Microfiber pollution in surface and subterranean aquatic environments: investigations in the Classical Karst Region

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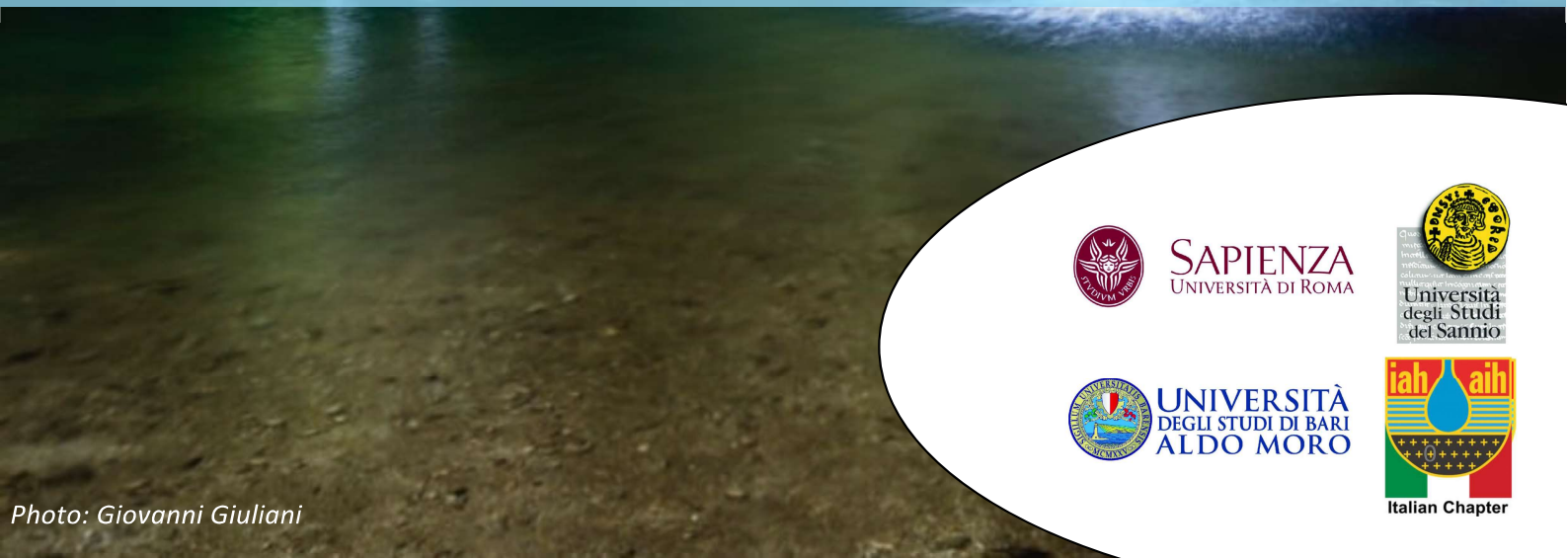

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Microfiber pollution in surface and subterranean aquatic environments: investigations in the Classical Karst Region

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Abstract

Anthropogenic (natural, man-made cellulosic and synthetic) microfiber pollution in karst and subterranean areas is still poorly studied. The Classical Karst Region is a rocky limestone plateau stretching from the NE Italy and the SW Slovenia, rich in protected habitats and species, including different stygobionts, such as the *Proteus anguinus*. To preserve these ecological heritages, different European, national and local laws are present. However, regulations often do not take account of the ecological connections between different habitats. In this preliminary study we collected and investigated several water and submerged sediment samples in surface (springs) and subterranean (caves) aquatic environments of the Italian sector of the Classical Karst Region.

Water and submerged sediment samples were analysed according to the methods described in Balestra et al. (2023) and Balestra & Bellopede (2023). All samples were pre-treated through the application of 30% HO for organic matter removal. Detected microfibres (5-0.1 mm) were counted and characterized by size and color via visual identification under a microscope, with and without UV light, exploiting fluorescence given by additives added in many materials. Spectroscopic analyses were carried out on different microfibres to determine materials typology.

Anthropogenic microfibres were found in all examined water and submered sediment samples with high amounts, especially in sediments, highlighting a possibile accumulation of pollutants over time. Only 10-15% of microfibres were syntetics; most of the analysed fibres were cotton. Most microfibres were smaller than 1 mm and abundances increased with the decrease of the considered size. Most of the microfibres were fluorescent under UV light ($> 80\%$) and have especially blue fluorescence. Fluorescent microfibres were mainly transparent, and non-fluorescent ones were especially black, blue and grey.

Anthropogenic microfibres could threat ecosystems and contaminate water resources. Vulnerable and stygobitic species hosted in these habitats could consume or assimilate microfibers, therefore, potentially negative consequences for subterranean water safety at all the levels, such as ecological functionality, biodiversity distribution, ecosystem services and human

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health should be investigated too.
Our results show the presence of anthropogenic microfibres in all examined aquatic habitats, improving knowledge in micro pollutants water contamination, and providing essential information for future research. Analyses on a greater number of aquatic surface and subterranean habitats should be done to better understand this kind of problem. Microfibre pollution monitoring in karst areas must become a priority for habitat conservation, species protection and water resources management, improving analyses on a larger number of aquatic surface and subterranean environments, and taking into account the ecological connections between different habitats.

Keywords: microplastics, microfibers, karst aquatic environments, caves, springs