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# Editorial: Challenges in characterizing nano- to macro-plastics and adhered substances in the aquatic environment

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Editorial on the Research Topic Challenges in
Challenges in characterizing nano- to macro-plastics and adhered substances in the aquatic environment

## Introduction

Globally, plastic contamination is one of the serious planetary threats, affecting almost all environmental matrices such as air, water, soil, sediment, and biota (including humans). It is estimated that ~19 to 23 million metric tonnes of plastic waste were generated and entered the environment in 2016, worldwide (Borrellee et al., 2020). Moreover, as the trend goes, the predicted growth in plastic waste may exceed efforts to mitigate plastic pollution around the world. Even with immediate and concerted action, it is estimated that 710 million tons of plastic waste will enter the aquatic and terrestrial ecosystems by 2040 (Lau et al., 2020). Therefore, many countries around the world are struggling to manage the current volume of plastic waste and plastic contamination in the environment. Based on the size, plastic waste is categorized into nanoplastics (1 nm to <1,000 nm), microplastics (1 μm to 5 mm), mesoplastics (>5 mm to <10 mm), and macroplastics (≥10 mm). Plastic itself can be a pollutant, but it can also act as a vector to transport toxic chemicals (e.g., persistent organic pollutants, trace metals, pesticides, and antibiotics) and harmful organisms (e.g., pathogens and invasive species) to pristine ecosystems. Therefore, these pollutants are of great public concern due to their ubiquitous nature and the potential hazards posed for humans and ecosystems.

We have recently highlighted the challenges in plastic research, including the standardized sampling and analytical methods (Veerasingam et al., 2020; Bagaev et al., 2021), research gaps in the identification of polymer types of microplastics (Veerasingam et al., 2021) and eco-toxicological effects of microplastics on biota (Anbumani and Kakkar, 2018). Using recent advanced analytical techniques to identify sources, transport pathways, and environmental and ecological impacts of plastic waste will provide a meaningful basis for better monitoring and mitigation purposes. Thus, this editorial introduces the Research Topic "*Challenges in Characterizing Nano- to Macro-Plastics and Adhered Substances in the Aquatic Environment*", highlighting the various techniques to monitor and characterize plastics and their associated substances in the aquatic environment, with the aim to address the detrimental effects on biota and mitigation strategies.

## Summary of papers published in this research topic

This Research Topic includes six papers (five research papers and one review article), covering quantification, characterization, eco-toxicological risk assessment, fate and transport pathways of plastics in the aquatic environment. Humans are exposed to nano/microplastics in different routes, including inhalation, ingestion and dermal infiltration. In the detailed review article, Bhuyan provided a perspective on the harmful effects of microplastics in fish and humans. Through this article, the author attempted to deliver an insight into the potential toxic effects of microplastics on fish and how it transfers through the food chain to humans. This study also highlighted the knowledge gaps in the microplastic ecotoxicology studies, and the author suggested a few recommendations for future research.

Gela and Aragaw investigated the abundance, occurrence, and identification of microplastics in sediment and agglomerated sewage water samples collected from four large ditches of Bahir Dar city in Ethiopia. Authors have found higher microplastic abundance in sediment than in the water samples. The results and data are useful to study the impact of microplastics on the water bodies, Tana Lake and Blue Nile River.

Sayed et al. discussed harmful effects of microplastic consumption on the reproductive performance of the freshwater mature male African catfish (*Clarias gariepinus*). Authors have used three different antioxidant supplements, *viz.*, lycopene, citric acid, and Chlorella, against reproductive injuries induced by microplastics in fish, and explored their protective potential. The results show that intake of microplastics is a potential source of reproductive stress.

Hamed et al. investigated the neurotoxicity of polyethylene (PE) type microplastics on the brain tissue of African catfish (*Clarias gariepinus*) to find out whether dietary feeding on *Chlorella*, citric acid, and lycopene help in alleviating their toxicity. Authors have demonstrated that microplastics ingestion has induced alterations in both enzymes and histology in the brain of catfish.

The research study by Varg et al. tested the effect of microplastics and toxic metals on *Daphnia magna* mortality and the changes in the consumption of free-living and host associated microorganism in the presence and absence of microplastics and Chromium (VI). This study provided novel insights related to pollutant effects directly on mortality and host-microbiome.

Plastic pollution is a transboundary environmental issue, deriving the pollutants from both distant and local sources. Therefore, it is important to identify plastics' sources, fate and transport pathways for effective monitoring and management programs. Allison et al. with 25 years (1994–2019) of citizen-science beach-clean data of northwest Scotland, using a particle tracking model simulated trajectories and distribution of plastic litter from potential sources. On the whole, all the six articles deal with the theme of the given Research Topic.

## Conclusion

We view that the results presented in this Research Topic may help in filling the knowledge gaps on the distribution, characterization, eco-toxicological effects, fate and transport pathways of microplastics in aquatic ecosystems. The outcomes clearly show that plastic pollution (from nano-size to macro-size) is an emerging environmental as well as ecological issue. Therefore, stakeholders, public and scientific communities need to understand the impacts of plastic pollution on the environment, including biota and humans, and look for mitigating this menace.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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