Microplastics in the Marine Environment: Implications on commercially important Fish and Invertebrate species of the Eastern Aegean Sea

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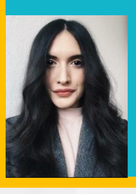

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- INTRODUCTION -

The occurrence of microplastics in the marine environment has increased over the last decades ,with estimates reporting **5.25 trillion particles of plastics** floating in the oceans in 2014[1]. Marine plastic debris represents a global threat to biodiversity as it may seriously affect the ecosystems functions and services of areas such as the **Mediterranean Sea**, defined as one of the most polluted seas worldwide[2]. And yet, detailed documentations on the distribution and extent of plastic pollution in the Mediterranean basin and its effects on marine life are currently lacking. The aim of this study is to investigate how the **abundance and distribution of microplastics** varies across marine species native to **Samos Island**, situated in the North-Eastern Aegean Sea (Greece) (Fig. 1).

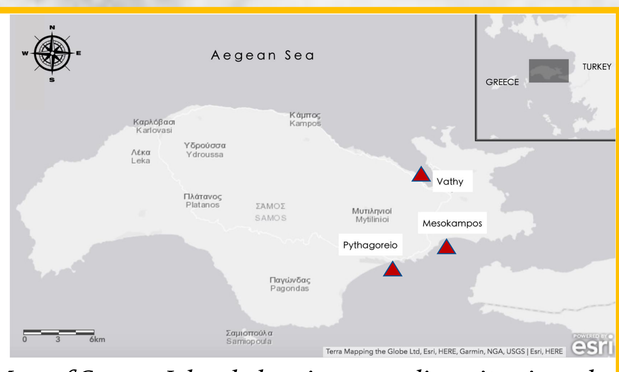


Figure 1. *Map of Samos Island showing sampling sites in red.*

- MATERIALS AND METHODS -

66 marine specimens were sampled including, **8** commercially important **fish species**:

- *Sparus aurata*
- *Sarda sarda*
- *Sphyraena viridensis*
- *Boops boops*
- *Diplodus annularis*
- *Serranus cabrilla*
- *Trachurus mediterraneus*
- *Mullus barbatus*

As well as **4 invertebrate** species:

- *Paracentrotus lividus*
- *Todarodes sagittatus*
- *Parapenaeus longirostris*
- *Ostrea edulis*

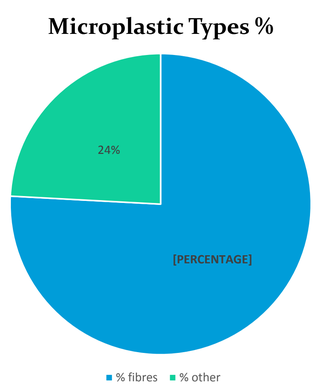
Laboratory analyses were conducted as follows: **dissection**, collection and **filtration**[3] of digestive system, analyses for microplastics **quantification and categorisation** through a hot needle test under magnification x40 (Fig. 2)

Figure 2. *Different steps followed in the lab protocol: dissection, filtration and microscope analysis.*

- RESULTS -

1. Microplastics size distribution

All individuals exhibited microplastic contamination, with a total of ***2,725 microplastic*** items identified among the ***66 examined specimens***. The abundance and prevalence of different types of microplastics were compared throughout all specimens collected. **Plastic fibres** were ubiquitous throughout all samples analysed and accounted for **76%** of all microplastics detected in this study (Fig. 3).



Figures 3. *Highlighting the percentage of microplastic fibers as the dominant microplastic type found throughout study.*

- RESULTS -

1. Microplastics across habitat ranges:

The distribution of total microplastics significantly differed across habitat ranges (ANOVA: $F(3, 62) = 7.896$, $p < 0.001$) (Fig. 4). Tukey HSD Test reported a **significant difference** in MP abundance between the following habitat categories:

- **pelagic-benthic** (p=0.027)
- **demersal-benthopelagic** (p=0.008)
- **pelagic-demersal** (p<0.001)

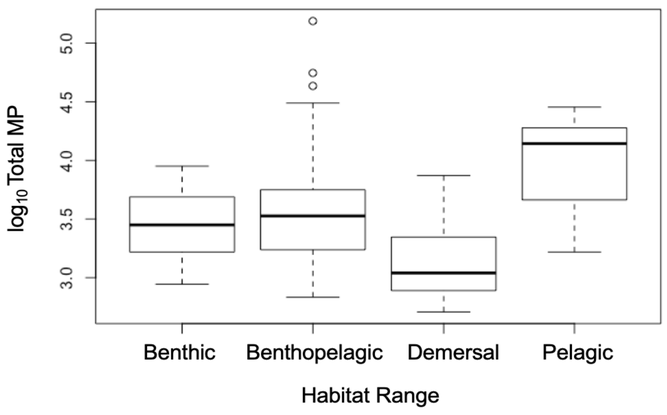
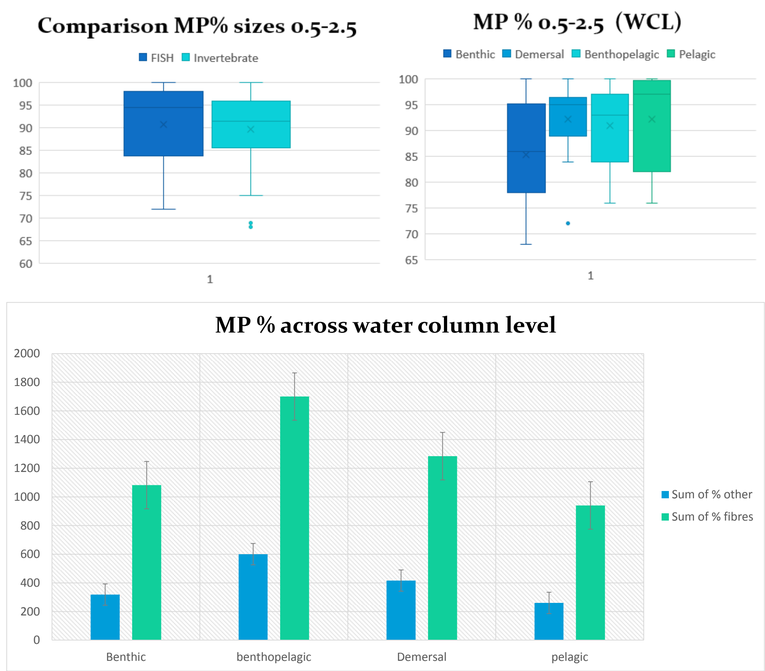


Figure 4. *Variation in microplastics distribution across different habitats, corresponding to different levels of the water column.*



Figures 5. *Variation in percentage of microplastics (MP) type & size distributions across species, and water column level (WCL).*

2. Microplastics across species with different feeding strategies:

The distribution of total microplastics significantly varied across individuals with different feeding behaviors (ANOVA: $F(3, 62) = 7.003$, $p < 0.001$) (Fig. 6). Tukey HSD Test reported a **significant difference** in microplastics abundance between the following feeding categories:

- **omnivorous-filter feeder** (p=0.005);
- **omnivorous-predator** (p=0.022).

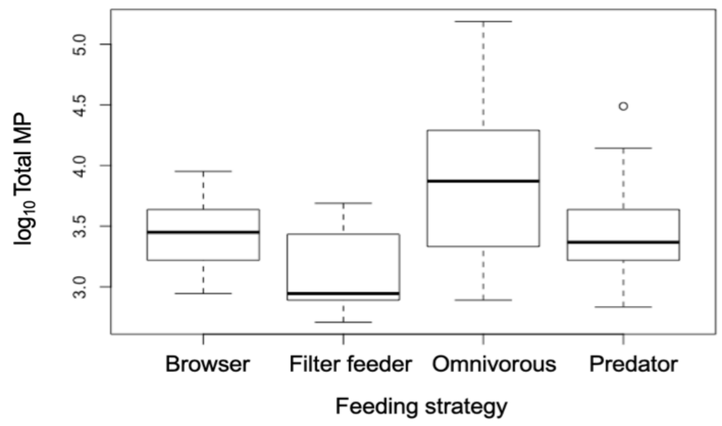


Figure 6. *Variation in microplastics distribution across species with different feeding strategies.*

- DISCUSSION -

- This preliminary study showed that microplastics are **ubiquitous and persistent** throughout the Aegean marine trophic chain.
- **Pelagic & omnivorous species** are the most susceptible to microplastics contamination. The broad feeding ecology and habitat preferences of these species might imply higher chances of ingesting microplastics.
- The **predominance of microplastic fibres** amongst other types of microplastics (hard fragments, rubber, plastics sheets, etc.), corresponds with previous studies.
- Most fibres found in the marine environment derive from sewage-discharges, as a consequence of **washing clothes** containing polyester and acrylic fibres[4].
- Further analyses are required to investigate possible relationships between the body size, species, age range of individuals, as well as the amount of microplastics found.

- CONCLUSION -

- These outlined findings prove that high rates of plastics can be found despite of spatial variation and suggests multiple sources from which microplastics can generate.
- As **three billion people**[1] rely on the ocean as their primary source of protein, it is crucial to spur further research efforts to investigate the unknown consequences of microplastic contaminants.
- Further and long-term targeted analyses on different species are necessary to assess the presence of microplastics at different levels of the entire trophic chain.
- Research and conservation efforts are required to intervene globally to **reduce plastic** waste and to determine potential **toxic exposure** of humans to contaminated seafood.

References:

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[4] Browne, M., Crump, P., Niven, S., Teuten, E., Tonkin, A., Galloway, T. and Thompson, R. (2011). Accumulation of Microplastic on Shorelines Worldwide: Sources and Sinks. *Environmental Science & Technology*, 45(21): 9175-9179.

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