RESEARCH ARTICLE

Micro Plastic Pollution in the Marine Environment

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ABSTRACT

Marine debris, more often than not consisting of plastic, is a global problem, negatively impacting wildlife, tourism and shipping. On the other hand, despite the durability of plastic, and the exponential increase in its production, monitoring data show limited evidence of concomitant increasing concentrations in marine habitats. In attendance appears to be a considerable proportion of the manufactured plastic that is unaccounted for in surveys tracking the fate of environmental plastics. Even the discovery of widespread accumulation of microscopic fragments (micro plastics) in oceanic gyres and shallow water sediments is unable to explain the missing fraction. Here, we show that deep-sea sediments are a likely sink for micro plastics. Micro plastic, in the form of fibers, was up to four orders of magnitude more abundant (per unit volume) in deep-sea sediments from the Atlantic Ocean, Mediterranean Sea and Indian Ocean than in contaminated sea-surface waters. This paper shows evidence for a large and hitherto unknown repository of micro plastics.

Keywords: *Debris, Bioaccumulation, Marine Environment, Marine Pollution*

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INTRODUCTION

Plastics are extremely durable synthetic polymers, yet more than 30% are made into disposable items such as packaging, which are typically discarded within a year of manufacture [1]. The allied incidental culture has led to an escalating plastic waste management problem, and widespread accumulation of plastic debris in the natural environment. Garbage is at the moment in attendance on shorelines and at the sea surface from pole to pole [1-2]. It has most important ecological impacts and is recognized as one of the key challenges of our century [1–3]. Though, despite extensive environmental monitoring, there is little evidence of the expected increasing abundance of plastic debris in natural habitats. Merely two studies [4-5] report an increase over time. Both these papers focused on micro plastics, which have not typically been included in routine monitoring, and are likely to represent a largely undocumented accumulation of plastic debris. Yet, even for micro plastic pollution, temporal trends are unresolved in the majority of datasets [6]. In addition, a recent study suggested that surface water plastic accumulation was tens of thousands of tones less than expected, and acknowledged that resolving the fate of the missing plastic is a fundamental issue [7-8]. Plastics can be denser (e.g. acrylic) or lighter (e.g. polypropylene) than seawater. Those that are buoyant float when first entering the sea, so historically attention has focused on the accumulation on shorelines and at the sea surface [9]. Nevertheless, for the reason that of fouling by organisms and adherence of particles, positively buoyant plastics can, over a timescale of weeks to months, become negatively buoyant and sink [10]. Some studies have shown the accumulation of large plastic items in the deep sea and one has reported the presence of micro plastic fragments at low densities [11-12].

Marine Pollution And The Food Web

Oceans receive pollutants from the atmosphere and from revering inflow. Coastal environments are added probable to be affected because they can receive pollutants from both sources. They are also fewer profound and can

receive secondary contaminations from pollutants which were stored in the sediments. Chiefly coastal areas near industrialized and highly populated areas can contain high concentrations of pollutants. Condition these areas have a limited mixing with water from the open ocean, like the Baltic Sea, the ecosystem becomes extremely vulnerable.

The different components of the ecosystem demonstrate a different vulnerability for certain pollutants in ocean. (Figure: 1) Pollutants accumulates when they are ingested at a higher rate than excreted. Pollutants which bioaccumulations can also bio magnify if the pollutant is accumulated at all levels of the food chain. Biomagnifying substances are typically lipophilic (meaning they tend to dissolve in fat rather than water), like organonochlorines, or have a high affinity for proteins, like methyl mercury. Pollutants which are mostly water associated, like heavy metals, don't tend to biomagnified. The latter may however bioaccumulation to very high concentrations in some organisms.

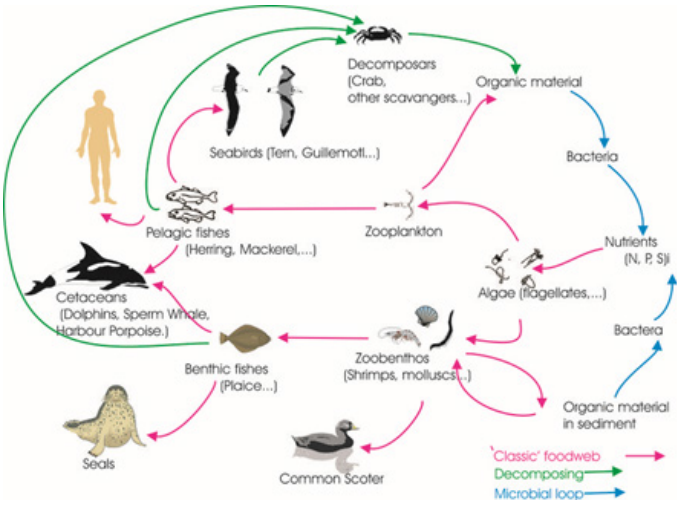

Figure: 1 Different components of the ecosystem demonstrate a different vulnerability for certain pollutants in ocean

Biomagnifying compounds more often than not affect the pinnacle of the ecosystem (sea birds, marine mammals, fishes,) most, because that's where they reach the uppermost levels. Compounds which don't biomagnifying will initial affect species with a low tolerance and those who accumulate them. Infantile stages have been shown to be particularly sensitive towards many pollutants. Sieve feeds, such as bivalves, more often than not have high bioaccumulation rates because they acquire large amounts of pollutants from suspended particles. Pollutants with low water solubility tend to be adsorbed to these particles.

Supplementary hazardous characteristics of pollutants are firmness and toxicity. Chemically firm pollutants, which are not biodegradable, can remain part of the ecosystem for long periods of time. Consequently their environmental concentration will continue to increase with increasing emissions. Yet after emissions have stopped they can continue to contaminate the ecosystem for decades.

Microplastics And Fisheries

Micro plastics are microscopic particles of plastic typically smaller than 1 mm but also include plastics that are less than 5 mm. (Figure: 2)

Figure: 2 SEM Image of Micro plastic in Ocean

The sources of this type of pollutant are diverse. Some are the direct result of small granules that are manufactured for industrial applications (e.g. microbeads, resin pellets) that enter marine ecosystems through accidental spillage (both at sea and on land), and failure to adequately contain waste from processing plants and their inappropriate use. Others are formed in the marine environment as a consequence of the breakdown of larger plastic material. More recently, studies have identified diffuse origins of micro plastics such as the shedding of synthetic fibers from textiles by domestic clothes washing and from the use of microbeads in the cosmetics industry. In both of these cases the micro plastics enter marine ecosystems through poor wastewater management. Even though the sources of micro plastics may be localized, due to their resilience and longevity, they can become distributed throughout the marine environment through hydrodynamic processes. Densities of micro plastics are reported to be higher in regions that are nearer to the point source of the pollution, such as urban centers, harbors, and coastal habitats; however, they are also reported in the coastal sediments of remote islands where there is little or no local plastic production and in the open ocean, in particular, accumulations within subtropical gyres. Densities as high as 100,000 plastic particles per cubic meter of seawater have been reported in an area adjacent to a polyethylene production plant and 33 particles per cubic meters in the Ocean.

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CONCLUSION

The prevalence of micro plastics in the marine environment is likely to increase in the immediate future given the rising consumption of plastics worldwide. International awareness and response on micro plastics, however, is gaining momentum. Global initiatives such as the Global Programme of Action for the Protection of the Marine Environment from Land based Activities, the International Convention for the Prevention of Pollution from Ships, and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter have been in existence for several decades. Avoid plastic save Blue Wealth.

Conflicts of interest/Competing interests

- Marine debris, more often than not consisting of plastic, is a global problem, negatively impacting wildlife, tourism and shipping.
- On the other hand, despite the durability of plastic, and the exponential increase in its production, monitoring data show limited evidence of concomitant increasing concentrations in marine habitats.
- In attendance appears to be a considerable proportion of the manufactured plastic that is unaccounted for in surveys tracking the fate of environmental plastics.
- Even the discovery of widespread accumulation of microscopic fragments (micro plastics) in oceanic gyres and shallow water sediments is unable to explain the missing fraction.
- We show that deep-sea sediments are a likely sink for micro plastics.
- Micro plastic, in the form of fibers, was up to four orders of magnitude more abundant (per unit volume) in deep-sea sediments from the Atlantic Ocean, Mediterranean Sea and Indian Ocean than in contaminated sea-surface waters.

Consent to Participate (Ethics)

Not applicable

Consent to Publish (Ethics)

Not applicable

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Author contribution

A. Mohamed Sikkander (author) contributed to the study conception and design. Material preparation, data collection and analysis were performed by A. Mohamed Sikkander. The first draft of the manuscript was written by A. Mohamed Sikkander and commented on previous versions of the manuscript. Both of the authors read and approved the final manuscript.

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