

ENVIRONMENTAL RESEARCH
LETTERS

EDITORIAL

Do we need more research on the environmental impacts of plastics?

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Abstract

We question whether the rapid growth in research on the impacts of environmental plastics over the last decade has substantially improved our understanding of these impacts. By the mid-1990s, the major environmental and economic impacts of plastics were sufficiently well known to conclude that they posed a significant environmental threat. Accordingly, the focus of the Third International Marine Debris Conference shifted from researching impacts to devising solutions. We should re-embrace this message, and study how best to change the inappropriate human behaviours that lie at the heart of the plastics crisis. The main role of natural scientists should be to provide robust monitoring data to assess the success of the various mitigation efforts.

The 2022 is the 50th anniversary of two seminal papers in science documenting the occurrence of plastic pellets in surface waters of the North Atlantic Ocean (Carpenter and Smith 1972, Carpenter *et al* 1972). The two papers effectively were the first reference to microplastics in the environment, and documented the trophic transfer of ingested plastics. Their publication marked the start of the era of environmental plastics. Prior to 1972, the accounts of plastic entanglement and ingestion by a suite of marine organisms were largely anecdotal (Ryan 2015, <https://litterbase.awi.de>).

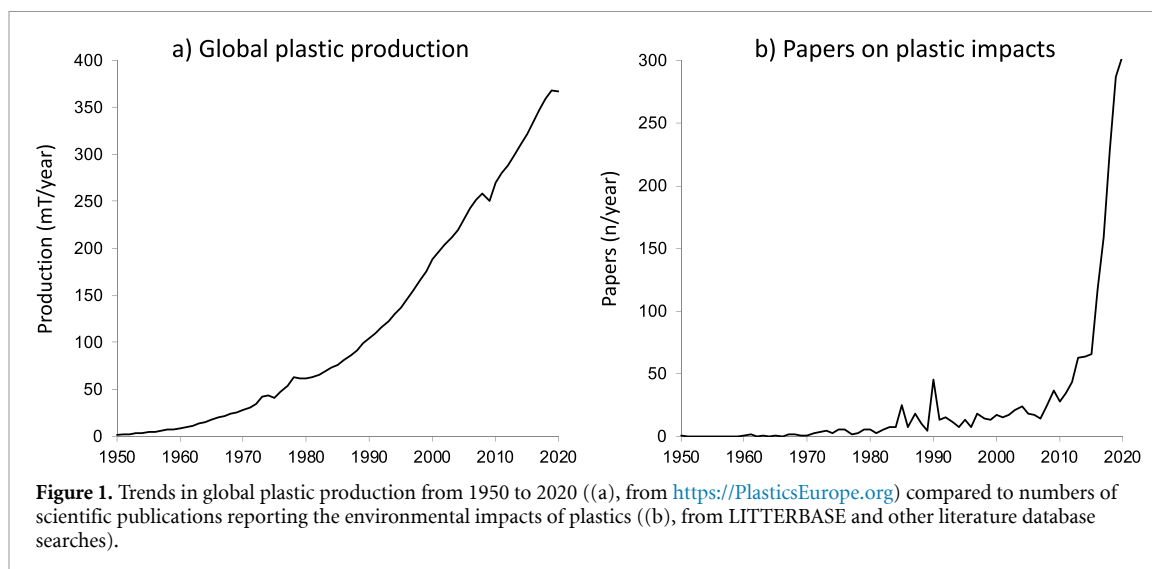
Awareness of the scope of the environmental threats posed by plastics grew over the next two decades, driven to a large extent by the first two international marine debris conferences in the 1980s. By the Third International Marine Debris Conference in 1994, it was clear that plastics were ubiquitous pollutants of marine systems worldwide, impacted a wide range of marine organisms, and had significant economic costs. As a result, the focus of the 1994 meeting was on 'Seeking Global Solutions' (Coe and Rogers 1997).

Despite this history, the following 25 years have seen enormous growth in research publications documenting the impacts of plastics on marine environments, far outstripping the growth in plastic production over the same period (figure 1). And although we have greatly improved our understanding of the fate of plastics in the environment (van Sebille *et al* 2020,

Macleod *et al* 2021), and some novel impacts have been discovered (e.g. Leslie *et al* 2022), most papers report the same issues from different species or from other parts of the world. While they serve to highlight the pervasive nature of plastics in the environment, they do little to further our understanding of the nature of the threat posed by plastics, nor do they address the root cause of the problem.

Lavers *et al* (2022) bemoan the small budgets allocated to plastic research. From 2015 to 2021, four major research councils budgeted 40 times less on plastics research than climate change. However, at over \$34 million, the amount involved was substantial. Lavers *et al* (2022) do not report how those funds were used, but judging from the papers published, a substantial proportion was used to simply reinforce what we already know. Of the 16 global research priorities to mitigate the impacts of plastic pollution on marine wildlife identified by Vegter *et al* (2014), only three deal directly with tackling the amounts of plastic entering the environment.

We should revisit the message from the Third International Marine Debris Conference and focus research on tackling environmental plastics rather than further documenting their impacts. We need research that explores how best to change human behaviour to prevent the ongoing littering of plastic items, which constitutes by far the largest source of environmental plastics. We also need to support policies, strategies and interventions that will ensure



effective solid waste management in countries where current practices are deficient, leading to widescale leakage of plastics (Jambeck *et al* 2015). And we need to better enforce existing legislation controlling the disposal of plastic wastes, given evidence of widespread flouting of regulations by certain industry sectors (e.g. Ryan *et al* 2019, 2021).

There needs to be a shift to promoting the circularity of plastics. Focus needs to be on the recovery of plastics as a feedstock into the secondary resources sector (Geyer *et al* 2017). For this to happen there needs to be investment in technology development. In addition, redesign of plastics needs to be a priority to ensure that they can either be recycled, reused, repurposed or even designed out of the system (World Economic Forum 2016).

If adopted, this approach would see a shift from natural scientists to resource economists and social scientists as the major recipients of funding to tackle the plastics crisis. The main role of natural scientists should be to provide robust feedback on which mechanisms are effective in stemming the amount of litter entering the environment both on land and at sea (Ryan *et al* 2020a). Focus also should be on reducing macroplastic inputs, as these constitute the vast majority of the mass of environmental plastic (Lebreton *et al* 2018, Ryan *et al* 2020b), and are much more tractable to address than microplastics (Ryan *et al* 2020a). Reducing the amount of macroplastic in the environment is the most effective way of preventing the formation of secondary microplastics.

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