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Abundance of microplastics and its ecological risk assessment in coral reef regions of Peninsular Malaysia

Kok Ping Lim [a,b], Chengjun Sun [c,*], Sumiani Yusoff [a], Jinfeng Ding [c], Kar Hoe Loh [a], Jingxi Li [c], Phaik Eem Lim [a,*]

[a] Institute of Ocean and Earth Sciences, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[b] Institute for Advanced Studies, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[c] Key Laboratory of Marine Eco-Environmental Science and Technology, Marine Bioresource and Environment Research Centre, First Institute of Oceanography, Ministry of Natural Resources, Qingdao 266061, China

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ABSTRACT

Microplastic contamination is an emerging concern in marine ecosystems, with limited knowledge on its impact on coral reefs, particularly in Malaysia. Surface waters were collected from several coral reef regions in Peninsular Malaysia by towing a plankton net behind the boat. Microplastics were detected at all sites, with a mean abundance of 0.344 ± 0.457 MP/m^3. Perhentian Islands (0.683 ± 0.647 MP/m^3) had significantly higher microplastic levels than Tioman Island (0.108 ± 0.063 MP/m^3), likely due to oceanographic differences. Over half of the microplastics (55.7 %) were small microplastics (<1 mm), with the 0.05–0.5 mm size class being most abundant (29.2 %). Fragments and fibres dominated, and black, blue, and green were the prevalent colours. Polyethylene (PE), rayon (RY), chlorinated polyethylene (CPE), and polypropylene (PP) were the most common polymers. This study reveals the abundance and characteristics of microplastics, provides important data for further research on microplastics in coral reef ecosystem.

1. Introduction

Global production and consumption of plastic has seen exponential growth over the past few decades, driven by its versatility, durability, and cost-effectiveness. Due to high consumer demand, annual plastic production has increased drastically from 1.5 million metric tonnes (Mt) in 1950 to 400.3 Mt in 2022 (PlasticEurope, 2024). However, this surge in plastic usage has led to significant environmental concerns, particularly regarding improper plastic waste management. Up to 2015, approximately 6300 Mt of plastic waste had been generated, with about 9 % been recycled, 12 % incinerated, and 79 % accumulated in landfills or the environment (Geyer et al., 2017). It was estimated that 60 to 99 Mt of mismanaged plastic waste were produced globally in 2015, and a figure projected to rise to 155 to 265 Mt per year by 2060 (Lebreton and Andrady, 2019). By 2019, the global abundance of plastic particles in the marine environment was approximately 82 to 358 trillion particles (Eriksen et al., 2023). A substantial portion of plastic waste often ends up in marine environments, where it breaks down into smaller particles known as microplastics, with sizes ranging from 1 μm to 5 mm (Frias and Nash, 2019). These tiny particles are pervasive in the oceans, raising alarms over their potential impacts on marine ecosystems.

Microplastics have become ubiquitous in marine environments, with their presence documented from surface waters (Khalik et al., 2018) to the water column (Tang et al., 2023a), and the deepest ocean trenches (Zhang et al., 2020). Marine life, ranging from plankton (Desforges et al., 2015) to large marine mammals (Lusher et al., 2015), can ingest microplastics present in the environment, leading to several health issues. The trophic transfer of microplastics has been frequently reported in both field (Markic et al., 2018; Nelms et al., 2018; Welden et al., 2018) and laboratory settings (Costa et al., 2020; Hasegawa and Nakaoka, 2021). Some organisms exhibit certain preferences during foraging, resulting in the ingestion of specific types of microplastic. For example, amberstripe scad sampled in Rapa Nui have consumed many blue microplastics that resemble copepod prey (Ory et al., 2017). Microplastics pose a range of ecological threats, including physical and chemical hazards to marine organisms. They can act as vectors for harmful pollutants (Wright et al., 2013), potentially causing toxic effects when ingested by marine life. Owing to their high surface area to volume

* Corresponding authors.
E-mail addresses: csun@fio.org.cn (C. Sun), phaikeem@um.edu.my (P.E. Lim).

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