Waste water treatment as a source of microplastic pollution

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Photography encouraged

Context

This poster summarises the results of two field studies looking at microplastic abundance in relation to Waste Water Treatment Works (WWTW). The objectives of these studies was to establish if environmental microplastic abundance in river water and sediment is elevated near to points where treated water from WWTW is released to rivers and near to sites where WWTW solid sludge is spread on agricultural land as fertilizer.

Microplastic pollution is widespread across the globe, pervading land, water and even air. These environments are commonly considered independently, however a recent review paper (Horton & Dixon, 2018) proposed a conceptual model demonstrating the close linkages between sources, environmental processes and possible areas of accumulation.

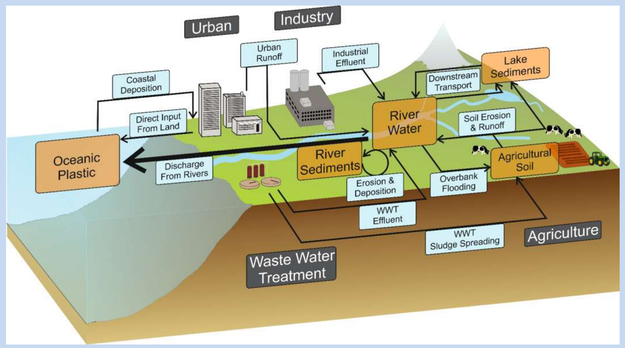


FIGURE 1. The "Plastic Cycle" from Horton & Dixon, 2018 showing linkages between sources and vectors for environmental plastic pollution

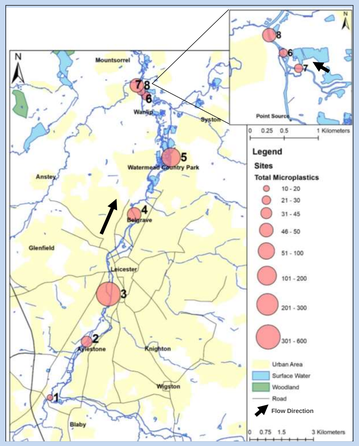
Types & Sources of Plastics

There are a variety of possible routes by which plastic pollution can leak into terrestrial and freshwater environments (Fig. 1), and a range of processes whereby this plastic pollution can be dispersed, or retained, between or within different environmental stores. There are currently gaps in quantifying the relative importance of these inputs, which include WWTW. In this study, based in central UK, we analysed the abundance of microplastic in river water, sediments in relation to WWTW effluent discharge and soils on which WWTW sludge had been spread as fertilizer.

Key Points

- **Waste Water Treatment Works (WWTW) can release microplastics to environment both in effluent and solid waste**
- **Tertiary treatment may a high proportion of microplastics from resulting effluent**
- **Solid sludge used as agricultural fertilizer can have high levels of microplastics and these can leak into wider environment**

WWTW Effluent



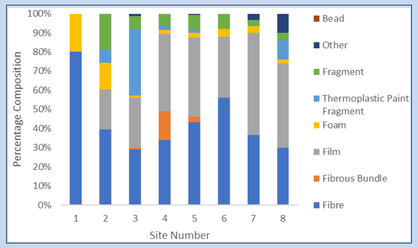


Figure 2. (a) (left) Proportional circle map showing total microplastics found at each site along a 16.4 km transect of the River Soar. Point source on the inset map shows input of WWTW effluent. This shows a negligible influence of WWTW effluent on overall abundance, likely due to tertiary treatment of effluent. (b) (above) Proportion of microplastic shape at each site.

Results from river sampling in the River Soar indicate that the WWTW effluent discharge has a negligible influence on overall microplastic concentrations. The strongest relationship is between urbanisation (population density) and abundance, which also influences the composition of microplastics; in samples from heavily urbanised locations there is an increased abundance of thermoplastic paint fragments, likely from road markings (Fig 2b). At the site nearest to the WWTW effluent discharge there is an increase proportion of fibres in the sample, which may indicate the presence of fibres from laundry which have not been removed during treatment.

WWTW Sludge

A strong relationship was found between abundance of 1-2mm microplastics in soils where sludge spreading had taken place three years previously and an adjacent watercourse. However, a correlation was not found for the 2-4mm size fraction. This could indicate differences in transport/retention behaviour for different sizes of microplastics. Overall abundance was high for a rural river (mean 15, max 28 per 100g-1) – values comparable to urban samples from literature. Although soil values are lower than previously reported for soils with sludge spreading.

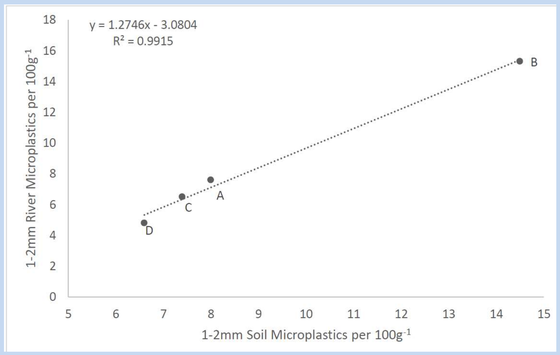


Fig. 3. Abundance of 1-2mm microplastics in agricultural soils and adjacent watercourse (Tetbury Avon)

Next Steps

These pilot results demonstrate further targeted sampling of WWTW would be valuable in understanding their importance as a microplastic vector. Specifically, direct sampling of effluent discharge and tracing microplastic abundance and composition downstream at plants with different treatment processes. In terms of sludge spreading longitudinal studies looking at leaching of microplastic particles into the environment would be valuable. We are keen to collaborate with other groups to achieve this.

Conclusion

WWTW can be important sources of microplastic pollution. However, the degree to which individual plants contribute will be heavily influenced by treatment processes and by the methods of sludge spreading. There is a need to conduct further, targeted sampling and for a unified regulatory approach.

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