Presence and Abundance of Microplastics in the Thames River Basin, UK

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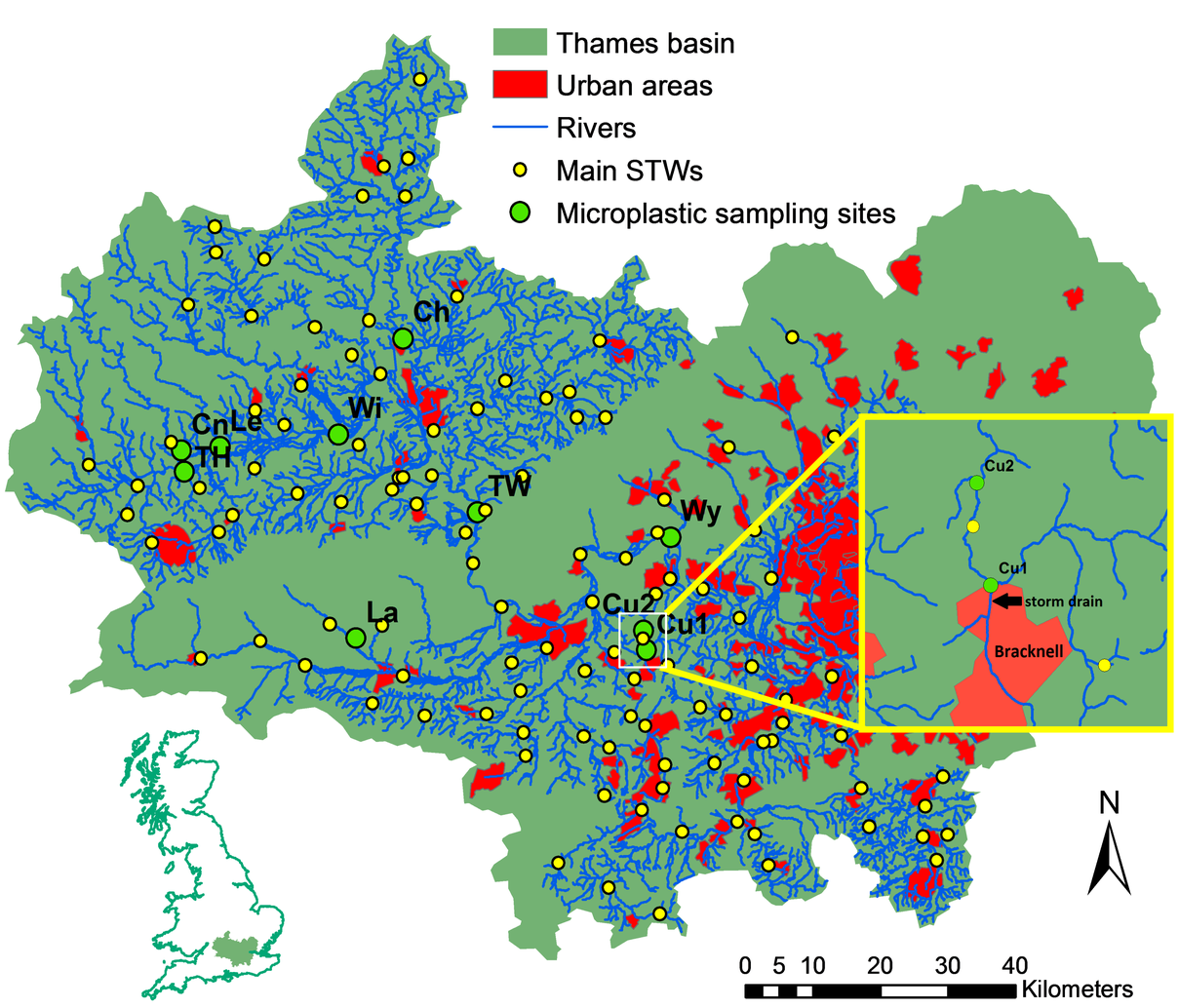
Background:

• Fewer studies on microplastics in freshwater environments exist (none to date in the UK) compared to the many in marine environments.

• Types of microplastic are classified as **primary** (including pre-production pellets and 'microbeads' in personal care products) and **secondary** (formed by the degradation and breakdown of larger plastic items) (Wagner et al. 2014).

• Macroplastic in the Thames (second longest UK river flowing through London and other cities) has been recently commented on (Morritt et al 2014) but in addition it is likely that microplastics will be found within these watercourses due to the urbanisation within the Thames basin and input from sewage treatment outfalls and storm drains.

Fig. 3. (above) Storm drains at the Cut (site 1) – direct input from roads/land (untreated). *Photo courtesy of James Miller.*
Fig. 4. (right) Microplastics extracted from a sediment sample from the Cut 1.



Particle extraction and analysis:

• Samples were wet sieved into 4 size fractions for analysis: 2-4mm, 1-2mm, 1mm-250µm and 250µm-53µm, each fraction subsequently dried and weighed.

• Samples of 2-4mm and 1-2mm were first sorted-by-eye to remove visible microplastics, then floated and overflowed using $ZnCl_2$ solution, supernatant filtered, dried and microplastic particles removed-by-eye under a binocular microscope.

• A representative selection of particles were analysed using a Raman spectrometer to determine their composition and confirm they were plastic.

Results and discussion:

• Microplastics were found in all four sites on the Thames, even those considered 'clean', with little effluent input or urbanisation.

• Cut 2 (the most polluted site) had fewer microplastic particles compared to the less polluted Cut 1. This is based on % effluent and population equivalent density in and around the river sites. This discrepancy in results is likely due to the storm drain input at Cut 1.

• Plastics found are likely **secondary** (derived of in-situ litter) rather than **primary** (from hygiene products, introduced via effluent). This also explains the higher number of plastics (especially fragments) found at the more urbanised Cut 1 site.

Sampling locations and method:

• 10 sites were chosen within the Thames Basin, ranging from highly urbanised 'dirty' areas with high effluent input to 'clean' rural areas with low effluent input.

• Focussed on 4 sites for initial analysis:
2 most polluted and **2 least polluted** of the ten, based on % effluent (based on models of flow and effluent input).

• 4 replicate sediment samples were collected at each site using a stainless steel scoop to fill a 1L glass jar approx. 1 m from the river bank and at 1 m intervals.

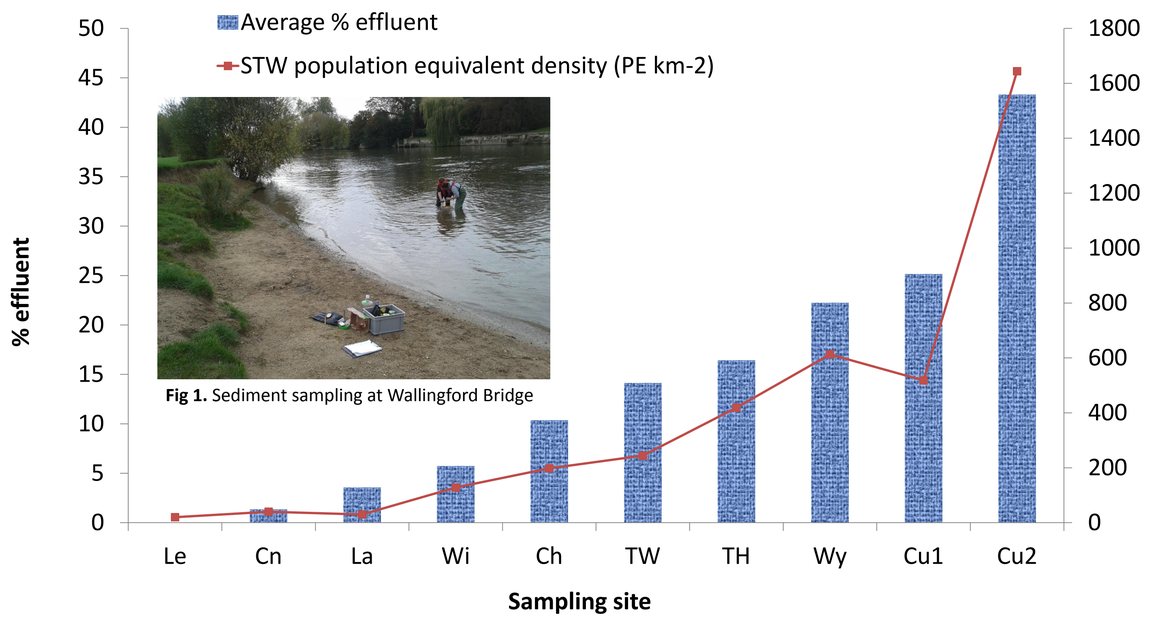


Fig 1. Sediment sampling at Wallingford Bridge

Fig. 2. Average % effluent and STW population equivalent density (PE km^{-2}) for each site. No data are available for average % effluent at the Leach as there are no significant upstream STWs. Effluent input at this site can therefore be considered to be negligible.

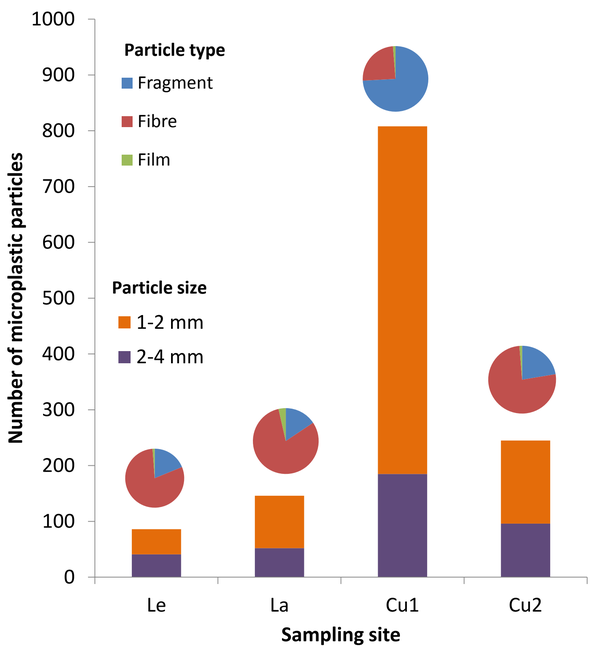


Fig. 5. The number of particles of each size fraction at each site (columns) and the corresponding proportions of different particle types found (pie charts).

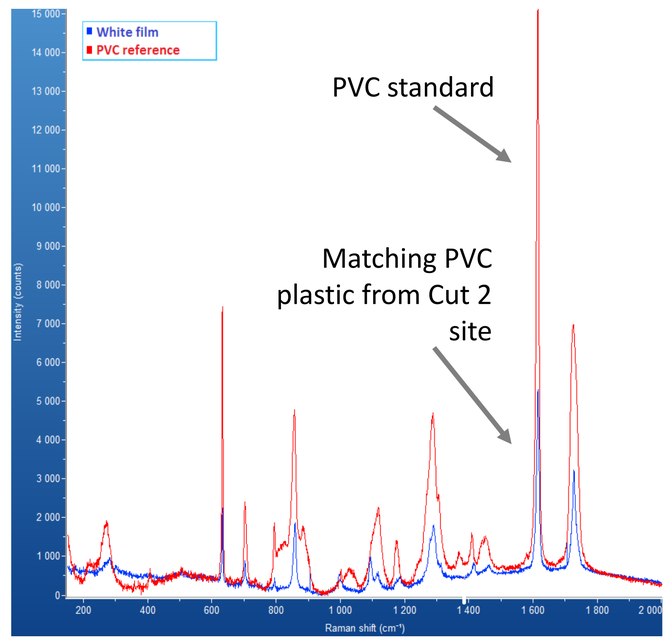


Fig. 6. Raman spectrum for a white film found at the Cut 2 site overlaid with a plastic reference spectrum for comparison.

Conclusions:

• Microplastics are found in all analysed sites of the Thames basin.

• Input of microplastics is via a combination of effluent, in-situ litter degradation and runoff.

Next steps:

• Analyse remaining 6 sites to confirm the pattern of polluted → non-polluted.

• Analysis of smaller size fractions to determine a relationship between these and the larger fractions.

•Analyse gut contents of local fish to observe ingestion.

References:
1. Wagner, M. et al. 2014. Microplastics in freshwater ecosystems: what we know and what we need to know. Environmental Sciences Europe, 26 (12).
2. Morritt, D., Stefanoudis, P.V., Pearce, D., Crimmen, O.A., Clark, P.F., 2014. Plastic in the Thames: a river runs through it. Marine Pollution Bulletin, 78, 196–200.

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