In-depth characterization revealed polymer type and chemical content specific effects of microplastic on Dreissena bugensis

Julian Brehm*[1], Magdalena V. Wilde , Lukas Reiche , Lisa-Cathrin Leitner , Benedict Petran , Marcel Meinhart , Simon Wieland , Sven Ritschar[2], Matthias Schott , Jan-Pascal Boos , Sven Frei[3], Holger Kress , Jürgen Senker[4], Andreas Greiner , Thomas Fröhlich , and Christian Laforsch†[5]

[1]University of Bayreuth, Animal Ecology 1 – Universitätsstraße 30, 95447 Bayreuth, Germany
[2]Chair of Animal Ecology I – Universitätsstraße 30, 95447 Bayreuth, Germany
[3]Department of Hydrology – Universitätsstr. 30 95447 Bayreuth, Germany
[4]Inorganic Chemistry and Northern Bavarian NMR Centre, University of Bayreuth – Universitätsstraße 30, 95447 Bayreuth, Germany
[5]University of Bayreuth – Universitätsstraße 30, 95447 Bayreuth, Germany

Abstract

Microplastic particles (MPs) are a major threat to ecosystems worldwide, resulting in a great need to investigate their impacts on ecosystems. To date, most studies dealing with the effects of MPs on organisms used commercially available polystyrene spherical particles, with no to little characterization of their physicochemical properties. However, MPs occurring in the environments are a composition of various polymer types with different properties. Therefore, it is hard to tell how and if the polymer type and its associated properties determine their impact on organisms. Here we show how different polymer types of MPs in the same shape, concentration, and size range (20-120μm) affect the freshwater mussel *Dreissena bugensis* in comparison to mussel shell fragments as natural particle control. By using hall sensor-based real-time valvometry, we studied behavioural responses via the movement of the mussels' valves and show that mussels cannot distinguish between natural particles and MPs. Furthermore, we performed an in-depth characterization of the used MPs. Different types and quantities of additives and residual monomers were found in the different polymer types, which can be linked to polymer type-dependent adverse effects on the molecular level. Recycled PET elicited the most substantial adverse effects on *D. bugensis*, likely caused by anthranilamide, anthranilonitrile and butylated hydroxytoluene within the MP fragments, which have been described as toxic to aquatic organisms. Since PET is among the most abundant MPs found in nature, sublethal effects may gradually manifest at the population level, leading to irreversible ecosystem changes. In summary, adverse effects in organisms caused by MPs are dependent on specific physical and chemical properties of the particles.

Keywords: real, time valvometry, filter feeders, proteomics, PET, drinking bottles

*Speaker
†Corresponding author: Christian.Laforsch@uni-bayreuth.de