginning with the monitoring of the amount of plastic put in the ocean and methods to make it illegal to dump in the oceans. On January 16, 2018 the first European Strategy for Plastics in a Circular Economy was adopted, to in turn lead to the goal of making packaging reusable or recyclable and modernize the plastics productions in Europe.

The United States of America has also passed some laws to enforce proper prevention and remedy of the oceans. These laws include – The Marine Protection, research and sanctuaries Act of 1972, The Act to prevent Pollution from Ships and the Marine Debris Research, prevention and reduction Act of 2006. The U.S department is said to have hosted various Our Ocean Conferences which involved the discussion of the concerns involving the sustainability relating to the oceans.

The popularization of this huge environmental issue was the work of a number of non-profit organizations which were very determined to draw attention towards the presence and possible threats possessed by this garbage patch in the ocean, the organizations involved mainly are: Algalita, Project Kaisei, Surfrider Foundation, Sea Education Association and 5 Gyres are among some of them. The Sea Education Association is said to be conducting research on the garbage patch for around 25 years. Organizations such as the Plastic Pollution Coalition and the Plastic Oceans Foundation are using social networking sites and campaigns to promote biodegradable or reusable materials in replacement for the plastic products. Similarly, the Ocean Clean Up Foundation which was designed mainly to focus on the cleaning up process of the garbage



patch. It launched its latest floating device recently which uses natural forces of the ocean to collect and catch the plastics and the other floating debris present in the oceans. Thus, the main goal involves the tackling of this problem with creative solutions at ever level of the society, from communities to industries to governments to international organizations.

REMEDIES AND STEPS TAKEN:

The main focus of the enacted policies and the various organizations has been the prevention marine debris as a long-term strategy. However, complete mitigation of the plastic debris involves concrete actions and responses to the already present debris until the prevention goals are attained. This involves various steps at individual levels as well as society levels, that include:

- Illegal dumping on land, and littering associated with recreational beach activities can be reduced by promoting activities that promotes the “4Rs” of reduction, reuse, recycling, and recovery.
- Public awareness on ways to dispose of plastic and engage local communities should be fostered to drive the agenda.
- Best management practices information could be shared among several countries and industries to develop initiatives for integrated solid waste management programs that include marine debris issues and reduce the amount of plastic waste generated, developing a framework legislation that takes into account issues such as the end of life” plastic management issues.
- Research and new technology must be put in for the to assess the further steps, to address the gaps and to reduce any further plastic from entering oceans. Thus, research must help evaluate the impact of these persistent materials on the oceans, while the technology should consider the prevention, elimination and ways of recycling them.

CONCLUSION:

It can be concluded that there are four main dimensions to the problem of this plastic trash patch - plastic is extremely easy to diffuse in the oceans which is the reason why these plastic get caught up in the gyres to form a patch , it does not biodegrade easily but breaks down into individual polymers forming tiny plastic bits that are even more dangerous to the nature , it affects the ecosystem by largely impacting the marine organisms which ingest or get entangled and the humans that pose a threat by the chemicals that are absorbed by the plastic bits, and it is a global issue as the size of the garbage patch is rapidly increasing raising environmental concerns– which can be related to how effective the various national policies on waste minimization in developed and near developed countries are; how operative the municipal, industrial, commercial and recreational solid waste management services and programs actually are; and how well stakeholders will respond and contribute to their implementations.

Certainly, the sea- focused regulation has helped decrease the plastic load entering the oceans; however, the primary sources of plastic marine debris need to be handled with further severity on all local, national and international levels.

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