

Fredric Windsor BSc MSc MRSB
Postgraduate Researcher
Cardiff University

1. Thank you for the invitation to submit evidence to the ongoing inquiry into microplastics by the National Assembly's Climate Change, Environment and Rural Affairs Committee.
2. I am a postgraduate researcher at Cardiff University focusing on the transfers and effects of persistent pollutants, including (micro)plastics, in river systems.
3. As part of a collaboration between Cardiff University and the University of Exeter we have been investigating the interactions between aquatic organisms and microplastics in rivers across South Wales.
4. The following paragraphs address the four questions posed by the Committee.

To what extent are microplastics, including synthetic microfibers, a problem within Wales' aquatic environment? How does this impact on environmental and human health?

5. Data from the rest of the UK and other regions of the globe indicate that microplastics are potentially ubiquitous across aquatic ecosystems.
6. There remains relatively limited information about the distribution of microplastics in Wales' aquatic environment. Data collected in our recently published research suggests that microplastics are present across a range of river systems in South Wales (<https://www.sciencedirect.com/science/article/pii/S0048969718327669>). The data presented therein, however, are confined to predominantly urban river systems.
7. Our understanding of the environmental problems generated by microplastics is relatively rudimentary. Although a large body of laboratory-based evidence suggests potential negative effects, recent studies have indicated that perceived risk from plastic pollution may not represent the actual effects observed in natural systems (<https://pubs.acs.org/doi/abs/10.1021/acs.est.7b02219>). Further research is required to better understand the environmental effects of microplastics.
8. The effects of plastic on humans has received little attention. Indirect links between plastics and human health have been generated with plastic associated chemicals, such as phenols and phthalates, observed in humans. Questions, however, remain over the relative toxicity of these compounds to humans (<http://rstb.royalsocietypublishing.org/content/364/1526/2153.short>). Direct links between microplastics and human health are uncommon. Recent studies have shown that microplastics are present in both commercial bottled water (<https://www.sciencedirect.com/science/article/pii/S0043135417309272>) as well as tap water ([Helmholtz Centre for Polar and Marine Research](http://www.helmholtz-berlin.de/en/Research/Research%20Centres/Helmholtz%20Centre%20for%20Polar%20and%20Marine%20Research)), but associated health risks remain speculative.

What are the main sources of microplastic pollution, including microfibres?

9. There appear to be a wide range of microplastic pollution sources across the aquatic environments. Sources, identified across multiple studies in different regions of the world, include; wastewater treatment works, storm/road drains, combined sewage overflows, litter, degradation of larger macroplastics and reapplication of sewage sludge across agricultural areas. There are also a number of perceived/potential sources which have yet to be adequately investigated.
10. A comprehensive review of sources across aquatic systems is presented in a European Commission Report by ICF in association with Eunomia and partners (<http://www.eunomia.co.uk/reports-tools/investigating-options-for-reducing-releases-in-the-aquatic-environment-of-microplastics-emitted-by-products/>).
11. Within our study specific sources of microplastic pollution in river systems were difficult to identify. It was, however, observed that the levels of microplastic ingestion by several aquatic insects increased with increasing wastewater contributions. Nevertheless, the presence of microplastic within organisms across all sites indicates that a wide variety of sources are contributing to microplastic pollution observed in aquatic ecosystems.

How comprehensive is our knowledge about the scale of microplastic pollution and its effects? What should the research priorities be?

12. Our understanding of the distribution of plastic pollution is gradually increasing, with a growing body of research indicating the widespread nature of microplastic pollution. There remain, however, several large gaps in our knowledge. Two particularly important gaps are: (i) knowledge regarding microplastic pollution is dominated by research in marine ecosystems, with relatively few studies assessing freshwater or terrestrial habitats; and (ii) small particles (<20 µm), for example tyre dust, are below current detection limits of most analyses, so we have a poor understanding of both distribution and quantity of plastic particles of this size in the environment.
13. Knowledge regarding the effects of microplastic pollution is also limited and there is currently significant debate surrounding the difference between a range of 'perceived' or potential ecological effects and 'actual' effects from microplastic exposure (<https://pubs.acs.org/doi/abs/10.1021/acs.est.7b02219>). As eluded to previously, several of these perceived risks have been shown to less severe than expected in experimental investigations. Many other potential mechanistic effects, however, remain unexplored and subsequently our understanding of environmental effects is uncertain. Improving knowledge of the effects of microplastic pollution in natural systems is important.
14. A number of recent projects have been commissioned to assess plastic pollution in aquatic environments, including the "*Plastic Rivers: fate and transport of microplastics in rivers*" led by investigators at the University of Birmingham and funded by the Leverhulme Trust. Several other industry funded projects are also currently in operation. The data derived from these projects look to improve our understanding of plastic pollution in aquatic ecosystems.

What is currently being done to minimise the release of microplastics into the environment? What more can be done, and by whom, to address this issue within Wales?

15. The large number of potential sources of plastic pollution indicates that an integrated strategy is required to address the release of plastic into the environment across the entire life cycle of plastic.
16. It appears crucial to prevent the entrance of plastic into the environment, as remediation of existing plastic pollution is extremely difficult and expensive. A range of activities are currently aimed at minimising the entrance of microplastics into the environment. A few examples include; manufacturers promoting reduced washing of synthetic clothing (e.g. [Patagonia](#)) and developing alternative technologies for the reuse of plastics (e.g. [Thermal Compaction Group](#)), water companies working towards more effective methods of removing microplastics during wastewater treatment (e.g. Dwr Cymru Welsh Water) and volunteer groups removing litter from rivers and coastlines (e.g. [Thames21](#)).
17. Public engagement has been critical thus far, and appears particularly important in the future. Knowledge exchange partnerships, such as the UK Microplastics Network (<http://www.ukmicroplasticsnetwork.co.uk>) provide a platform through which stakeholders in plastic production and utilisation are able to interact. Interactions between stakeholders enables a range of activities that may lead to a reduction in plastic waste, including: behavioural change, identifying suitable alternatives for single-use plastics, improved removal of plastics from wastewater and changes to supply chain management.