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# IMPACTS OF PLASTIC POLLUTION IN THE MARINE ON ECOSYSTEM AND HUMAN HEALTH

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**ABSTRACT:**

Plastic pollution, accumulation in the environment of synthetic plastic products to the point that they create problems for wildlife and their habitats as well as for human populations. In 1907 the invention of Bakelite brought about a revolution in materials by introducing truly synthetic plastic resins into world commerce. By the end of the 20th century, plastics had been found to be persistent polluters of many environmental niches, from Mount Everest to the bottom of the sea. Whether being mistaken for food by animals, flooding low-lying areas by clogging drainage systems, or simply causing significant aesthetic blight, plastics have attracted increasing attention as a large-scale pollutant.

Plastic pollution is a relatively new threat. Plastic only began to be widely used after World War II, but already the mass of all plastic ever produced is twice as high as the overall mass of all terrestrial and marine animals combined. Production has rocketed in the last decades.

Oceanic plastic pollution is not evenly distributed. Planetary hotspots include the five large ocean gyre systems (where the 'garbage patches' accumulate floating plastic debris), coastal and ocean areas near major emission points such as the deltas of large rivers that run through urban centers, coral reefs, mangroves, and the deep seafloor, especially canyons. of plastic pollution on the sustainability of seafood value chain. Global aquaculture production maintained relatively steady increase after year 2010. Plastic pollution can afflict oceans, land, and waterways. It is estimated that about 1.1 to 8.8 million metric tons of plastic waste enters the world ocean from coastal communities every year. Living organisms, mostly marine animals, can be injured either by the mechanical effects, such as the entanglement in plastic objects and problems related to the ingestion of plastic wastes, or via exposure to chemicals in plastics that interfere with their body physiology. Also, humans are affected by plastic pollution, by disruption of various hormonal mechanisms, etc.

**KEYWORDS:**

**PLASTIC, OCEAN, POLLUTION, WILD LIFE, HUMAN AND WATER**

## INTRODUCTION

The study evaluated the impacts of plastic pollution on the sustainability of seafood value chain. Global aquaculture production maintained relatively steady increase after year 2010. Plastic pollution can afflict oceans, land, and waterways. It is estimated that about 1.1 to 8.8 million metric tons of plastic waste enters the world ocean from coastal communities every year. Living organisms, mostly marine animals, can be injured either by the mechanical effects, such as the entanglement in plastic objects and problems related to the ingestion of plastic wastes, or via exposure to chemicals in plastics that interfere with their body physiology. Also, humans are affected by plastic pollution, by disruption of various hormonal mechanisms, etc. The mainstream plastic wastes accumulations in the environment have adversely affected both terrestrial and aquatic wildlife and wildlife habitat (habitation); with humans utterly affected by the growing rate of plastic pollution. More than 5 trillion pieces and fragments of plastic wastes are distributed in the world oceans worldwide. If the plastic pollution problem is not solved, by 2050, there possibly will be more plastic wastes in the world oceans, rivers, lakes, etc. than fishes and other aquatic organisms; this puts the sustainability of seafood value chain in threat. There are three main pathways by which plastic debris always affect wildlife; entanglement, ingestion, interaction. Entanglement in plastic debris is responsible for the deaths (both reported and unreported) of many aquatic organisms, such as fish, seals, and turtles, as well as birds. These marine animals get caught up in the plastic debris and end up suffocating/drowning. Greenpeace International (2018) stated that in a 2006 report called Plastic Debris in the World's Oceans, it was estimated that over 267 different species of animals have suffered entanglement and plastic debris ingestion. It was estimated that at least 400,000 aquatic mammals perish annually as a result of plastic pollution in oceans. Interaction includes the contact with plastic debris (with exclusion of entanglement) including abrasions, use as substrate, collisions, and obstructions. Many marine animals, especially Whales and Sea turtles, are affected by the pollution caused by plastics through ingestion. Large quantities of plastic wastes have been found in stomachs of beached whales. A pilot whale was found almost dead in June 2018, and later died, in a water canal at Southern Thailand close to the border with Malaysia after it

swallowed more than 80 pieces of plastic bags which weighed up to 3Ib. Some species of sea turtle are jelly fish consumers, but regularly mistake plastic bags for their natural prey, jelly fish. This plastic debris may kill the sea turtle by the obstruction of its oesophagus. Deep sea animal species have been found with quantities of plastics in their stomachs. Microplastics ingestions have been indicated to occur for various organisms.

## THE PROBLEM OF PLASTICS

Plastic is a polymeric material—that is, a material whose molecules are very large, often resembling long chains made up of a seemingly endless series of interconnected links. Natural polymers such as rubber and silk exist in abundance, but nature's "plastics" have not been implicated in environmental pollution, because they do not persist in the environment. Today, however, the average consumer comes into daily contact with all kinds of plastic materials that have been developed specifically to defeat natural decay processes—materials derived mainly from petroleum that can be molded, cast, spun, or applied as a coating. Since synthetic plastics are largely nonbiodegradable, they tend to persist in natural environments. Moreover, many lightweight single-use plastic products and packaging materials, which account for approximately 50 percent of all plastics produced, are not deposited in containers for subsequent removal to landfills, recycling centres, or incinerators. Instead, they are improperly disposed of at or near the location where they end their usefulness to the consumer. Dropped on the ground, thrown out of a car window, heaped onto an already full trash bin, or inadvertently carried off by a gust of wind, they immediately begin to pollute the environment. Indeed, landscapes littered by plastic packaging have become common in many parts of the world. (Illegal dumping of plastic and overflowing of containment structures also play a role.) Studies from around the world have not shown any particular country or demographic group to be most responsible, though population centres generate the most litter. The causes and effects of plastic pollution are truly worldwide.

According to the trade association Plastics Europe, worldwide plastic production grew from some 1.5 million metric tons (about 1.7 million short tons) per year in 1950 to an estimated 275 million metric tons (about 303 million short tons) by 2010 and 359 million metric tons (nearly 396 million short tons) by 2018; between 4.8 million and 12.7 million metric tons (5.3 million and 14 million short tons) are discarded into the oceans annually by countries with ocean coastlines.

Compared with materials in common use in the first half of the 20th century, such as glass, paper, iron, and aluminum, plastics have a low recovery rate. That is, they are relatively inefficient to reuse as recycled scrap in the manufacturing process, because of significant processing difficulties such as a low melting point, which prevents contaminants from being driven off during heating and reprocessing. Most recycled plastics are subsidized below the cost of raw materials by various deposit schemes, or their recycling is simply mandated by government regulations. Recycling rates vary dramatically from country to country, and only northern European countries obtain rates greater than 50 percent. In any case, recycling does not really address plastic pollution, since recycled plastic is "properly" disposed of, whereas plastic pollution comes from improper disposal.

## PLASTIC POLLUTION IN OCEANS AND ON LAND

the ocean is downstream from nearly every terrestrial location, it is the receiving body for much of the plastic waste generated on land. Several million tons of debris end up in the world's oceans every year, and much of it is improperly discarded plastic litter. The first oceanographic study to examine the amount of near-surface plastic debris in the world's oceans was published in 2014. It estimated that at least 5.25 trillion individual plastic particles weighing roughly 244,000 metric tons (269,000 short tons) were floating on or near the surface. A 2021 study determined that 44 percent of plastic debris in rivers and oceans, and on shorelines, was made up of bags, bottles, and items related to takeout meals. Plastic pollution was first noticed in the ocean by scientists carrying out plankton studies in the late 1960s and early 1970s, and oceans and beaches still receive most of the attention of those studying and working to abate plastic pollution. Floating plastic waste has been shown to accumulate in five subtropical gyres that cover 40 percent of the world's oceans. Located at Earth's midlatitudes, these gyres include the North and South Pacific Subtropical Gyres, whose eastern "garbage patches" (zones with high concentrations of plastic waste circulating near the ocean surface) have garnered the attention of scientists and the media. The other gyres are the North and South Atlantic Subtropical Gyres and the Indian Ocean Subtropical Gyre.

In the ocean, plastic pollution can kill marine mammals directly through entanglement in objects such as fishing gear, but it can also kill through ingestion, by being mistaken for food. Studies have found that all kinds of species, including small zooplankton, large cetaceans, most seabirds, and all marine turtles, readily ingest plastic bits and trash items such as cigarette lighters, plastic bags, and bottle caps. Sunlight and seawater embrittle plastic, and the eventual breakdown of larger objects into microplastics makes plastic available to zooplankton and other small marine animals. Such small pieces of plastic, which are less than 5 mm (0.2 inch) in length, make up a sizable fraction of plastic waste in the oceans. By 2018, microplastics had been found in the organs of more than 114 aquatic species, including some species found only in the deepest ocean trenches. By 2020, scientists had estimated that at least 14 million metric tons (15.4 million short tons) of microplastic particles were resting on the floor of the ocean, and other research had revealed that the movement of deep-sea currents was creating microplastic "hot spots" in parts of the oceans, such as one located in the Tyrrhenian Sea that contained nearly two million microplastic pieces per square metre (about 186,000 pieces per square foot).

## WHERE IS ALL THIS PLASTIC IN THE WORLD'S OCEANS COMING FROM?

Many of the sources are known, but not all of them. The rise of single-use items is a major factor: in 2015, half of all plastic waste was from packaging alone; while according to a 2018 estimate, single-use plastics account for 60-95% of global marine plastic pollution. Land based sources near coastlines and rivers further inland contribute the large majority of marine plastic pollution: a recent analysis estimated that Europe, for example, releases 307-925 million litter items into the ocean annually, of which 82% are plastic. But there are also significant marine based sources, with one study estimating that at least 22% of marine litter comes from fisheries. The air, too, is a vector for plastic pollution: wear of vehicle tyres and brakes are a major source of microplastic emissions, as is wind abrasion from plastic-coated surfaces, waste processing, roads and agriculture.

## PLASTICS CONTINUE TO BREAK DOWN IN THE OCEAN

Due to the challenges of collecting ocean plastic and the persistent nature of plastic in the environment, once plastic is in the ocean it's almost impossible to remove it. Moreover, once it has entered the ocean, it continues to break down: macro-plastics become microplastics, and microplastics become nano-plastics, making recovery even more unlikely. Even if all plastic pollution inputs into the ocean were to stop today, this process of degradation means the mass of microplastics in oceans and beaches will more than double between 2020 and 2050.

Plastic production is expected to more than double by 2040 and plastic pollution in the ocean is expected to triple. This could lead to a four-fold increase in oceanic macro-plastic concentrations by 2050, and an alarming 50-fold increase in oceanic microplastics by 2100. Microplastic concentrations of 1.21 x 105 items $m^{-3}$ have been proposed as a threshold level, above which significant ecological risks occur. This threshold has already been exceeded in certain pollution hotspots. Ecological risks of microplastic pollution at the global ocean surface are expected to spread considerably by the end of the 21st century.

## PLASTIC POLLUTION HARMS MARINE LIFE THROUGH ENTANGLEMENT, INGESTION, SMOTHERING AND CHEMICAL LEACHING

Plastic pollution is now found everywhere in the ocean, and almost every marine species is likely to have encountered it. According to a conservative assessment of current research, a total of 2,141 species have so far been found to encounter plastic pollution in their natural environments.

The large majority of these interactions were related to ingestion, entanglement or smothering, with a further 738 species observed to colonize plastic items.

## THE MAIN NEGATIVE EFFECTS OF PLASTICS ARE:

**1. ENTANGLEMENT –** Items like ropes, nets, traps and monofilament lines from abandoned, lost or discarded fishing gear wrap themselves around marine animals causing strangulation, wounds, restricted movement and death. Birds also use marine debris for their nests, which can entrap parents and hatchlings. Fishing lines entangled 65% of coral colonies in Oahu, Hawaii, and 80% of these colonies were entirely or partially dead. Even in the remote Arctic deep sea, up to 20% of sponge colonies have been entangled with plastic, and entanglements increased over time.

**2. INGESTION –** Marine animals of all kinds – from apex predators down to the plankton at the base of the food chain – ingest plastic. This can cause serious harm to the animals, affecting food uptake by creating a false sense of satiation or blockages in digestive systems, as well as leading to internal injuries. Laboratory experiments have shown reduced growth in fish when their food is contaminated by high volumes of microplastics, while at the other extreme a single plastic drinking straw in its digestive system likely caused the death of a whale shark. Plastic ingestion in seabirds is global, pervasive, and increasing. It has been estimated that up to 90% of all seabird and 52% of all sea turtle individuals nowadays ingest plastics. Many emaciated whales and dolphins found stranded are also found to have ingested macro plastics. negative impacts on growth, immune response, fertility and reproduction as well as altered cell functions and behaviours in the impacted species with levels of harm directly related to exposure concentrations.

**3. SMOTHERING –** Plastic pollution deprives corals, sponges and bottom dwelling animals of light, food and oxygen, making sediment oxygen deficient and reducing the numbers of organisms in the sediment. This can negatively affect ecosystems and give pathogens a foot hold, which can have detrimental effects on marine life. Smothering is particularly harmful in coral reefs and mangroves.

**4. CHEMICAL POLLUTION –** Not all the ingredients in plastics are harmful, but many of them are and can leach from plastics into the marine environment. The smallest plastic particles can cross into the body cells and some of them can even reach the brains of marine animals.

## SOME OF THE MOST CONCERNING CHEMICAL POLLUTANTS FOUND IN PLASTIC CAN INCLUDE:

**ENDOCRINE DISRUPTORS –** These interfere with hormones, disrupting breeding, development and behaviour in many kinds of marine life. Even some plastics that are labelled as food-safe can be highly toxic to aquatic animals and people alike.

**PERSISTENT ORGANIC POLLUTANTS –** These long-lasting substances, such as polychlorinated biphenyls (PCBs), affect organisms and environmental health. Because they don't degrade, they can be transported over long distances by wind and water, eliciting long-lasting impacts far from their origin.

**INGESTED PLASTIC CAN MOVE RIGHT UP THE MARINE FOOD CHAIN – AND IS NOW FOUND IN HUMAN DIETS, TOO.**

Research have confirmed the existence of microplastics in the water column and the incorporation of these particles into sinking aggregates. These sinking particles are consumed partly or completely by plankton and other tiny organisms, which form the base of marine food webs. Disruptions in the efficiency of biological processes due to ingestion of plastic could affect the amount of food reaching the sea floor, which can cause changes in food-limited sea floor ecosystems. This was demonstrated by a recent study, which exposed salps to concentrations of microplastic likely to occur in the future. When these water fleas were then fed to fish, the nano plastics were found to cross the blood-brain barrier and caused behavioural changes including lower feeding and movement rates. As these impacts spread through the food chain, they could harm the functioning of the broader ecosystem.

Despite a recent surge of research on their effects on organisms, surprisingly little is currently known about the potential impacts of plastics on human health – but it's safe to say people are inhaling and ingesting them. Ingestion of microplastics by blue mussels, for example, has been demonstrated through most of their natural and introduced range and the same is true for oysters. Since both are consumed whole by humans, there's no way of avoiding the plastics they contain. Similarly, four out of brands of canned sardines and sprats were found by researchers to contain plastic particles.

**TARGETING THE CAUSES OF PLASTIC POLLUTION BEFORE IT HAPPENS IS FAR MORE EFFECTIVE THAN CLEANING IT UP AFTERWARDS**

One of the solution that is often proposed is the collection and removal of plastic pollution from the ocean. In the same way that carbon-capture technology has been promoted by some groups to alleviate climate change, large-scale removal technologies for marine plastic pollution – with futuristic technological and yet unproven solutions – are increasingly being promoted. However, even if they were shown to be theoretically possible, the widespread use of such technological solutions would likely have significant economic costs and would not sufficiently turn the plastic pollution tide. Furthermore, the impact of removal on marine ecosystems has not been adequately assessed. such removal solutions could do more harm than good if they amplify the mortality of bycaught marine life and continuously remove substantial amounts of biomass in the middle of the food limited ocean, especially when scaled up. They are also likely to have significant carbon footprints, and would almost certainly not remove the smaller plastics from the ocean. There are some removal methods for microplastics, but most of them are currently only applicable for wastewater treatments.

A far more important approach is simply to prevent plastic waste entering the environment in the first place, which also implies a major reduction in primary plastic production. Such an approach would have additional benefits including reduced resource use and pollution from manufacturing, transportation and disposal of plastic waste. After decades of delays, the world is finally beginning to come together to act collectively and decisively on the climate crisis. The global plastics crisis, too, should be everybody's urgent business. There's no time to waste: action must begin now.

**A BINDING INTERNATIONAL TREATY IS URGENTLY NEEDED**

A new global treaty on plastics must be binding, ambitious and hold states to a common standard of action. The treaty should contain specific, clear and universally applicable rules and obligations across the lifecycle of plastics that allow for an effective response to the global plastic pollution crisis. It must include provisions to ensure that those rules can be evaluated and gradually strengthened over time and shaped in a way that promotes global equity and incentivizes participation and compliance.

**THE TREATY SHOULD INCLUDE:**

- A clearly formulated vision of eliminating direct and indirect discharge of plastic into nature, based on the precautionary principle and in recognition of the devastating impacts of plastic pollution.
- An obligation to develop and implement ambitious and effective national action plans, on prevention, control and removal of plastic pollution.
- Common definitions, methods, standards and regulations for an efficient and harmonized global effort to combat plastic pollution across the lifecycle of plastic, including specific requirements to ensure circularity and bans on certain plastic products deemed to pose a particular risk to the environment, such as certain single-use plastic products and intentionally added microplastics.
- Explicit bans on certain acts considered to defeat the object and purpose of the treaty, including deliberate dumping of plastic waste in river systems and internal waters.
- An agreed measurement, reporting and verification scheme for tracking plastic pollution discharges and the progress made to eliminate them at a national and international level.
- A specialized and inclusive international scientific body with a mandate to assess and track the scale, scope and sources of plastic pollution, harmonize scientific methodologies and collate state-of-the-art knowledge to provide inputs for decision-making and implementation.
- A global financial and technical arrangement, as well as technology transfer assistance, to support the effective implementation of the treaty by all parties.

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