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EDITORIAL

Source, fate, and effects of plastic litters in the European land-sea continuum

Jean François Ghiglione[1] **· Alexandra ter Halle**[2]

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Bend down on a coastal beach or a riverbank and you will inevitably spot them. A quick look into a gutter and there they are. Drag a plankton net into a lake, river, or ocean, and you will easily collect them. Plastic debris is everywhere. It knows no borders, transferring the thousands of chemicals that compose it—or attach themselves to its surface—from one ecosystem to another, along with the microorganisms (including pathogens) that colonize it.

By dedicating this special issue of *Environmental Science and Pollution Research* (ESPR) to the source, fate, and effects of plastic litters in the European land-sea continuum, we aimed to bring together scientists from different fields of expertise to improve our understanding of plastic pollution across ecosystem boundaries. Most of them took part in the Mission *Tara Microplastics* conducted over 7 months to investigate plastic pollution across nine major European rivers. They discovered that the median concentration of large microplastics (LMPs, 500 µm–5 mm)—the most studied size fraction to date—was lower in European rivers than in other global regions, while small microplastics (SMPs, 25–500 µm) were found to dominate in mass, with SMP/LMP ratios reaching up to 1000:1 in some rivers. Results were also coming from other field campaigns, including a comparison between the two most plastic-polluted zones of the world ocean (*Tara Mediterranean* and *Tara Pacific*). The use of a 3D Lagrangian simulation of the dispersion of riverine microplastics into the Mediterranean Sea indicated that 65% of river inputs consist of floating microplastics drifting in the surface layer and 35% of dense MPs sinking to deeper layers, with further dispersion at sea driven by mesoscale and sub-mesoscale structures.

A citizen science initiative with schoolchildren *Plastique à la loupe* was also introduced, which compared for the first time the distribution of different litter sizes (macrolitter and meso- and microplastics) over a large set of riverbanks and coastal beaches sampled in France. Special emphasis was also given to the mismanaged litters in French urban areas, with articles depicting their composition, spatiotemporal variations, sources, and transport dynamics in cities of all sizes. An example of the physiological impact of microplastics was given by exposing beached plastic pellets to mussels, key intertidal bioengineers, and filter-feeders that are particularly susceptible to both plastic ingestion and release of potentially toxic mixtures of intrinsic and extrinsic chemical compounds. Finally, a pan-European study of the bacterial plastisphere revealed for the first time the presence of a virulent human pathogenic bacterium (*Shewanella putrefaciens*) detected on microplastics in a river. A clear distinction between plastisphere metabolomes and diversity from freshwater and marine water was found in most of the river-to-sea continuum, helping to mitigate the risk of pathogens transfer between freshwater and marine systems. With the United Nations global plastic treaty on the horizon, this special issue emphasizes the need to unite interdisciplinary expertise to deepen our understanding of plastic pollution and to conduct reliable ecological risk assessments across ecosystem boundaries.

Declarations

Competing interests The authors declare no competing interests.

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✉ Jean François Ghiglione
ghiglione@obs-banyuls.fr

[1] CNRS, Sorbonne Université, Laboratoire d'Océanographie Microbienne (LOMIC)/UMR 7621, Observatoire Océanologique de Banyuls, Banyuls sur mer, France

[2] Laboratoire Softmat, Université de Toulouse, CNRS UMR 5623, Université Toulouse III – Paul Sabatier, Toulouse, France

Dr. Jean-Françoıs Ghiglione Dr. Jean-Françoıs Ghiglione is the director of research at the CNRS, specializing in microbial ecotoxicology at the Laboratory of Microbial Oceanography (LOMIC, UMR7621, France), leading the research team *Marine Microbial Ecotoxicology*. His current researches focus on the quantification, microbial colonization, biodegradation, and toxicity of plastic litters in aquatic environments (see Publication list). He was the scientific coordinator of the Mission *Tara* Microplastics. After being a member of the Scientific Council of CNRS-INSU, he is currently a member of the Scientific Council of IFREMER and he is also the French representative in the International Arctic Council for marine litters. He is a cofounder of the start-up PlasticAtSea, a cofounder of the international network EcotoxicoMic (https://ecotoxicomic.org), a cofounder of the French research group Polymers and Oceans (https://www.gdr-po.cnrs.fr), and part of the Scientific coalition for an effective UN Plastics treaty (https://ikhapp.org/scientistscoalition/).

Dr. Alexandra ter Halle Dr. Alexandra ter Halle is director of research at the CNRS, specializing in analytical chemistry at the Laboratory Softmat (Softmat laboratory UMR5623, France). Her current research focuses on understanding the fate and behavior of micro and nanoplastics in the environment in order to ultimately prevent this pollution. She is the scientific coordinator of the French NGO Expedition 7ème Continent (Expéditions Septième continent). She is a cofounder of the French research group Polymers and Oceans (https://www.gdr-po.cnrs.fr) and a part of the Scientific coalition for an effective UN Plastics treaty (https://ikhapp.org/scientistscoalition/).