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From Evidence to Action: The Emerging Role of Biologists in Addressing Microplastic Pollution

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Abstract

Microplastics (MPs) are no longer an environmental issue confined to the open ocean. Over the past decade, MPs have been detected across almost all environmental compartments on Earth (Ambrosini et al., 2019) and in a wide range of organisms, including humans (Leslie et al., 2022; Braun et al., 2021). Given this ubiquity, MPs now represent one of the most pervasive forms of contamination, extending beyond the disciplinary boundaries in which the issue was first acknowledged. Biologists, in particular, play a critical role in this context by interpreting the mechanisms of exposure, uptake, and biological effects across taxa, thereby linking environmental presence to ecological and human health consequences. Consequently, the central question facing scientists today is no longer whether MPs are present in the environment or in what quantities, but what actions can and should be taken to address and mitigate their impacts.

From documentation to direction

For the past decade or so, scientists have devoted considerable effort and time in generating baseline data, refining detection methods, mapping environmental distribution, and characterizing the effects of organismal exposure. This phase has been crucial in transforming what was once a speculative concern into a well-documented, quantifiable global phenomenon, with MPs now detected from ocean sediments to the snow and ice of the highest glaciers. However, over time, a growing body of literature has increasingly confirmed their presence, effects, and potential risks, leading to a saturation of descriptive knowledge. At present, the field of MPs stands at a critical juncture, where the focus must expand beyond documentation toward risk assessment, mitigation strategies, and engagement with behavioural and policy frameworks aimed at addressing this contaminant. Detection tells us where the problem lies, but action will determine whether it can be controlled, at least to a level that minimizes threats to life.

Scientists as solution providers

Scientists have now reached a juncture where they must step beyond their traditional comfort zones, where their role is often perceived as ending at the laboratory, once findings are published, responsibility is largely assumed to shift to regulators and policymakers for translation into real-world solutions.

However, scientists, particularly biologists, are uniquely positioned to lead this effort in multiple ways. Understanding how organisms respond to MP exposure, and how these effects propagate through food webs and ecosystems, remains fundamentally a biological question. It is therefore crucial to develop sensitive biomarkers capable of detecting sub-lethal impacts before they become irreversible. Such biological insights are essential for informing and guiding engineering-based solutions. Furthermore, the discovery of PETase, a bacterial enzyme capable of degrading polyethylene terephthalate (PET), has opened new avenues of research focused on engineering enzymes and microbial systems for the remediation of plastic-contaminated wastewater. Thus, biologists have a critical role to play in designing nature-based mitigation strategies, not only by generating evidence-based knowledge, but also by actively contributing to the translation of science into real-life solutions, policy development and effective public communication.

What is next?

At present, emerging avenues are making the transition from evidence to action more achievable than it may have seemed a few years ago. Interdisciplinary and collaborative approaches in research are no longer optional but essential, given the complexity of the challenges involved. In addition, rapidly advancing artificial intelligence and modern analytical tools are transforming once labour-intensive processes, enabling researchers to focus more on higher-order questions and interpretation. Citizen science initiatives are also expanding rapidly, supporting researchers by enabling more efficient large-scale data and sample collection. Furthermore, emerging technological frameworks and innovations, such as the circular economy, green materials, enzyme engineering, and sustainable filtration technologies, are opening new pathways not only for prevention but also for the effective mitigation of environmental contamination.

What we still do not know

Despite advances in technology and the growing availability of data, methodological inconsistencies remain a major limitation in this field. Several systematic reviews have repeatedly highlighted the lack of standardized sampling, extraction, and identification protocols, making it difficult to compare findings across studies (Primpke et al., 2020). Furthermore, the long-term biological effects of chronic, low-dose exposure to MPs in humans remain poorly understood, as most existing knowledge is derived from short-term or high-dose experimental models that may not accurately reflect real-world exposure conditions. Most importantly, a significant gap persists between scientific evidence and policy implementation across many countries, indicating that the availability of data has not translated into effective regulation, funding priorities, or public behavioural change. Identifying these gaps is therefore essential for setting realistic priorities in the next phase of research.

A local perspective of a global challenge

Researchers in countries such as Sri Lanka, as well as many other nations with similar economic constraints, face significant challenges in securing adequate funding for research. Despite these limitations, Sri Lankan researchers have generated important evidence demonstrating MP contamination in marine protected areas, agricultural soils, and in the aftermath of the 2021 X-Press Pearl disaster (Dharmadasa et al., 2021; Weerasekera et al., 2024). Given the scarcity of resources, future research should prioritize context-specific exposure pathways, such as coastal fisheries, inland waterways, agricultural runoff, and drinking water systems, rather than duplicating descriptive detection studies that have already been extensively conducted elsewhere. At the same time, locally generated findings should be made available using standardized methodologies wherever possible so that they contribute meaningfully to the broader global evidence base.

These priorities are particularly important for Sri Lanka as an island nation, where dense coastal populations, heavy reliance on fisheries and marine resources, and inadequacies in waste management infrastructure increase vulnerability to plastic pollution. Moreover, in the absence of coordinated national research frameworks, studies are often undertaken by isolated research groups in an *ad hoc* manner. Strengthening interdisciplinary collaboration, promoting data sharing, and establishing national research priorities would help maximize the impact of limited resources while more effectively identifying and addressing critical knowledge gaps.

Defining priorities for future research

It would be easy to conclude this editorial with yet another call for more research! However, MP pollution is no longer an issue limited by a lack of data. Rather, it is constrained by the limited translation of knowledge into action, insufficient coordination among stakeholders, and inadequate implementation of existing evidence. Biologists should not remain on the sidelines of this effort, contributing data for others to interpret and apply. The discipline already possesses the tools, robust evidence base, and increasingly standardized methodologies needed to lead interdisciplinary solutions rather than merely support them. Monitoring alone is no longer a sufficient endpoint.

Future biological research should therefore be evaluated not only by the knowledge it generates but also by its capacity to enable tangible environmental outcomes. This includes informing mitigation technologies, guiding environmental management, shaping public policy, and supporting behavioural change. Based on the substantial amount of evidence accumulated over the past decade, the scientific priority should now shift from documenting the occurrence of MPs to reducing their release, developing effective mitigation strategies, and accelerating the adoption of sustainable alternatives to conventional plastics. The challenge before us is no longer to prove that MPs are everywhere, but to ensure that the knowledge we have gained is translated into meaningful action before their impacts become increasingly difficult to reverse.

References

Ambrosini, R., Azzoni, R. S., Pittino, F., Diolaiuti, G., Franzetti, A., & Parolini, M. (2019). First evidence of microplastic contamination in the supraglacial debris of an alpine glacier. *Environmental pollution*, *253*, 297-301. https://doi.org/10.1016/j.envpol.2019.07.005

Braun, T., Ehrlich, L., Henrich, W., Koeppel, S., Lomako, I., Schwabl, P., & Liebmann, B. (2021). Detection of microplastic in human placenta and meconium in a clinical setting. *Pharmaceutics*, *13*(7), 921. https://doi.org/10.3390/pharmaceutics13070921

Dharmadasa, W. S., Andrady, A. L., Kumara, P. T. P., Maes, T., & Gangabadage, C. S. (2021). Microplastic pollution in marine protected areas of Southern Sri Lanka. *Marine Pollution Bulletin*, *168*, 112462. https://doi.org/10.1016/j.marpolbul.2021.112462

Leslie, H. A., Van Velzen, M. J., Brandsma, S. H., Vethaak, A. D., Garcia-Vallejo, J. J., & Lamoree, M. H. (2022). Discovery and quantification of plastic particle pollution in human blood. *Environment international*, *163*, 107199. https://doi.org/10.1016/j.envint.2022.107199

Primpke, S., Christiansen, S. H., Cowger, W., De Frond, H., Deshpande, A., Fischer, M., ... & Wiggin, K. J. (2020). Critical assessment of analytical methods for the harmonized and cost-efficient analysis of microplastics. *Applied Spectroscopy*, *74*(9), 1012-1047. DOI: 10.1177/0003702820921465

Weerasekara, P. G. Y. W., De Silva, D. S. M., De Silva, R. C. L., Amarathunga, A. A. D., Bakir, A., McGoran, A. R., ... & Reeve, C. (2024). Sampling and analysis of microplastics in the coastal environments of Sri Lanka: Estuaries of the Kelani River to Mahaoya. *Water*, *16*(13), 1932. https://doi.org/10.3390/w16131932