Microplastics have lethal and sublethal effects on stream invertebrates and affect stream ecosystem functioning

López-Rojo N.

Pérez J.

Alonso A.

Correa-Araneda F.

Boyero L.

Microplastics (MPs) are contaminants of increasing concern due to their abundance, ubiquity and persistence over time. However, knowledge about MP distribution in fresh waters and their effects on freshwater organisms is still scarce, and there is virtually no information about their potential influence on ecosystem functioning. We used a microcosm experiment to examine the effects of MPs (fluorescent, 10-?m polystyrene microspheres) at different concentrations (from 0 to 103 particles mL?1) on leaf litter decomposition (a key process in stream ecosystems) and associated organisms (the caddisfly detritivore Sericostoma pyrenaicum), and the extent to which MPs were attached to leaf litter and ingested and egested by detritivores, thus assessing mechanisms of MP trophic transfer. We found that MPs caused detritivore mortality (which increased 9-fold at the highest concentration) but did not affect their growth. Analysis of fluorescence in samples suggested that MPs were rapidly ingested (most likely through ingestion of particles attached to leaf litter) and egested. Leaf litter decomposition was reduced as a result of increasing MP concentrations; the relationship was significant only in the presence of detritivores, but microbially-mediated decomposition showed a similar trend. Our findings provide novel evidence of harmful effects of MPs on aquatic insects and stream ecosystem functioning, and highlight the need for the standardization of methods in future experiments with MPs in order to allow comparisons and generalizations.

Detritivores

Ecotoxicity

Freshwater ecosystems

Litter decomposition

Plastic

Fluorescence

Microplastic

Plastics

Polystyrenes

Stream flow

Water

Detritivores

Ecosystem functioning

Ecotoxicity

Freshwater ecosystem

Leaf litter decomposition

Litter decomposition

Microcosm experiments

Polystyrene micro-sphere

Aquatic ecosystems

microsphere

polystyrene

concentration (composition)

decomposition

detritivory

ecosystem function

ecotoxicology

freshwater ecosystem

invertebrate

litter

plastic

sublethal effect

aquatic invertebrate

Article

controlled study

detritivore

ingestion

leaf litter

lethality

litter decomposition

microcosm

mortality rate

nonhuman

particle size

plastic waste

river ecosystem

stream (river)

Trichoptera

water pollution

animal

chemistry

drug effect

ecosystem

insect

plant leaf

river

toxicity

Hexapoda

Invertebrata

Sericostoma pyrenaicum

Trichoptera

Animals

Ecosystem

Insecta

Microplastics

Plant Leaves

Rivers