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Seasonal microplastic documentation in Kerala mangrove sediments

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ABSTRACT

Seasonal microplastic abundance evaluation in the sediments of the diverse mangrove environments in Kerala - Kannur, Kochi and Kollam was attempted. Samples were collected from three stations of Kannur: Pazhayangadi (KP), Valapattanam (KV) and Dharmadam (KD); two stations of Kochi: Mangalavanam (MN) and Kundannur (KK) and two stations of Kollam : Munro Thuruthu (KM) and Ashramam (KA). Seasonal comparison recognized that microplastics are more in MN during pre-monsoon season and least in KP sediments during post monsoon. Among the samples analysed fragments identified as more in numbers than filament microplastics. The dominant colour of microplastics were observed as black. This study serves as a baseline for microplastics distribution in the mangrove sediments of Kerala.

Key words : *Microplastics, Mangroves, Sediments, Abundance, Seasonal, Kerala*

Introduction

Plastic is the most versatile and multiutility substance used. But their disposal has been growing concern. It ends up as a cause for several environmental consequences. Plastic production and usage have extensively increased in uncontrollable manner globally. About 80% of plastic producing in India is thermosetting plastic and are recyclable. But only 60% are recycled and others ends up in landfills. These plastics undergo degradation as a result of exposure to UV light and other physical processes. The plastic debris on beaches and floating water is exposed to solar UV radiation undergoes weathering degradation and gradually loses its mechanical integrity (Pegram and Andrady, 1989). Due to this extensive weathering plastics generally develop surface cracks (Cooper and Corcoran, 2010). This can lead to the generation of secondary microplastics in the marine environment. Microplastics can be termed as plastic fragments smaller than 5.0mm in size. Microplastics come from a variety of sources including larger plastic debris that degrades into fragments and microbeads, a type of microplastics itself manufactured from polyethene plastics that are added as exfoliants to health and beauty products. These tiny particles easily go through water filteration systems and end up in ocean posing a threat to aquatic life.

Mangroves play a very important role in coastal ecosystems located at the interface between land and sea in tropical and subtropical areas of theworld. Mangrove plants may grow in different types of soil; therefore, their vegetation, species

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composition and structure may vary considerably at the global, regional and local scales (Vilarrubia, 2000). Mangrove sediments are deposited by rivers and the sea. Mangrove ecosystems are able to store large amounts of organic carbon (Fujimoto *et al*., 1999) and in some mangrove ecosystems organic-rich sediments depth have been found (Twilley *et al*., 1992). The present study tries to document the identification and distributionof microplastics in the mangrove sediments from selected transectsof Kerala.

Materials and Methods

Sampling area ranges throughout the mangrove forests in Kerala. Kerala is the southernmost state along the western coast of peninsular India. Mangrove wetlands are one of the most productive aquatic ecosystems and are characterized by high number of primary producers. Kerala had very thick mangrove vegetation especially along its coastline. The samples were collected from diverse mangrove environments (Fig. 1)- Kannur (Valapattanam, Dharmadam, Pazhayangady,)-developing and existing mangrove, Kochi (Mangalavanam, Kundannur-KUFOS) -estabished mangrove and Kollam (Munro thuruthu, Asramam)-degrading mangrove. The samples were collected from these regions during three different seasons; monsoon, pre monsoon, post monsoon. Sampling and analysis follows the standard analytic procedures (Dris *et al.,* 2018; Klein *et al.,* 2015; Cole *et al.,* 2013; Hidalgo-Ruz *et al.,* 2012; Everall *et al.,* 2007).

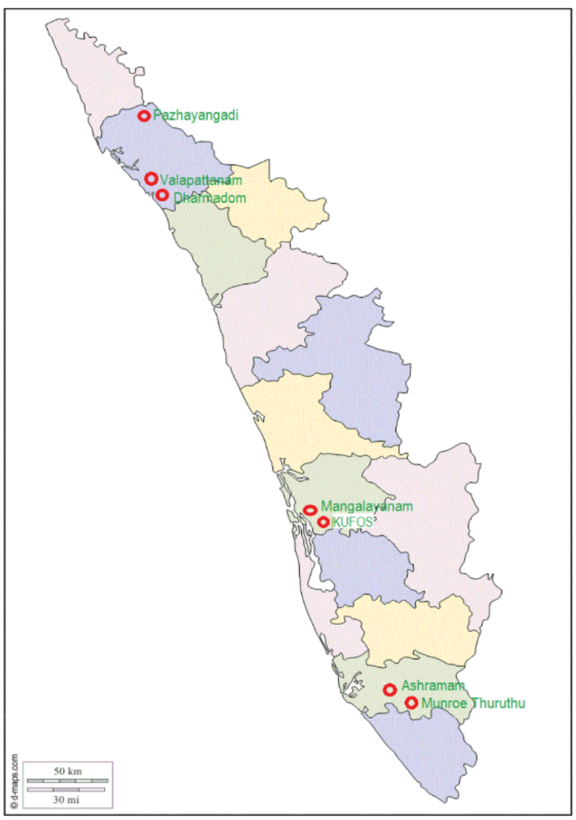

Fig. 1. Sampling Locations

Results and Discussion

The distribution of microplastics in the study area was not in a uniform manner, there are variations in the number between seasons and in between stations (Table 1). Based on microplastics changes, it was identified that more abundance in Mangalavanam (MN) region during pre-monsoon season and least in Pazhayangadi (KP) sediments during post monsoon. From the samples identified fragments are more in numbers than filament microplastics. The colours obtained from present study were red, green, blue, black, transparent and other colours. Among all the samples analysed dominant colour identified is black. Qualitative analysis by using FTIR spectroscopy helped to identify groups like Poly Amide (PA), Poly Ethylene (PE), Poly Styrene (PS), Poly Vinyl Chloride (PVC) , Poly Ethylene Terephthalate (PET) and Poly Propylene (PP). The FT-IR results from all the 7 stations during different seasons (Monsoon, Pre – Monsoon, Post – Monsoon) revealed majority of microplastic found of the polymer polyamide with the absorption peaks at a range of 3500-3350 cm^{-1} for N-H bond, polypropylene / polyethylene with the absorption peaks at a range of 2960-2850 cm^{-1} for C-H bond and 1300-800 cm^{-1} for C-C bond 1580-1460 cm^{-1} for C-C bond and polystyrene / polyethylene

Table 1. Total number of microplastics

Stations	Monsoon	Pre-monsoon	Post Monsoon
KM	10	12	6
KP	3	4	2
KV	5	8	5
KD	6	5	3
KA	7	4	4
MN	15	18	8
KUFOS	8	10	3

terephthalate with the absorption peaks at a range of 1580-1460 cm^{-1} for C-C aromatic and 1300-800 cm^{-1} for C-C (plane). In the stations KA, KP, KM, KD, KV, MN, KUFOS absorption peak found at 800-600 cm^{-1} for C-Cl which indicates the polymer polyvinyl chloride.

The study of microplastics along the Indian coast is very few, but the published works undoubtedly indicates the presence of microplastics. Occurrence of small plastic debris in Alang Sosiya ship breaking yard (Gujarat) identified polymers such as, nylon, polystyrene, polyester and glass wool and an average of 81 mg/Kg of small fragments in sediment resulting directly from ship breaking activities (Reddy *et al.*, 2006). The occurrence of microplastics was more forthe month of June than January and most of them were yellow coloured in Goa coast. (Veerasingam *et al.*, 2016). A study conducted in Kerala, along Vembanad lake, found that LDPE (Low Density Poly Ethylene) was the most abundant (26-91%) and PE was the most frequent type of polymer and average particles from the sediment were 252.8 particles m^2 (Sruthy and Ramasamy, 2017). Present study portraits the distribution pattern of microplastics in the mangrove sediments of Kerala. This baseline microplastics abundance highlight the need of detailed microplastics analysis of the Kerala mangrove sediments.

Conclusion

Mangroves are the lungs of nature and they have a great role in maintaining the balance of the ecosystem. Current study showed the seasonal microplastic abundance in the sediments of the mangrove environments in Kerala (Kannur, Kollam and Kochi). Microplastics profusion are more during pre-monsoon (MN) and least in during post monsoon (KP). Fragment type microplastics were identified as prominent component in the detected microplastics. Black microplastics were found in most of the study area. Results from the study highlight the plastic pollution issue in the mangrove environment which stress the necessity for controlled scientific plastic management strategy in the environment.

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