Microplastic contamination in reservoirs: an invisible threat to ecosystem and water quality integrity

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INTRODUCTION

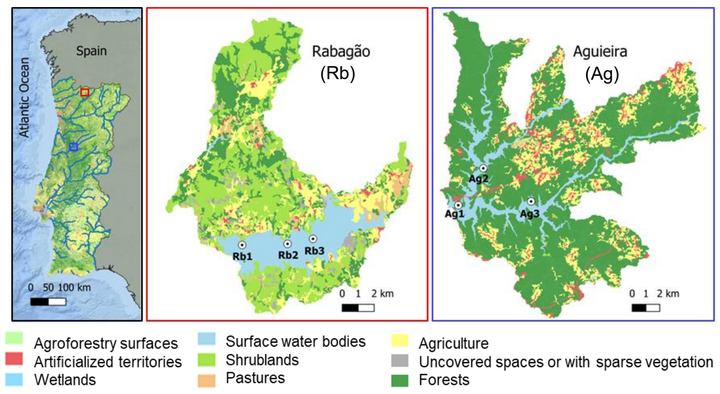
- **Reservoirs** are vital freshwater ecosystems, that provide water for human consumption.
- **Microplastics** (MPs; particles between 0.001 and 5 mm) are emerging contaminants with ecological and potential human health impacts that have been found in reservoirs, specially in Asia.
- However, MPs are not included in the Water Framework Directive (WFD) approach to assess the water quality of these heavily modified water bodies.

AIMS

- **Quantify and characterize the microplastics** present in the sub-surface water layer (photic layer) of Alto Rabagão (Rb) and Aguieira (Ag) reservoirs;
- Evaluate the contribution of MPs in the **assessment of water quality** of the target reservoirs;
- Identify the **potential sources of MPs** in the reservoirs under study.

METHODOLOGY

Study areas



Characterization of the surrounding landscape and analysis of pressures

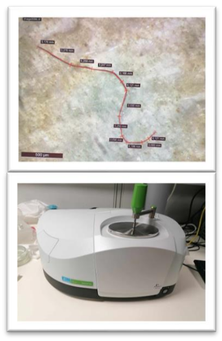
- **Land Use** and **Land Cover** Map (COS) for 2018, version 2, level 1;
- **Anthropogenic pressures** relating to the 3rd planning cycle of the Hydrographic Region Management Plans (PGRH; 2022-2027).

Sampling in each reservoir

- Sub-surface water samples at **3 sampling sites** (Rb1, Rb2, Rb3, Ag1, Ag2, and Ag3 in the maps)
- *In situ* measurement of general physical and chemical parameters

Sampling periods
Winter – Spring – **3 X Summer** - Autumn

Laboratory procedures and data analysis[1,2,3]



- **Physical, chemical, and biological parameters** according to WFD
- Water samples filtration and observation for **MPs characterization (type, color, and size)**
- Polymer identification by **FTIR analysis**

RESULTS AND DISCUSSION

Surrounding landscape and pressures

		Rb	Ag
COS 2018 v.2 Level 1		%	%
1	Artificialized territories	1.43	5.52
2	Agriculture	15.7	15.2
3	Pastures	5.15	0.555
4	Agroforestry surfaces	0.012	0.098
5	Forests	19.6	69.8
6	Shrublands	39.5	0.415
7	Uncovered spaces or with sparse vegetation	2.83	0
8	Wetlands	0	0
9	Surface water bodies	15.8	8.38
Pressures		Total = 28	Total = 194
Rejection into soil		0	1
Rejection into water		0	1
Urban (soil)		0	7
Urban (water)		0	27
Aquaculture		1	0
Surface catchments		10	17
Underground catchments		17	137
Alterations to the riverbed and banks		0	1
Navigation support structures		0	3

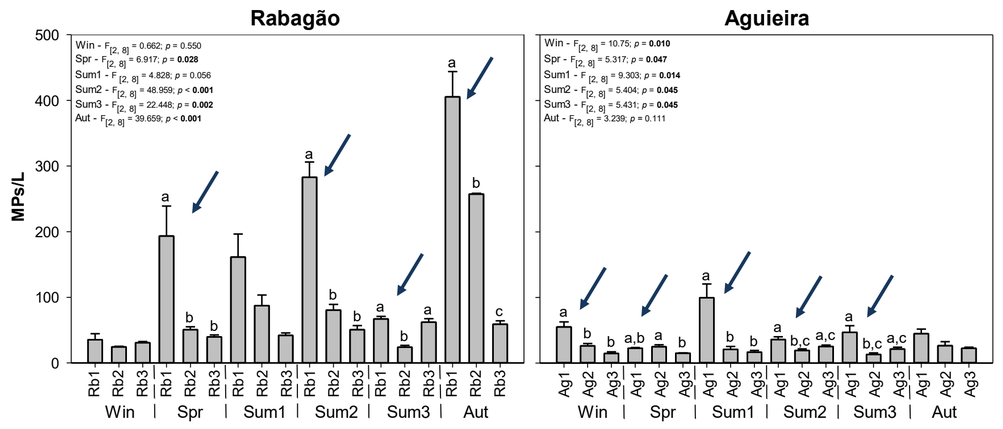
- **Rb** is mainly covered by **shrublands.**
- **Ag** is mostly composed by forests used **for intensive forestry, which contributes to low water quality**[4].
- **Agriculture** is predominant in both study areas, associated with the use of fertilizers and discharge of effluents[5].
- **Ag** reservoir is subject to multiple pressures, including the high number of **WWTPs** and the presence of **navigation support structures** near the sampling sites.
- In the **Rb** reservoir, **aquaculture (trout farming)** is the most significant pressure.

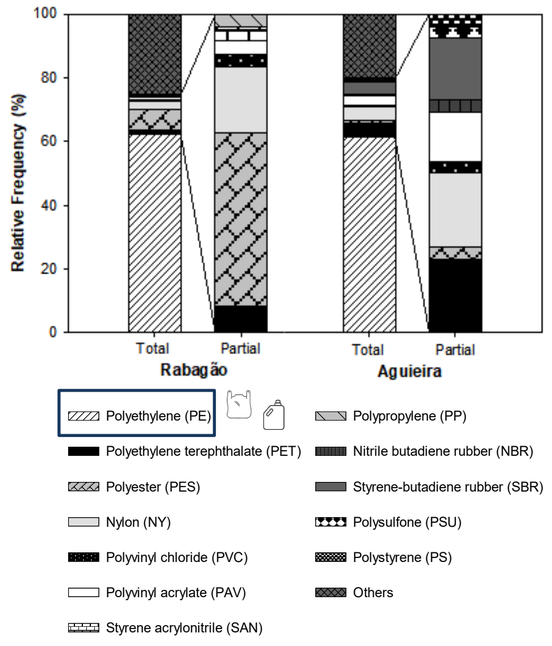
Assessment of water quality

- Similarly to the previous WFD classifications[6,7]:
  - **Rb** showed a Good ecological potential;
  - **Ag** was classified as Moderate, mainly due to **high temperature and pH values, low values of transparency** as well as **high concentrations of nutrients and chlorophyll *a.***

Microplastics characterization

Consistent with previous studies[8,9], our results indicate that reservoirs are conducive to the accumulation of MPs, exhibiting similar patterns. For both reservoirs:





- The **sampling site near the dam** (Rb1 and Ag1) showed the higher MPs/L concentration;
- **Fibers** were the predominant type of MP
  - Rb: 74.6 - 99.4 %; Ag: 86.1 - 100 %
- **Black** (Rb: 16.6 - 50.5 %; Ag: 8.8 - 62.0 %), **blue** (Rb: 10.2 - 43.3 %; Ag: 17.6 -55.9 %) and **grey** (Rb: 15.1 - 35.0 %; Ag: 1.8 - 27.6 %) were the most common colors;
- The majority of MPs observed were **between]0.1 and 0.5 mm]**
  - Rb: 29.2 – 61.3 %; Ag: 25.0 – 55.0 %

- **Polyethylene** was the predominant polymer identified, resulting from anthropogenic activities, being the most widely used polymer in single-use plastics.

But ... Despite **Rb** reservoir being better classified, it showed a **higher concentration of MPs** than Ag (108.6 and 30.7 MPs/L, respectively).

CONCLUSIONS

Alto Rabagão (Rb)
Good ecological potential
Higher concentration of MPs

vs

Aguieira (Ag)
Moderate ecological potential
Lower concentration of MPs

The ecological quality apparently does not reflect the concentration of MPs

This study underscores:

- ✓ the importance of **incorporating MPs analysis into the evaluation of these vital water bodies;**
- ✓ the need to **improve monitoring and legislation regarding plastic use**, as recreational and leisure activities, in addition to other pressures, appear to have a significant impact on contamination by MPs.
- Analysis of other components, such as **sediments** and **the hydrodynamics of particles in the aquatic ecosystems**, would be important to better understand and complement these results.

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