

Legacy plastics: interventions to remove existing plastic from aquatic environments

Executive summary

Plastic is a persistent and bio-accumulative environmental pollutant that can cause harm at all levels of biological organisation. Environmental concentrations are predicted to triple by 2060 under business-as-usual scenarios due to increased production and the continued mismanagement of plastic waste¹. The effects of plastic pollution on human health remains less well understood, but the negative economic impacts on tourism and reduced psychological benefits in terms of human interaction with the environment, are apparent.

In accordance with the ‘waste hierarchy’, preventing plastic from entering the environment must be the policy priority. However, some amount of plastic removal from the environment will likely be necessary to reduce the risk of harm to ecosystems and potentially to humans. This is due to the high amount of plastic already in the environment, the negative environmental consequences, and because these negative consequences are predicted to increase as concentrations increase.

These factors suggest that approaches to remove plastic from the environment are likely to be of increasing interest to policymakers. Already, governments around the world are negotiating a legally binding agreement on plastic pollution – the United Nations (UN) Plastics Treaty. At the time of writing, the latest draft includes a potential obligation for member states to: monitor plastic pollution within their jurisdiction; identify plastic pollution hotspots; and adopt effective mitigation and remediation measures to reduce environmental plastic pollution, including clean-up activities within identified hotspots.

This report summarises some of the technologies and other interventions that are available to clean-up legacy plastics from the environment, as well as discussing their feasibility, effectiveness and environmental impacts. The report also presents approaches to identify accumulation hotspots – which may help to prioritise areas for clean-up.

Plastic clean-up technologies and interventions

Current technologies and interventions available to remove plastic from aquatic environments target plastic in either wastewater treatment facilities, rivers, estuaries, harbours or on beaches. The overall effectiveness of clean-up interventions in reducing the mass of plastic in the environment is questionable given that a substantial proportion of this debris is microplastic, which is distributed widely in the water column and sediment and is almost impossible to remove with current technologies. However, some removal approaches which target larger, macroplastic litter within pollution hotspots may deliver benefits, especially when these are located in relatively close proximity to the source of the debris, for example in rivers.

Feasibility, effectiveness and cost will vary according to the type of intervention and the habitat in question, and many clean-up technologies are specific to either certain types of plastic, certain environments, or both. It is likely that a range of interventions will be needed to target different situations.

1 Based on current trends of a 4.5% annual growth in plastics production between 2017 and 2100 – and that between 1.75% and 4.67% of yearly plastic production becomes marine. See Everaert G, Van Cauwenberghe L, De Rijcke M, Koelmans AA, Mees J, Vandegehuchte M, & Janssen CR. 2018. Risk assessment of microplastics in the ocean: Modelling approach and first conclusions. *Environmental pollution*, 242, 1930-1938.

Removing plastic from the environment close to source, before it distributes widely and / or breaks up into smaller fragments, is likely to be the most effective. The majority of plastic waste enters the ocean via rivers. Once in the oceans, it is estimated that around 88% of plastic stays close to the shoreline, with floating offshore plastic making up just 2% of marine plastic. Coastlines, shallow water habitats and beaches are rich in wildlife, high in natural capital and important for human wellbeing. Therefore, interventions that target rivers and the coastline may be particularly valuable. For example, beach cleans, and other volunteer-led activities are relatively low cost and have been shown to be effective, scalable and sustainable.

The effectiveness and environmental impact of most clean-up technologies have not been formally evaluated, and this report suggests that such evaluation should take place prior to deployment and ideally before technologies are brought to market. For any given habitat, the impacts of clean-up should be weighed against the impacts of leaving plastic in the environment.

Identifying priority areas ('hotspots') for clean-up

The report outlines the technologies, modelling and monitoring techniques available to identify hotspots of plastic pollution. These could be used to prioritise areas where clean-up may be most valuable and effective. For example, hydrographic modelling combined with empirical monitoring and remote sensing techniques could be used in combination to predict and identify areas of plastic accumulation and to help understand pathways and fluxes of pollution. Here we refer to 'hotspots' as areas where plastic pollution is most likely to cause harm to ecosystems or human wellbeing, and therefore where cleaning up would be most beneficial.

Key findings

- 1. To tackle plastic pollution and its negative consequences prevention, is, and should remain, the priority.**
Over-emphasis on clean-up interventions could divert attention away from more systemic solutions focused on minimising plastic use, including investing in more benign and sustainable alternatives, and efforts to move to a circular plastic economy through effective reuse and recycling.
- 2. Some amount of legacy plastic removal may be beneficial.**
Particularly in environments that have high natural capital and / or social value, where the risks associated with clean-up activities are shown to be lower than the risks associated with leaving plastic in the environment.
- 3. Priority areas for clean-up (hotspots) in the environment can be identified according to:**
 - (a) the natural and social capital value of the area
 - (b) the potential hazards that plastic pollution poses in this area
 - (c) the feasibility and likely effectiveness of clean-up
 - (d) the risk of negative consequences from clean-up.
- 4. Based on the range of options currently available, those that involve hand-picking litter from shorelines and / or intervene close to the source of plastic pollution are likely to be the most effective.**
- 5. The environmental impacts and cost effectiveness of clean-up technologies remain largely unknown.**
To address this gap, efficacy and environmental impact assessments are required in the locations where the technology is to be deployed.