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Microplastic Accumulation in Two Invasive Mussel Species from Chepintsi Sand-Pit Lake, Bulgaria

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Abstract. This study aimed to assess the quantity and diversity of microplastics (MPs) accumulated in two invasive freshwater mussels: the Asian clam (*Corbicula fluminea* Müller, 1774) and the zebra mussel (*Dreissena polymorpha* Pallas, 1771). Artificial lakes near large urban areas often support multiple human activities and are exposed to considerable anthropogenic pollution. For this reason, mussel samples were collected from the Chepintsi sand-pit lake near Sofia, Bulgaria. Sampling was conducted in the spring using a hand dredge (front edge, 17.5 cm; total length, 190 cm). The analysis detected microplastic particles - mainly fibers and fragments of different colors and sizes - in almost all specimens. Fragments were the most common type, and colorless particles were the dominant color category.

Key words: freshwater mussels, microplastics.

Introduction

Plastic is one of the most widespread synthetic polymers in the environment, contributing to significant pollution and ecological impacts. Once released, it undergoes fragmentation through chemical, physical, and biological processes, forming microplastics (MPs) smaller than 5 mm. Numerous studies identify wastewater treatment plants, industrial effluents, surface runoff, atmospheric transport, and the breakdown of macroplastics as major MP sources (Reza *et al.* 2024). After entering different lentic water ecosystems, MPs and their degradation products are ingested by a wide range of organisms, from invertebrates to fish (Jin-Feng *et al.* 2018), potentially causing reproductive abnormalities, reduced feeding, starvation, digestive impairment, bioaccumulation, and other adverse effects (Vaid *et al.* 2021).

Bivalves are considered valuable sentinel organisms for monitoring environmental pollution, as they can concentrate contaminants well above ambient levels (Su et al. 2016). In recent years, research on microplastic accumulation in the freshwater invasive mussels Asian clam and zebra mussel has increased significantly (Pastorino *et al.* 2021; Gedik & Atasaral 2022; Atamanalp *et al.* 2023; Vidal *et al.* 2023; Hongyu *et al.* 2024; Giarratano *et al.* 2024).

The present study aimed to examine microplastic accumulation in Asian clam (*Corbicula fluminea* Müller, 1774) and zebra mussel (*Dreissena polymorpha* Pallas, 1771) collected from the Chepintsi sand-pit lake.

Material and Methods

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Samples of Asian clam and zebra mussel were collected with a hand bottom drag with an entrance of 17.5 cm, a fine scraping edge, and a total length of 1.90m from the littoral zone of sand pit Lake Chepintsi. The Lake is an active sand and gravel quarry. The sampling point has geographic coordinates - 42°749942 N; 23°427704 E. The collected mussels were wrapped in aluminum foil and stored at –20°C until the laboratory analysis. Under laboratory conditions, the mussels were thawed at room temperature. Twenty individuals from each species were used for the study. All the mussels, as well as the glassware and instruments used, were thoroughly rinsed with Milli-Q water to prevent additional contamination from the external environment. The soft tissues were digested with 10% KOH as pooled samples of two or three individuals in a thermostat at 60° °C for 24 hours. The digested material was filtered using a glass-vacuum filtration system through glass-fiber filters (Whatman, 1 µm/Ø 47 mm). The filters were examined under a stereomicroscope (Leica S APO, Germany). During the experiment, control samples were taken for the air, pure Milli-Q water, and 10% KOH solution. Data are presented as mean values ± standard deviation per individual, with an additional mean value per gram of wet weight reported. The Asian clam showed a mean shell length of 15.61 mm and a mean wet weight of 2.36 g, and the zebra mussel - 12.48 mm and 0.24 g.

Results and Discussion

Microplastics (MPs) were detected in all examined specimens. In Asian clam, the mean abundance was 1.14 ± 1.20 particles per individual (2.6 particles/g wet weight), while zebra mussel contained 0.71 ± 0.49 particles per individual. These values are comparable to previously published data: Su *et al.* (2016) reported 2.5 particles/g wet weight, and Giarratano *et al.* (2024) found 0.07–1.27 MPs per individual and 0.2–2.9 particles/g in Asian clam. For zebra mussel Gedik & Atasaral (2022) reported 0.16–1 particles per individual.

The detected MPs were classified into fragments and fibers, with fragments predominating (Fig. 1). Zebra mussel accumulated a higher proportion of fibers (29%) than Asian clam (10%). Fiber lengths in zebra mussel ranged from 0.154 to 5.623 mm, consistent with values from nearby Lake Kazichene (Hongyu *et al.* 2024). Pastorino *et al.* (2021) isolated particles >149 µm, while Atamanalp *et al.* (2023) reported sizes of 1000–2000 µm. The fragments were mainly transparent, hard, and irregular, whereas fibers varied in length and thickness. Colorless MPs were dominant (71%), with blue, white, yellow-green, and yellow (Fig. 2). Reported dominant colors in other studies vary: white/colorless (Su *et al.* 2016), blue (Vidal *et al.* 2023), and black (Hongyu *et al.* 2024; Gedik & Atasaral 2022; Atamanalp *et al.* 2023).

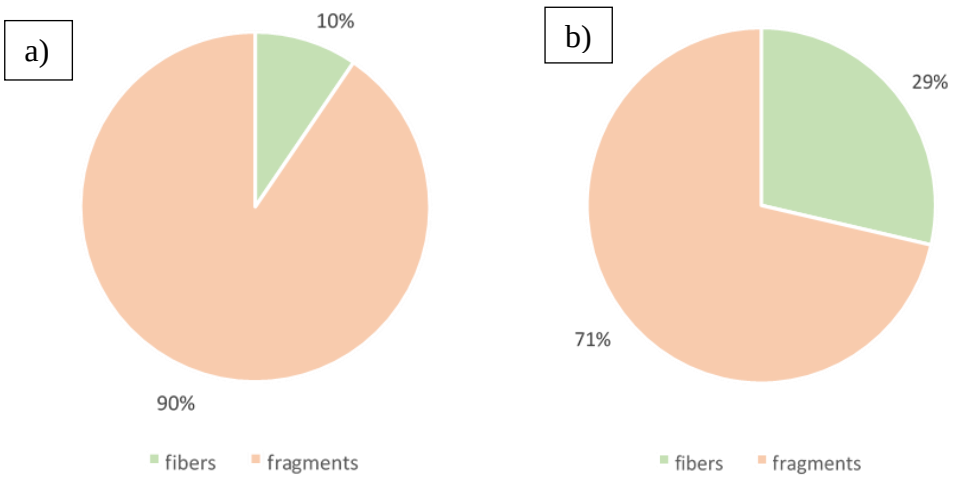

Fig. 1. Shape distribution of MPs in a) Asian clam and b) zebra mussel samples from Lake Chepintsi.

In Asian clam, fiber lengths ranged from 0.153 to 1.623 mm, similar to the values reported by Su *et al.* (2016). Vidal *et al.* (2023) reported 0.1–0.5 mm, while Giarratano *et al.* (2024) documented a broader range (42–1917 μm), exceeding the ones we observed in the present study.

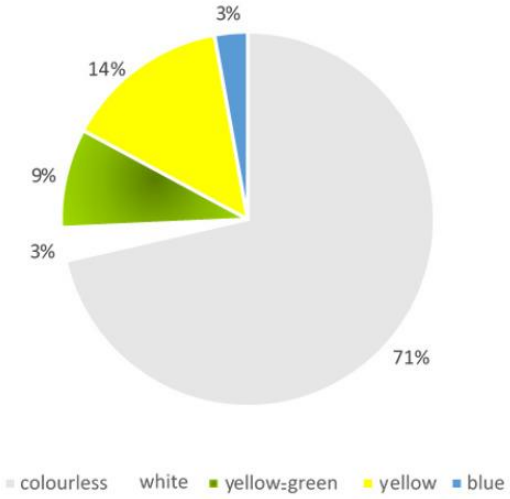

Fig. 2. Percentage distribution of microplastic colors in the samples of Asian clam and zebra mussel from Lake Chepintsi.

The accumulation of microplastics in both mussel species from Lake Chepintsi indicates contamination of the ecosystem. Asian clam is a burrowing filter-feeder, while zebra mussel inhabits the surface of the bottom (up to ~20 m depths). This indicates microplastics presence in different layers and substrates of the littoral zone.

Conclusions

Given these findings, both invasive mussel species demonstrate potential as complementary bioindicators for the assessment of microplastic contamination in freshwater environments. Further investigations - encompassing seasonal sampling regimes, advanced polymer characterization, and expanded spatial coverage - are required to resolve the sources, temporal dynamics, and ecological ramifications of MPs in intensively exploited artificial water bodies such as Lake Chepintsi.

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