Ecotoxicity Of Xxxxx To Freshwater Xxxxx. By xxx xxxxxx, PhD

1. Introduction

Europe contributed 57.8 of the 370 million tons of plastics produced worldwide in 2019. Global primary plastic production saw a sharp decrease from an expected 420 million in 2020 due to COVID-19 (Plastics Europe 2020). However, an average of 33% of the plastics produced in Europe is likely to end up in a landfill, rivers, and the ocean even after the introduction of the best management options (Lau et al., 2020). The ideal solution to the global plastics crisis would be to produce less plastic and to recycle it better; or at least prevent it from reaching aquatic ecosystems by establishing stronger environmental legislation and producer/consumer responsibilities (Blettel and Wantzen, 2019; Whitehead et al., 2021). The pollution of freshwater lentic and lotic ecosystems with plastic is evident and a systematic clean-up of river ecosystems is urgently needed. Naquash (et al.) (2020) provides a comprehensive review on MPs abundance on surface water and sediments globally illustrating MPs global impact. Understanding the pathways from source to rivers and the fate of aquatic microplastics (MPs) is paramount in assessing the ecological impact on freshwater biota and evaluating the effectiveness of environmental regulation and legislation (Whitehead et al., 2021). Microplastics (size ≤5 mm) are ubiquitous in water, soil, and air and available to a wide range of organisms (Brahney et al., 2020). Sewage effluent and urban drainage systems are the main source of river and stream MPs pollution (Wu et al., 2019); in arable/agricultural regions MPs enter water bodies from runoff using similar pathways to pesticides and fertilizers (Müller et al., 2020; Waldschläger et al., 2020; Zhang and Chen, 2020); or MPs may emanate from a landfill or from the breakdown of in situ litter in rivers (Horton et al., 2017), illustrated by the prevalence (70 ± 19%) of water samples with acrylates/polyurethane/varnish (APV) antifouling paint from the River Rhine (Mani et al. 2019). Hydrodynamic processes inherent to lentic and lotic water bodies as well as seasonal climatological conditions will affect MPs sinking and resuspension rates into and from sediment (Rodrigues et al., 2018; Dahms et al., 2020; Zhang and Chen, 2020), ultimately determining concentrations in, and bioavailability to, planktonic and benthic freshwater organisms and further adding to the complexity of understanding their impact on freshwater biota. For example, in an urban stream in Braamfontein Spruit, Johannesburg, Africa mean MPs abundance of 705 items m-3 was recorded in water samples, 166.8 kg-1 d/w in sediment, while 53.4 MPs g -1 w/w was found in Chironomus sp. larvae sampled from the sediment highlighting the relationship between benthic organisms and ingestion of settled MPs (Dahms et al., 2020).

Rodrigues et al. (2018) reported MPs seasonal variations from the Antuã River, Portugal, where the range of abundance in water was 58–193 items m-3 in March to 71–1265 items m-3 in October; while in sediment, the abundance ranged from 13.5–52.7 mg kg-1 in March to 2.6–71.4 mg kg-1 in October. Triebskorn et al. (2019) summarize their findings on MPs concentrations from effluents, surface water and sediments, varying with the type of waterbody (river or lake), size and closeness to urban areas, and population density. For MPs >300 µm concentrations range from 0.012 to 0.027 MPs m-3 for Lake Khovsgo, Mongolia and Laurentian Great Lakes, Canada-USA border; compared to urban lake Hanging Hangian and Wuhan rivers in China for MPs >50 µm with a range of 1,660-8,925 MPs m-3 ; and for canals in Amsterdam huge concentrations of 48,000-187,00 MPs m-3 were found for MPs size >10µm.

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