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Analysis, prevalence and impact of microplastics in freshwater and estuarine environments: an evidence review

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We used the systematic review procedure to assess the evidence available on the analysis, prevalence and impact of microplastics in freshwater and estuarine environments. As the study of microplastics in freshwaters is relatively new, measurement methods are yet to be standardized, and a wide variety of methods of variable robustness have been used. Critically, the sampling methodology used in the literature had a systematic influence on the concentration of microplastic particles returned. The volume of water sampled varied over many orders of magnitude, and there was a direct relationship between the size of the smallest particles studied and the volume of water sampled in both freshwater and estuaries: large volumes of water can only be sampled using nets of relatively coarse mesh, which in turn do not capture smaller particles. Consequently, the mean abundance of microplastic particles reported was inversely correlated with both the volume of water sampled and the size of particles studied.

The size of microplastic particles had a substantial and overriding effect on threshold concentrations above which microplastics affect freshwater and estuarine biota. For the ecotoxicological endpoints of feeding, behaviour, growth and survival there was a clear relationship between the size of the particles used in the test and the threshold concentration at which an effect was seen. Although the taxonomic coverage of test organisms was limited, there were sufficient data to test the influence of taxonomic group used on size-specific thresholds for Crustacea, fish and algae. There was no significant effect of either the endpoint measured or the taxonomic group used, suggesting that there might not be any difference in sensitivity among different taxa.

In order to establish a threshold concentration where microplastics present a hazard to a limited number of taxa, quantile regression was used to determine the size-specific concentration of microplastics that was lower than 90% of the thresholds identified for survival and, as a more conservative limit, across all endpoints tested including sublethal effects. By comparing these thresholds with the data on concentrations of microplastics reported by field studies, it was apparent that the calculated size specific threshold concentration for lethal effects was considerably higher than 99% of reported environmental concentrations. Lethal effects of

microplastics on freshwater and estuarine biota are likely to be limited to exceptional circumstances. Over certain size ranges the calculated size specific threshold concentration for sublethal effects was exceeded by the highest 10% of concentrations reported from environmental samples, suggesting that there is a risk of sublethal effects in a small proportion of sites.