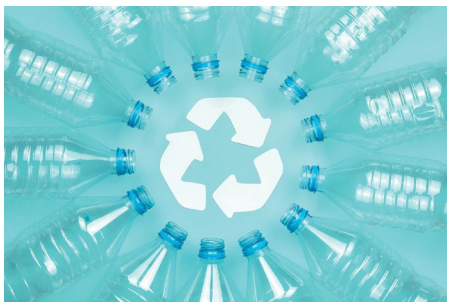
https://doi.org/10.1038/s41561-023-01255-7

Solutions for plastic pollution

Tackling plastic pollution not only requires improved understanding of environmental dynamics of plastics, but also needs turning scientific insights into actions.



Created in 1908, synthetic plastic was once hailed as one of the greatest inventions in human history, but its ubiquitous use has produced alarming environmental challenges. Modern life in many regions has been accompanied by a boom in plastic use, with global production increasing exponentially from 1950 to 2015 (ref. 1). About 8.3 billion tons of plastics have been produced to date, with more than 60% ending up in the environment and posing great risks to ecosystems and humans[1]. This year, the United Nation's World Environment Day followed up its 2018 theme 'beat plastic pollution' to focus on solutions, urging more and quicker actions from the public and stakeholders. While science has started to reveal the full picture of how plastics move through and transform in the environment, efforts to reduce plastic pollution need not wait as effective solutions are already available.

Every year, more than 460 million tons of plastics are produced globally, but only about 9% of this gets recycled[2]. Plastic waste is generated during production, consumption, and disposal of plastic products. Once released into the environment, the plastics can break down into microplastics and even nanoplastics, both of which can be transported for great distances in the ocean and atmosphere and remain in the environment for hundreds of years. Plastic pollution is a global problem, found even in regions with limited influence from human activities, including Mount Everest[3] and the Arctic[4].

In order to address plastic pollution, sources and sinks must be understood. Rivers and soils are normally the immediate sinks after plastic waste enters the environment, and the ocean is where it ends up. While the general plastic transport pathways are known, the magnitude and source of plastic entering the ocean remains poorly known. For example, estimates of riverine inputs of plastics to the ocean vary by up to five orders of magnitude due to different modelling approaches and inadequate field measurements[5].

Some of the uncertainties in the estimates of plastic sinks and sources arise from inadequate consideration of plastic size. Kaandorp et al.'s article in this issue reports that previous estimates of the total amount of floating plastic litter in the ocean may have been underestimated due to inaccurate representation of plastics larger than 2.5 cm. Previous model-based estimates of the annual inputs of plastics to the ocean from rivers and coastlines of 1,000 kilotonnes (ref. 6) had been difficult to reconcile with measurements of plastics floating in the ocean, suggesting an unidentified 'missing sink' in the marine plastic budget. However, accounting more accurately for larger plastics leads to a much lower input estimate of 500 kilotonnes, removing the need to invoke a 'missing sink'. The study also improves our understanding of how plastics are compartmentalized between surface and deep ocean waters, and along coastlines — critical information for effective remediation strategies.

Although larger plastics follow largely linear pathways with clearly defined sources and sinks, the transport pathway for microplastics and nanoplastics is more complicated. These tiny plastics experience a complex cycle of resuspension and deposition between the atmosphere and land surface, before ending up in the ocean[7]. Such complex cycling makes accurately estimating sinks and sources difficult.

While knowledge gaps persist, the solution to this environmental calamity is relatively straightforward. Preventing plastic waste from entering the environment in the first place is widely considered the best solution. To limit plastic pollution from sources, individuals can eliminate the use of unnecessary single-use plastics by changing our consumption behaviours, governments can improve waste management systems to increase recycling and reduce leakage, and companies can improve plastic products to boost reuse. Ending the manufacture and use of disposable plastic bags, bottles, wrapping, food containers, and cutlery would reduce the mass of plastic waste that enters aquatic environments by about 40% (ref. 8).

Given the ubiquity of plastics, everyone can be part of the solution to plastic pollution. There is much science can do to help us better understand the sources, transport, and fate of plastics in the environment and guide effective plastic pollution mitigation efforts. We call for not just more research, but actions from our readers and authors to reduce plastic use and increase plastic recycling.

Published online: 8 August 2023

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