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The California State University
COUNCIL ON OCEAN AFFAIRS, SCIENCE & TECHNOLOGY (COAST)

Microplastic and Microfiber Pollution

Background

Microplastics (MPs) and microfibers (MFs) (generally defined as particles <5 mm in length) have been detected throughout ocean and coastal environments globally, and they are increasingly being studied for their impacts to aquatic life and human health. Primary MPs are designed for commercial use (e.g., microbeads, industrial pellets/nurdles). Secondary MPs originate from larger pieces of marine debris (macroplastics) that fragment into smaller pieces by physical, chemical and biological degradation. MFs originate from synthetic textiles, fishing gear, and car tires. MP/MF identification and quantification is a nascent field of study. Given the rapid increase in plastic consumption and other synthetics and low recycling rates, their abundance in the environment is anticipated to increase in the future.

The majority of MP/MFs found in ocean and coastal waters originate from land-based sources. Until recently, treated wastewater was thought to be the primary source of MPs into coastal waters. A recent study in San Francisco Bay found 300 times more MPs are entering the bay from stormwater runoff compared to wastewater discharge[1]. Contributions from atmospheric deposition are largely unknown but are also being considered in attempts to comprehensively identify and quantify sources.

MP/MFs are thought to affect organisms primarily through ingestion and inhalation and the subsequent exposure of chemicals inherent to the plastic itself. Studies have shown that nanoplastics (microplastics <1 micrometer) are able to pass through the digestive track and into the tissues of an organism, thus increasing chemical exposure. However, the impact of microplastic translocation on organism health is yet unknown. For example, a World Health Organization report states that it is not possible to draw any firm conclusions on toxicity related to MP exposure through drinking water, in part, because of a paucity of data on nanoplastics[2]. Studies on the detection, occurrence and toxicological effects of MPs, MFs and nanoplastics to organisms are increasing, but the science is still at its early stages. More work is required to understand how these tiny materials and the contaminants associated with them impact marine and coastal organisms.

Select Experts: please feel free to contact the following CSU experts.

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Abundance and distribution of marine debris along California's coast. Pursuing novel and low-cost technology to identify MPs.

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Use of bioswales and other bioretention structures to capture MPs before entering waterways.

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Advanced microscopic techniques (AFM-IR) to identify nanoplastics.

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Decomposition of plastics in seawater and the impact of plastics on human and marine mammal health.

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Impact of marine debris on fish, marine mammals, and seabird health resulting from ingestion of toxic particles.

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Identification and quantification of MPs in commercially-important fishes off California's coast.

State of California efforts to control MPs

In 2018, the California legislature passed two bills addressing MPs. Senate Bill (SB) 1422 focuses on MPs in drinking water[3]. In response, the State Water Resources Control Board (SWRCB) formally defined MPs and is currently developing a standard methodology to test drinking water for MPs. SB 1422 also requires the SWRCB conduct four years of testing. These activities will support the development of a health-based guidance level for MPs in drinking water, the first of its kind worldwide.

SB 1263 largely focuses on MPs in the marine environment and calls for the development of a Statewide Microplastics Strategy, which was approved by the Ocean Protection Council in February 2022[4]. This first-in-the-nation strategy identifies preventative actions and research priorities that will further the state's efforts to reduce MP pollution along its coast.

COAST-funded research

In 2021, COAST funded two large (~$400,000 each) MP/MF research projects that support the state of California's needs for scientific information. Dr. Eunha Hoh (San Diego State) is determining the toxicity of textile MFs and tire wear particles on marine organisms. Dr. Gerardo Dominguez (CSU San Marcos) is improving detection methods for nanoplastics through the development of highly specialized imaging technology. The results of these projects will inform state policies and priorities on MP and MF management.

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1. Sutton, R., *et al.* 2019. Understanding Microplastic Levels, Pathways, and Transport in the San Francisco Bay Region. San Francisco Estuary Institute: Richmond, CA.
2. World Health Organization, 2019. Microplastics in drinking-water.
3. Health and Safety Code section 116376
4. Public Resources Code section 35635

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Identification of sources of MP pollution to freshwater ecosystems.

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Developmental and aquatic toxicity of plasticizing agents, including perfluoroalkyl substances (PFAS), phthalates, and bisphenols.

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Ecological impacts of MPs in the marine environment; physiological impacts on marine organisms.

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Identification of toxic substances in MP samples.

The California State University Council on Ocean Affairs, Science & Technology (CSU COAST) is the umbrella organization for marine, coastal and coastal watershed related activities within the CSU, the nation's largest public four-year university system. Learn more at www.calstate.edu/coast.