Multiple Drivers of the Spatial Heterogeneity of Microplastics in Dam-Influenced Freshwater Systems

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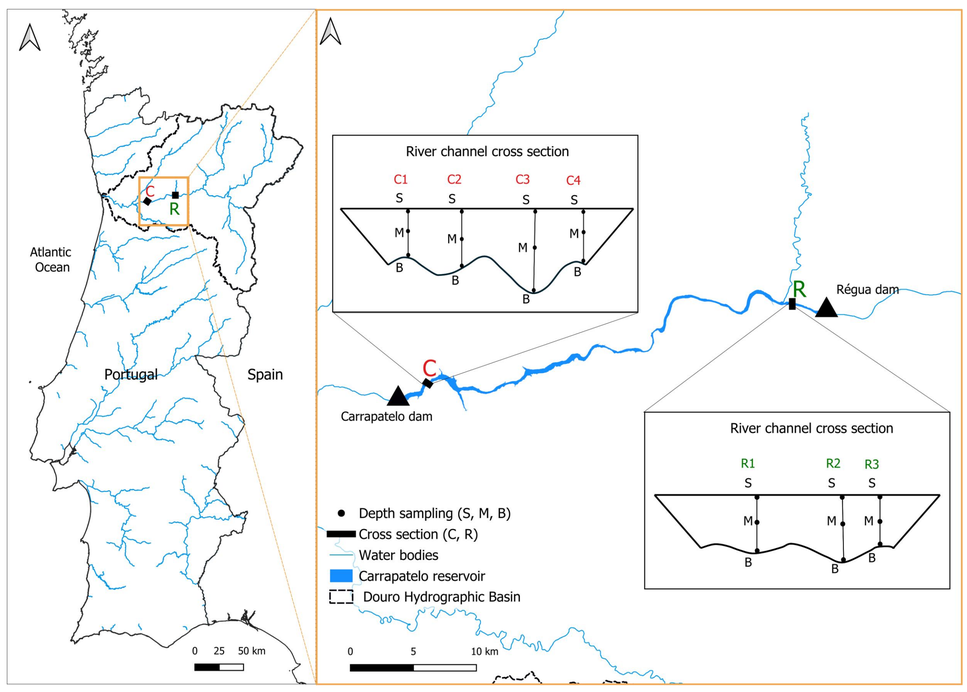
INTRODUCTION

- **Reservoirs** are crucial freshwater systems that provide ecological and socio-economic services, among them water for human consumption;
- **Microplastics (MPs)** are **emerging contaminants** with ecological and potential human health impacts that have been found in Portuguese and worldwide reservoirs[1,2];
- The occurrence and spatial distribution of MPs in an ecosystem are influenced by surrounding **anthropogenic sources** and by their interaction with hydrodynamic processes (e.g., **flow conditions**)[1,3].

AIM

Assess the occurrence and spatial distribution (vertical and lateral) of MPs in two reservoir sections between the Portuguese dams of Régua and Carrapatelo.

METHOD



Characterization of the **surrounding landscape** (area draining directly to the Carrapatelo reservoir):

- Land use and Land Cover Map (COS 2018 v.2 l.1)
- **Anthropogenic pressures** (3rd planning cycle of the Hydrographic Region Management Plans (PGRH,2022-2027)

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Recording of water **flow velocities**

+

Collection of water samples at two sections of **Carrapatelo reservoir** (**C**, **R**), in Winter

Vertical distribution of MPs

Surface samples (**S**)

Middle samples (**M**)

Bottom samples (**B**)

Lateral distribution of MPs

Riverbank samples (**C1**, **C4**, **R1**, **R3**)

Center samples (**C2**, **C3**, **R2**)

Filtration of water samples

MPs evaluation:

- Typology
- Colour
- Size category

Data Analysis

RESULTS & DISCUSSION

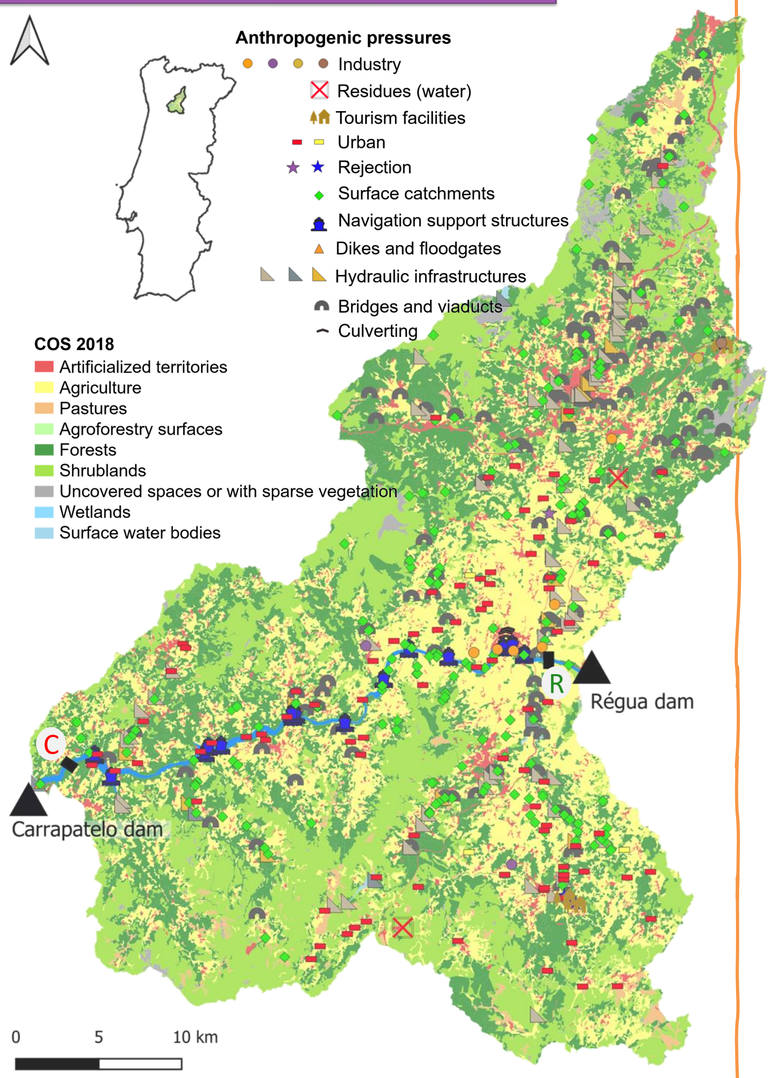
Characterization of the study area

Predominance of **forests (31%)**, **shrubland (28%)**, and areas dedicated to **agriculture (31%)**, especially closer to the reservoir. Agricultural practices are strongly related to the presence of MPs in water bodies[4].

Higher number of pressures (n=557), namely **surface catchments** for diverse uses and the presence of **man-made structures**, for hydraulic or transport purposes.

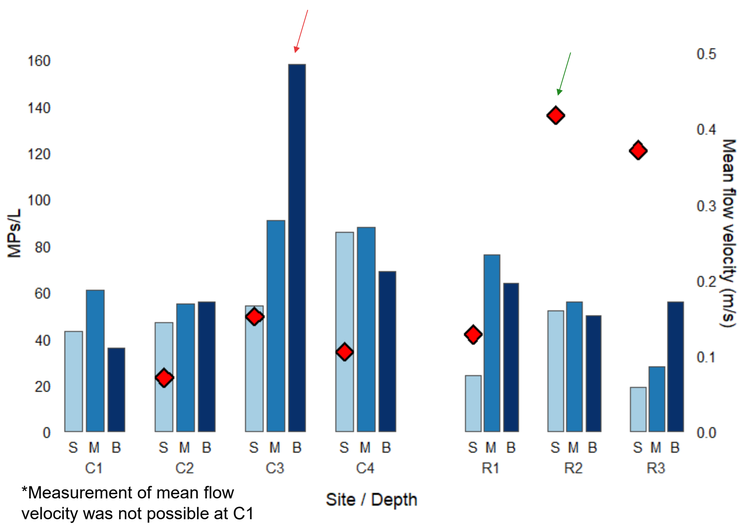
High number of **WWTPs discharges** (n=93), commonly related to elevated abundances of MPs, especially fibres[1].

Presence of **navigation support structures** and **strong tourism** in the region, also related to high abundances of MPs in the aquatic environment[5].



MP abundance

Highest value at **C3-B** (158 MPs/L), at the deepest sampling depth (50 m);



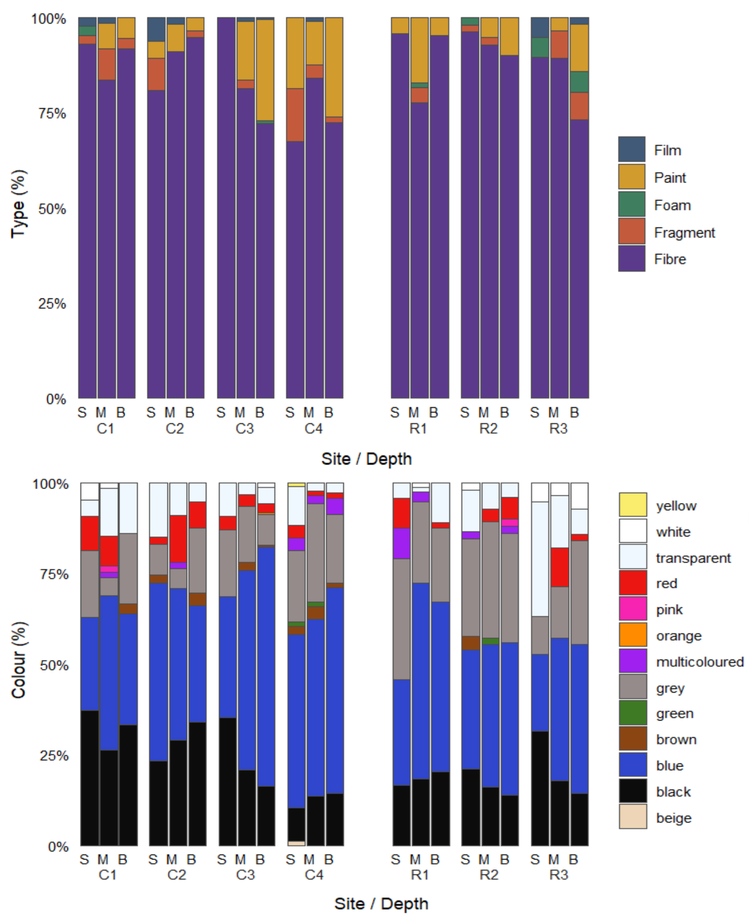
*Measurement of mean flow velocity was not possible at C1

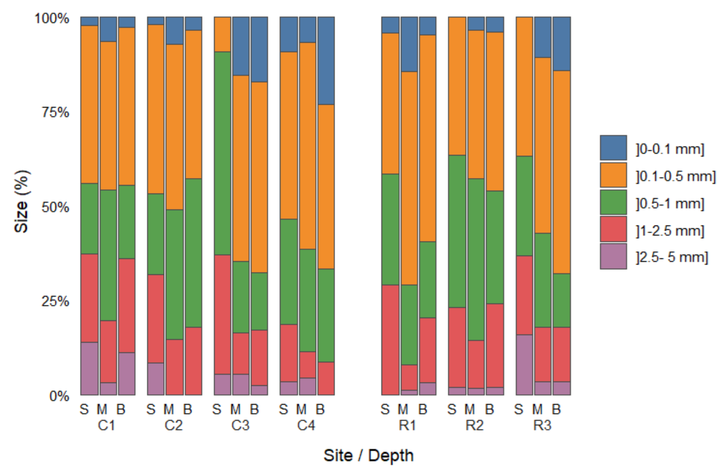
Lateral distribution: **higher riverbank-center variability** at **C** samples *vs* more uniform lateral distribution at R samples;

Vertical distribution: generally, **higher MPs abundances** at **greater depths** (M or B samples);

Higher flow velocities at **R** section, especially R2 (0.42 m/s), contributing to a homogeneous distribution of MPs in the water column.

MP characteristics





Predominance of **fibres**;

Predominance of **blue**, **black** and **grey** MPs, with a higher prevalence of transparent MPs at R3-S;

MPs between **0.1 and 1 mm** were dominant, with smaller and bigger MPs being less representative;

These characteristics are commonly observed for other reservoirs worldwide, and are related to diverse anthropic sources such as WTTPs discharges and aquatic activities[6,7].

CONCLUSION AND FUTURE WORK

- Although the R section is situated in a region with greater anthropogenic pressure, a **higher abundance of MPs** was observed in the **C section**. This reflects the **barrier effect of the Régua Dam**, which retains most MPs coming from the upstream Douro River, combined with the substantial **input of MPs directly into the Carrapatelo reservoir** (from navigation, tourism, etc.). These particles then accumulate further due to the **barrier effect of the Carrapatelo Dam**.
- Higher flow conditions tend to contribute to vertical mixing and a more homogeneous distribution of MPs in the water column; however, other factors, such as **increased runoff** during rainy seasons, **sediment resuspension**, and **variability in polymer densities**, also affect the distribution of MPs.

For a better understanding of the effects of hydrodynamics on MPs distribution (vertical and lateral), our future work will focus on analysing **polymer composition** (FTIR analysis) since polymer type is directly related to density and, consequently, to MPs' behaviour in the water column.

REFERENCES

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