

RESEARCH ARTICLE

Textural and Chemical Characteristics of Microplastics in Coastal Sediments along the Southeast Coast of Sri Lanka: Implications for Possible Sources

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Abstract

At present Microplastics (MPs) have been recognized as one of the most critical and emerging sources of marine pollution with a significant impact on marine and coastal biota. The current study aimed to comprehend MP pollution along the Southeastern coast of Sri Lanka by investigating their spatial distribution, morphology, composition and possible sources. For the study, 23 coastal sediment samples were collected from straight beaches and 8 samples were collected from lagoon areas of the Southeast coast extending from Kalmunai to Panama. About 5 kg of surface sediments were collected from the wrack line to the berm zone at each sampling site. The MPs were isolated by density separation using 1.20 g/ml NaCl solutions. The amount, shape, and colour of isolated MPs were analyzed on the petrographic microscope. The Scanning Electron Microscope (SEM) and Fourier Transform Infrared (FTIR) Spectroscopy were employed to investigate their morphology and chemical composition respectively. The results indicated the presence of both mesoscopic- and microscopic-sized plastics in the studied sediments. The MPs occurred in five morphological categories; fibers (86.77%), flakes (6.61%), fragments (3.58%), foams (1.93%), and films (1.10%), and nine various colours. The SEM images demonstrated the presence of different weathering surfaces such as scratches, pores, protrusions, grooves, pits, and scales in these MPs. These weathered surfaces may have been formed due to mechanical abrasion, chemical reactions, photodegradation, and microbial degradation. The FTIR analysis revealed that the main polymer compositions of MPs are polyethylene and polystyrene. The distribution of MPs along the coast varied greatly (from 0 to 45 MPs 500 g⁻¹) and shows the highest amount in lagoon environments (>20 MP 500 g⁻¹) indicating land-derived sources of MPs. An in-depth textural and compositional characterization of MPs, and their spatial distribution investigations will advance the understanding of MP pollution in the Southeastern coast of Sri Lanka.

Keywords: Microplastics, Coastal sediments, Marine biota, Surface morphology

1. Introduction

Microplastics (MPs), plastic particles smaller than 5 mm in size, are one of the emerging environmental threats across the globe as a consequence of their non-biodegradability and bioaccumulation [1][2][3][4][5]. The MPs can either originate as primary MPs, which are commonly produced in cosmetics, pharmaceutical industries, synthetic textiles, and plastic pellets used in plastic industries or secondary MPs, which result as a consequence of physical, chemical, and biological fragmentation of macro-plastics [6][7][8].

A considerable fraction of MPs is lower in density than seawater, causing them to float on aquatic bodies and accumulate rapidly in the oceans. [1][9][10]. Therefore, at present MPs have been recognized as one of the most critical sources of marine pollution with a significant

impact on marine and coastal biota [11][10][12]. As a recent example, numerous tons of primary MPs were released into the marine environment of Sri Lanka as a result of the X-Press Pearl incident, which resulted in serious environmental damage and the deaths of marine organisms [13]. The MPs associated with marine environments are called Marine Microplastics (MMPs). These MMPs are readily accessed by a variety of aquatic organisms and eventually transferred along the food chain [14][11][10][15]. The accumulation of MMPs in marine organisms' cells and tissues causes long-term biological impacts such as inhibition of growth and development, changes in behaviour and feeding, genetic damage, and reproductive and immunological toxicities [16][4]. Also, they cannot be easily removed from the marine environment because of their small size [10]. Therefore, the raised MP concentrations in seawaters cause numerous