10 FACTS
on microplastics and nanoplastics in estuarine environments

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Estuaries are the main gateway for plastic pollution to enter the ocean.

Estuaries, where rivers meet the sea, are major carriers of microplastics.

As one of the most productive natural habitats in the world, this poses a serious threat to aquatic species and possibly human health.

Here are 10 facts on the role of river and estuarine systems in ocean plastic pollution and its potential impacts.

1

Estuarine systems are major microplastic accumulation hotspots.

Microplastics are retained in the sediments and the accumulated amount mimics the global plastic production during the last several decades. Since 2000, the plastic particles deposited on the seafloor has tripled. The buried microplastics once trapped in the seafloor do not degrade, either due to lack of erosion, oxygen, or light. Therefore, plastics from the 1960s remain on the seabed, leaving the signature of human pollution.

2

Microplastic pollution is ubiquitous in estuaries and adjacent coastal areas.

The contamination is present in a variety of climatic (tropical, temperate and Mediterranean) and tidal (few cm to 4 m tidal range) regimes. Microplastic abundances may vary from one estuary to another, but they are consistently more abundant near the mouth of the river.

3

The concentration of microplastics in estuaries is driven by urban development.

The concentration of microplastics is especially high near urban centers along rivers and wastewater treatment plant outflows. The latter are the main source of microfiber pollution, the type of microlitter more commonly found in estuaries.

4

The distribution of microplastics in estuaries depends on local hydrodynamics.

The dynamics of estuarine waters are mainly controlled by river freshwater outflow, coastal currents, waves and tides. In tide-dominated estuaries, microplastic concentration increases during rising tide. Where tides are less than two meters of tidal range, the lower the flow of the river, the higher the concentration. In estuaries where marine and fresh waters are well mixed, microplastic concentration depends on the turbulence with higher concentrations below the surface.

5

Ocean currents, tides and waves can transport microplastics hundreds of kilometres away from estuaries into the ocean in a matter of months.

Computer simulations show that estuaries are the major pathways for microplastic pollution to enter the sea and ocean. A microplastic particle from the Ebro estuary in the Northwestern Mediterranean Sea can reach Sicily in six months. However, computer simulations are still limited regarding how microplastics move vertically in the water column. Dispersion simulations need in situ information about microplastics to properly address vertical motion in the water column.

6

All aquatic species in and adjacent to estuarine environments are contaminated with microplastics to some degree.

Filter feeders such as bivalves are amongst the most exposed marine organisms (53% of oysters and 85% of mussels had ingested microplastics). Estuarine-dependent marine fishes (white mullet, silver mojarra and Brazilian mojarra) were also exposed (75% of the specimens analysed had ingested microplastics). In coastal areas influenced by the estuarine outflow, 86% of European hake and 85% of Norwegian lobster contained microplastics and/or synthetic microfibers in their gut.

7 Microplastics pose a threat to coral reef systems.

Microplastic pollution can cause a reduction in coral growth, a substantial decrease of detoxifying and immunity enzymes, an increase in antioxidant enzyme activity, high production of mucus, reduction of fitness, and negative effects on their symbionts. Microplastics may cause impacts on corals in shallow, mesophotic, and deep-sea zones at different latitudes, underlining an emerging global threat.

8 Filter feeders can efficiently remove microplastics from seawater.

Bioremediation is one of the few options available to reduce microplastic pollution that is already present in coastal marine environments. In laboratory experiments, different species of filter-feeder communities removed almost 90% of the microplastic from surrounding waters. The contamination can even be incorporated by *Sabella spallanzianii* (polychaete worm).

9 Low-density polyethylene (LDPE) is one of the most common types of microplastic found in estuaries and the marine environment.

Microplastics and nanoplastics are mostly formed by the fragmentation of larger plastic items. Polyethylene, one of the most common plastic polymers produced, is more susceptible to surface oxidation, the first step in the fragmentation process. Investigating these processes under different environmental conditions is of paramount importance because they can suggest the types of synthetic polymers that are less prone to fragment into microplastics.

10 Nanoplastic pollution represents a serious risk for aquatic organisms.

Nanoplastic (<0.001 mm) particles are likely more abundant than microplastic particles, but are difficult to monitor due to technical limitations. Nanoplastics between 20 and 200 nanometres (0.00002-0.0002 mm) were the most abundant fraction detected in seawater and mussels. It represents a risk for aquatic organisms as they can pass through the cellular membrane, potentially harming species living in estuarine and marine environments. The type of polymers detected in nanoplastics mimics the type of polymers found in microplastics.

Photo: Sabella spallanzianii (polychaete worm)

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This fact sheet was compiled as part of the JPI Oceans i-plastic project (Dispersion and impacts of micro- and nano-plastics in the tropical and temperate oceans: from regional land-ocean interface to the open ocean). It is intended to aid scientists, science communicators, and science policy advisors.

The i-plastic project is a collaboration between five institutions from four countries.

For further information please check:

https://i-plastic.net/
https://jpi-oceans.eu/ecological-aspects-microplastics

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