

Microplastics Pollution: A Silent Killer that Leads to the Next Global Environmental Disaster

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Consumption of plastic products within the society has increased exponentially in recent years. Many favorable properties of plastics including durability and low-cost make plastics the obvious choice in many situations. Unfortunately, society has been slow to expect the need for dealing adequately to prevent plastics entering the marine environment. Consequently, plastic pollution has become a pressing environmental problem, and is the most widespread problem affecting the marine environment since society uses

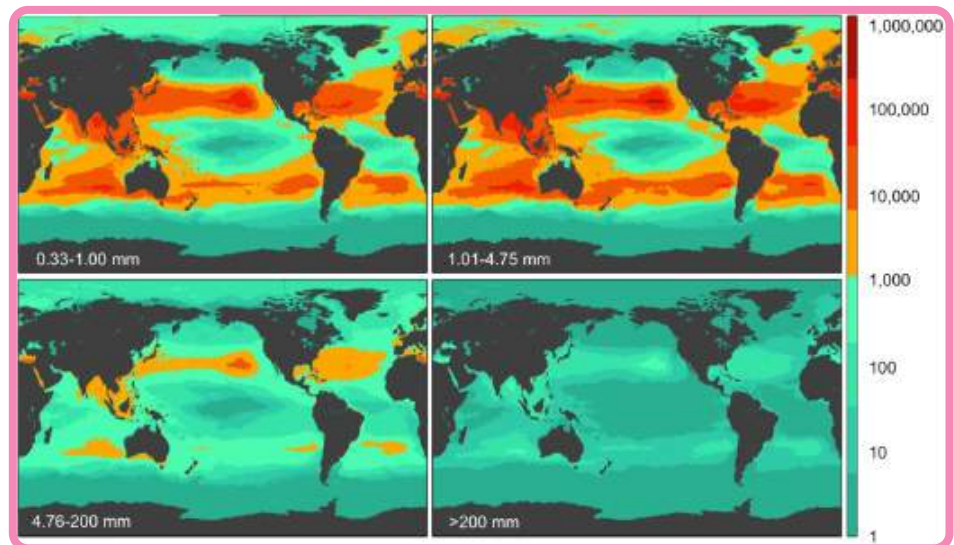


Figure 1: Model results for global count density in four size classes of plastics

the ocean as a convenient place to dispose of litter and waste products.

What are microplastics?

Plastic particles are in different shapes and sizes, but those that are less than five millimeters in length are called “microplastics”. These microplastics in the environment represent one of the most serious environmental threats of present day. It is a great issue at the moment in the media, and rightly so. Unfortunately, there is no other way to discuss the issue of



Figure 2: Widespread of Microplastics in the environment

microplastics other than through experiencing a global catastrophe. It appears that every corner of the planet is now contaminated with microplastics as they are in the air we breathe, the water we drink, seafood we eat and even in extremely remote regions such as on the tops of mountain peaks, and in the deepest trenches of the ocean. However, microplastics now appear to be a ubiquitous pollutant of the beaches, surface waters and the marine sediment worldwide.

The origin of microplastics can be shown through two main pathways such as primary and secondary. The distinction between primary and secondary microplastics depends on whether the particles were originally manufactured to be that size or whether they have occurred due to the breakdown or fragmentation of larger debris. Primary microplastics include micro-beads used in cosmetic formulation, plastic powders used in molding, and several types of virgin pellets of spherical or cylindrical shaped particles typically around 5 mm in diameters that are widely used in industrial process. Secondary microplastics are created due to the fragmentation of larger macroplastic items into smaller microplastics. This type of microplastics can also be released into the environment during the use of products such as textiles, paint, and tyres. With high UV irradiation and physical abrasion by waves, microplastics production due to the fragmentation of larger plastic items is most effective on beaches. Even if we were able to stop the discharge of macroplastic litter into the sea

today, there is an issue with the ongoing degradation of the plastic particles which can result in a sustained increase in microplastics for many years to come.

Sources of microplastics

The sources depend on where the litter entered the sea, either land-based or sea-based. Land-based sources include domestic, agricultural and industrial activities that result in plastic debris being washed out from land, and aggregation in the ocean during storms via rivers, streams and sewage treatment plants. Recreational activities along the coast, general public litter, harbors and unprotected landfills, as well as dumps located near the coast are also identified as sources. Sea-based sources are fisheries, recreational boats, energy production systems, shipping, research, and legal and illegal dumping activities.

Transport and distribution

Day by day the number of microplastics in the ocean are growing due to the inescapable rise of plastics consumption, as well as inadequacy in re-use, recycling and waste management practices in many parts of the world which has led to this pathetic situation. We still know relatively little of the fate of microplastics, e.g. whether particles are more limited to the shelf and the coastline, or whether they are being deposited in deep-sea sediments. The vertical movement depends on the types and sizes of particles, e.g. plastic fragments that are heavily bio-fouled tend to sink, but once the fouling species has been removed by grazing or deterioration, it may become buoyant again. Therefore, the behavior of different sized particles and the density of the plastic itself may also play a role. Further information such as the locations where macro plastic debris accumulates and where

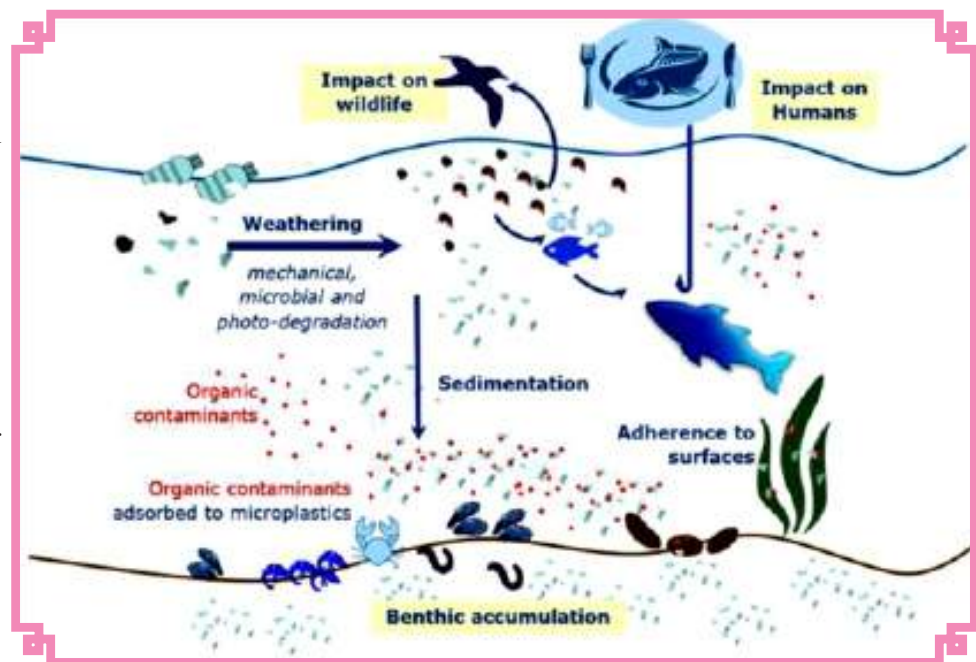


Figure 3: Potential transport pathways of microplastics and their interaction with the biota

microplastics are expected to be deposited in sinks needs to be gathered.

What are the impacts of microplastics?

As mentioned before, microplastics accumulating in the marine environment may be one of the greatest threats facing the planet. Commonly, plastics are light and durable. Thus discarded objects can easily be transported long distances from their source. A large quantity of microplastics normally float on the surface, being less dense than seawater, whereas microplastics with a density that exceeds that of seawater (>1.02 g.cm⁻³) will sink and accumulate in the sediment. However, the buoyancy and density of plastics depend on the polymer type, and may change during their residence at sea due to processes such as weathering and bio-fouling. Therefore, habitat degradation due to microplastics and marine debris have extensive impacts on biodiversity, since many critical areas such as coral reefs, mangroves, marshes, and sea grass that serve as breeding grounds or nurseries for the majority of marine species are affected. It not only damages habitats directly via physical and chemical impacts, but it can also lead to reduced recruitment and reproduction for certain species, which may indirectly alter or degrade critical nurseries and other fragile ecosystems. Microplastics may also have the capacity to modify the population structure with potential impacts on ecosystem dynamics. This can also negatively effect photosynthesis of primary producers, and on the growth and reproduction

of secondary producers, ultimately giving reduced results of productivity of the whole ecosystem, and hence represent a primary concern.

Plastics also carry other chemical compounds called additives in addition to the polymer resin. Even though polymers are generally non-toxic, the additives can have serious impacts on the health of marine organisms. Besides additives, they may also contain adsorbed chemicals from the surrounding water. Since plastics are hydrophobic, other hydrophobic (or lipophilic) chemicals present in seawater may have an affinity to the polymer. In addition, insecticides and pesticides are hydrophobic and have a tendency to accumulate on the plastic surfaces.

Furthermore, these microplastics overlap with the size range of

to come into contact with these materials. Very often the smaller fragments (nano size) can pass through the gut without hurting the organism. But larger fragment can cause damage, or induce starvation if it remains trapped inside the stomach or digestive tract. Generally, this can occur due to a misidentification of the litter or may be ingested accidentally during feeding. Likewise, microplastics in the water column may also be mistaken for planktonic prey by filter feeders and suspension feeders. Nevertheless, a range of marine biota including seabirds, crustaceans and fish can ingest microplastics. Such accumulation of ingested chemicals in the body tissue of the organism is called “bioaccumulation”. Organisms from a higher trophic level contain higher concentrations of contaminants via their prey. The rate of contaminants (bio magnification) accumulating

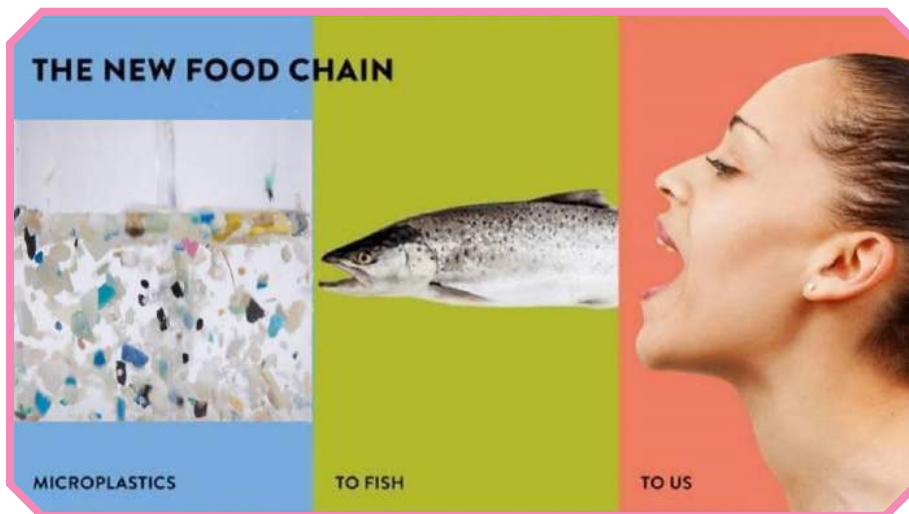


Figure 4: Potential risk of microplastics for human through food chain

food items for many creatures and animals that are at the base of the marine food web. Hence, the polluter does not always have to deal with consequences. But it is reasonable for marine wildlife

through the food web depends on the trophic levels of the particular organism.

Furthermore, it is predictable that human beings are exposed



Figure 5: Solutions for minimize microplastic pollution

to microplastics at different levels due to high seafood consumption worldwide. Majority of earlier studies had obtained microplastics in the guts of organisms, an organ that is not generally consumed directly by man. But shellfish such as mussels, clams and some shrimps are eaten whole or with their gut. However, a recent study suggest that ingested microplastics can get translocated from the gut, and into the muscular tissue in small amounts in tiny sizes that potentially make such plastic available to anything that eats that muscle tissue, whether it be larger fish or potentially human beings that occupy a high trophic level in the marine food chain.

Solutions for microplastics pollution

Trillions of microplastics that have already entered the oceans will be the next immense challenge in ocean conservation, and it would be sensible to attempt the elimination of these foreign particles from the natural environment at this stage. One of the credible solutions to the global disaster of plastic pollution is to minimize production. After that, it is essential to ensure that all plastic waste are captured before it escapes into the environment. We

can manage the waste volumes that currently exist by not adding to this problem the expected increase in plastics production. It is like, when you come home to find that the house is flooded, you do not try to reach the mop, but merely turn off the tap. However, the consequences are clearly worse for less developed and developing countries like Sri Lanka where waste management systems and infrastructure are not capable of capturing plastic waste.

It is the general view, that the world has to take three primary steps to get the microplastics problem under control. In the short-term, society needs to significantly restrict unnecessary single-use plastic items such as water bottles, plastic shopping bags, straws and utensils. Also, governments need to strengthen waste management and recycling systems to prevent waste from leaking into the environment through the domestic trash collection and landfills, and improve recycling rates as mitigation measures. Eventually, as a long term process, scientists need to devise ways to breakdown plastics into its most basic units which can be recast into new plastics or other materials, and also find alternatives that can be used in place of plastics.

Therefore, policy-makers and other decision-makers in the public and private sectors need guidance now on how best to target the microplastics issue. If not, microplastics pollution would be the next environmental catastrophe that Sri Lanka will face in the next decade.



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