CSIRO PUBLISHING

SPECIAL ISSUE

Environ. Chem. **2015**, *12*, i–ii
http://dx.doi.org/10.1071/ENv12n5_FO

Foreword

Foreword to the Research Front on 'Microplastics in the Environment'

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Accumulation of plastic in the oceans is recognised as one of today's major pollution problems and has attracted extensive world-wide media attention.[1] Over the last decade, a significant proportion of the research effort devoted to the impact of the presence of plastics in the environment has focused on studying small plastic particles – so-called microplastics – mostly plastic pellets, fibres and fragments formed by macroplastic degradation. Research has mainly dealt with the presence of microplastics in surface waters, their role as carriers of micropollutants, either sorbed or originally present as additives in the plastics themselves, and their potential noxiousness to biota. Studies covering all these aspects are included in this Research Front, preceded by two methodology-orientated articles. They will hopefully make a significant contribution to progress in the field rather than merely adding to the many purely descriptive studies currently being published.

Some methodological issues that are rarely addressed in narrative-type reviews on microplastics are discussed by Filella in her review.[2] These include various issues ranging from the meaning of how size and number are measured to the difficulties involved in comparing results as they are commonly published or the possible bias introduced by the choice of study locations. Microplastic abundance is placed for the first time in the context of natural particles in the same size range, and comprehensive supplementary tables are also provided. There is an urgent need for methods that allow fast and reliable analysis of microplastics and avoid error-prone visual inspection. In this perspective, the focal planar array (FPA) detector-based micro-Fourier-transform infrared (FTIR) imaging technique developed by Löder et al.[3] is a significant step towards non-biased analysis of microplastics.

Most of the published studies on microplastics look at beaches, seashores and marine waters (see Supplementary material of Filella[2]), whereas little is known of soils,[4] and freshwater systems have also attracted scant attention. Helping to fill this knowledge gap, four articles in this Research Front deal with freshwater. Whereas Dris et al.[5] provide an overview of the situation, particularly emphasising the importance of methodological issues, two original research papers contribute new data: Faure et al.[6] extensively cover the presence of microplastics in six of the largest Swiss lakes and in some rivers, and Dris et al. investigate an urban area, greater Paris,[7] including potential sources of microplastics (i.e. wastewaters and atmospheric fallout). This is the first time that microplastics have been detected in atmospheric fallout, confirming their ubiquity in all environmental compartments.

Turner and Holmes[8] also turn their attention to freshwater as a medium where interactions of trace metals with microplastics might take place. Up to now, trace metal sorption on microplastics – which has in any case received much less attention than that of organic micropollutants – had been studied under seawater conditions. The results of Turner and Holmes show a worrying increase in the propensity of freshwater microplastics to sorb trace metals as compared to seawater microplastics. The universality of the widely observed presence of organic micropollutants in microplastics has been confirmed by Faure et al.[6] in Swiss surface freshwater and by Rios Mendoza and Jones[9] in microplastics from the North Pacific Gyre, a well known debris accumulation zone in the ocean. Interestingly, measured values for polymer–water distribution coefficients for HAPs are in-line with laboratory determined octanol–water partition coefficients which may support predictive approaches in microplastic research and help to clarify earlier, contradictory, observations.

The harmful effect of plastics on marine organisms is well documented and cases of seabirds, turtles or mammals receive intensive media coverage. Less spectacular, but probably more insidious, is the fact that, due to their small size, microplastics are readily ingested by marine organisms and accumulate in the food chain. The similar patterns of spatial distribution (i.e. more abundant in pelagic than in neritic areas) observed by Panti et al.[10] in a marine protected area in the Mediterranean Sea indicate the potential for microplastics to enter the food chain. The literature available also shows that plastics in the ocean host communities of microbes that have evolved to live on these supports (an ecosystem referred to as the 'plastisphere' by some authors[11]). These plastics drift world-wide, thus acting as potential vectors for harmful organisms. Oberbeckmann et al.[12] make the point on biofilm formation in the case of microplastics.

Although this Research Front might appear to be only a small drop in the flood of studies currently appearing in the field, I think that these articles, taken as a whole, make a clear contribution to a deeper understanding of the challenges that the presence of microplastics in the environment pose to us. I thank all the authors and anonymous referees for their valuable contributions.

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References

[1] F. Thevenon, C. Carroll, J. Sousa (Eds), *Plastic Debris in the Ocean: The Characterization of Marine Plastics and their Environmental Impacts, Situation Analysis Report* **2014** (IUCN: Gland, Switzerland). Available at https://portals.iucn.org/library/sites/library/files/documents/2014-067.pdf [Verified 24 September 2015].

[2] M. Filella, Questions of size and numbers in environmental research on microplastics: methodological and conceptual aspects. *Environ. Chem.* **2015**, *12*, 527. doi:10.1071/EN15012

[3] M. G. J. Löder, M. Kuczera, S. Mintenig, C. Lorenz, G. Gerdts, Focal plane array detector-based micro-Fourier-transform infrared imaging for the analysis of microplastics in environmental samicroplasticsles. *Environ. Chem.* **2015**, *12*, 563. doi:10.1071/EN14205

[4] M. C. Rillig, Microplastic in terrestrial ecosystems and the soil? *Environ. Sci. Technol.* **2012**, *46*, 6453. doi:10.1021/ES302011R

[5] R. Dris, H. Imhof, W. Sanchez, J. Gasperi, F. Galgani, B. Tassin, C. Laforsch, Beyond the ocean: contamination of freshwater ecosystems with (micro-)plastic particles. *Environ. Chem.* **2015**, *12*, 539. doi:10.1071/EN14172

[6] F. Faure, C. Demars, O. Wieser, M. Kunz, L. F. de Alencastro, Plastic pollution in Swiss surface waters: nature and concentrations, interaction with pollutants. *Environ. Chem.* **2015**, *12*, 582. doi:10.1071/EN14218

[7] R. Dris, J. Gasperi, V. Rocher, M. Saad, N. Renault, B. Tassin, Microplastic contamination in an urban area: a case study in Greater Paris. *Environ. Chem.* **2015**, *12*, 592. doi:10.1071/EN14167

[8] A. Turner, L. A. Holmes, Adsorption of trace metals by microplastic pellets in fresh water. *Environ. Chem.* **2015**, *12*, 600. doi:10.1071/EN14143

[9] L. M. Rios Mendoza, P. R. Jones, Characterisation of microplastics and toxic chemicals extracted from microplastic samicroplasticsles from the North Pacific Gyre. *Environ. Chem.* **2015**, *12*, 611. doi:10.1071/EN14236

[10] C. Panti, M. Giannetti, M. Baini, F. Rubegni, R. Minutoli, M. C. Fossi, Occurrence, relative abundance and spatial distribution of microplastics and zooplankton NW of Sardinia in the Pelagos Sanctuary Protected Area, Mediterranean Sea. *Environ. Chem.* **2015**, *12*, 618. doi:10.1071/EN14234

[11] E. R. Zettler, T. J. Mincer, L. A. Amral-Zettler, Life in 'Plastisphere': microbial communities on plastic marine debris. *Environ. Sci. Technol.* **2013**, *47*, 7137. doi:10.1021/ES401288X

[12] S. Oberbeckmann, M. G. J. Löder, M. Labrenz, Marine microplastic-associated biofilms – a review. *Environ. Chem.* **2015**, *12*, 551. doi:10.1071/EN15069