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Occurrence of microplastics in waters from Bulgarian Black Sea coast: a pilot study

Zlatina Peteva, Stanislava Georgieva, Mona Stancheva, Angelika Georgieva

[1]Medical University-Varna, Faculty of Pharmacy, Department of Chemistry, Marin Drinov 55, 9002 Varna, Bulgaria

stgeorgieva@mu-varna.bg

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THE PROGRAM FOR MARITIME AFFAIRS AND FISHERIES 2014-2020
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Project	№ BG14MFOP001-6.004-0006 **„Investigation of priority chemical pollutants and biotoxins and assessment the state of the marine environment“**
Aim	**Assessment of the state of the marine environment by analyzing the levels of priority chemical pollutants and biotoxins in marine organisms and waters.**
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Beneficiary	Medical University - Varna, Bulgaria
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Priority PMAF	Union Priority 6 "Promoting the implementation of the Integrated Maritime Policy"
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Introduction

- Plastic pollution

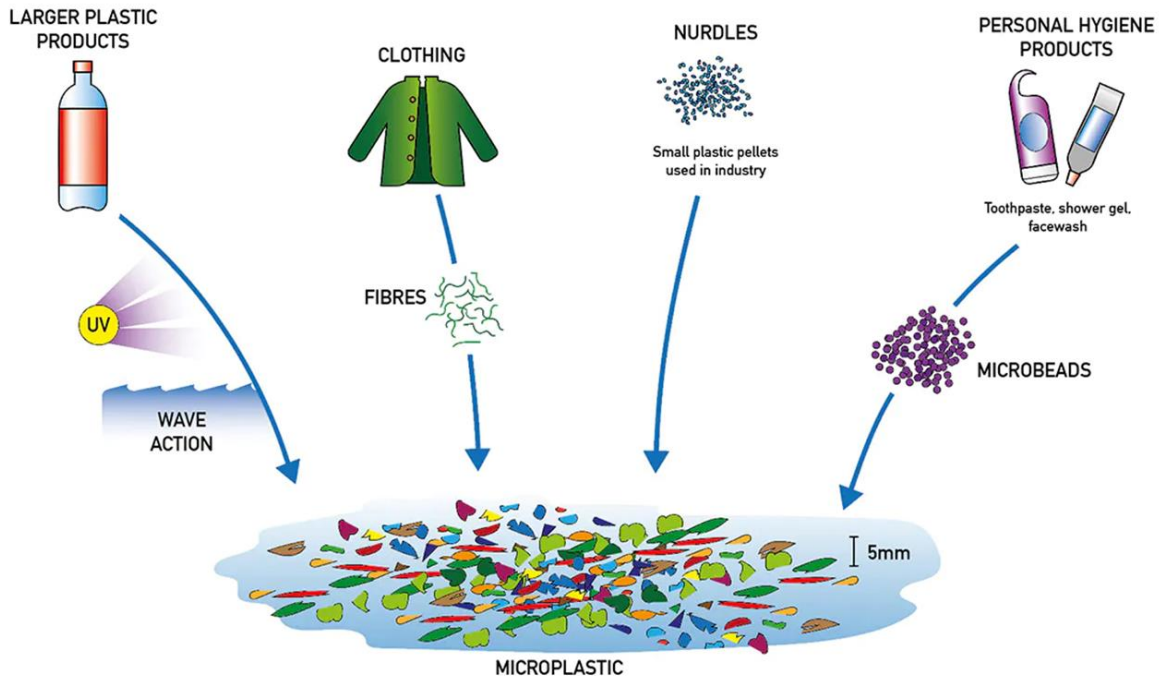
✓Increasing global concern

✓Plastics - key drivers of global supply and demand, BUT ….

- ❑ persistent
- ❑ concern for the environment

- Microplastics

✓ size - 0.01–5 mm



https://encounteredu.com/multimedia/images/sources-of-microplastics

Type

- pellets
- films
- fibers
- fragments

Origin

Primary

directly manufactured; small pieces of plastics

Secondary

result from weathering of larger pieces

Occurrence

- Marine environment
  - potential to be harmful to the marine biota
  - vectors for biological and chemical contamination
  - enter the food web at lower trophic levels → bioaccumulation of biological and chemical toxins
- First records

✓1971 - sea surface waters of the Sargasso Sea in the North Atlantic Ocean

✓ Black Sea ???

Black Sea studies

- survey on floating microplastics in the coastal zone of Bulgaria (the Southwestern Black Sea) (Berov D., Klayn S. 2020).

Area	**MPs in**	**References**
SE Black Sea coast, Turkey	surface waters	Aytan et al., 2016; Oztekin and Bat, 2017
Turkish coastline	sediments	Kilinc, 2017
Romanian Black Sea	waters	Pojar and Stock, 2019
Romanian coastline	sediments	Săvucă et al., 2017
Southwestern Black Sea, Bulgaria	floating MPs on the sea surface	Berov D., Klayn S. 2020
Black Sea Coast of the Anatolian side of Istanbul, Turkey	beach sands	Şener et al., 2019

Aim

- Investigation on the presence and characteristics of microplastic particles (MPs) along the Bulgarian Black Sea coast

Sampling

- spring 2021 sampling campaign
- sampling area: cape Kaliakra, Kavarna, Varna bay, Varna lake, Burgas bay, Sozopol
- depth of ca. 1 m., direct water collection

Materials and methods

Treatment protocol

Sample sieving

Peroxide digestion

Filtration over a membrane filter – separation of MPs

Visual analysis and identification – light microscopy.

Characterization by morphological types, size classes (Ferret diam.) and color

- Digestion of organic matter
- Floatation on salt water to separate plastic particles

- The criteria for visual identification and classification of plastics were based on Hidalgo-Ruz et al. (2012) and Kovač Viršek et al. (2016).

Characterization by morphological types, size classes (Ferret diam.) and color according Covernton et al. (2016).

Results

- Spring 2021 sampling campaign

Table 1. Presence of MP particles in studied samples

Sampling site	Nr of samples	MP concentration [items/L]
Kaliakra	3	0,7 ± 0,6
Kavarna (mussel farm)	3	13,7 ± 1,2
Varna Bay	3	1,8 ± 0,4
Varna Lake	2	10,7 ± 2,5
Burgas Bay	2	1,6 ± 0,6
Sozopol (mussel farm)	3	12,3 ± 1,5

- Widespread presence of microplastics in coastal waters
- Higher MP levels in the mussel farms areas

In comparison:

- Much higher MP levels than in UK waters (2018 sampling - 1.97 to 3.38 items/m^3) (Scott et al., 2019);
- Comparable with

✓ Contamination in the Mediterranean sea (Gündogdu, et al., 2017);

✓ Contamination in open Black Sea (Aytan et al., 2016), but higher than in a previous study in Bulgarian coastal waters (Berov &Klayn, 2020)

!!! Higher density → no mesh used

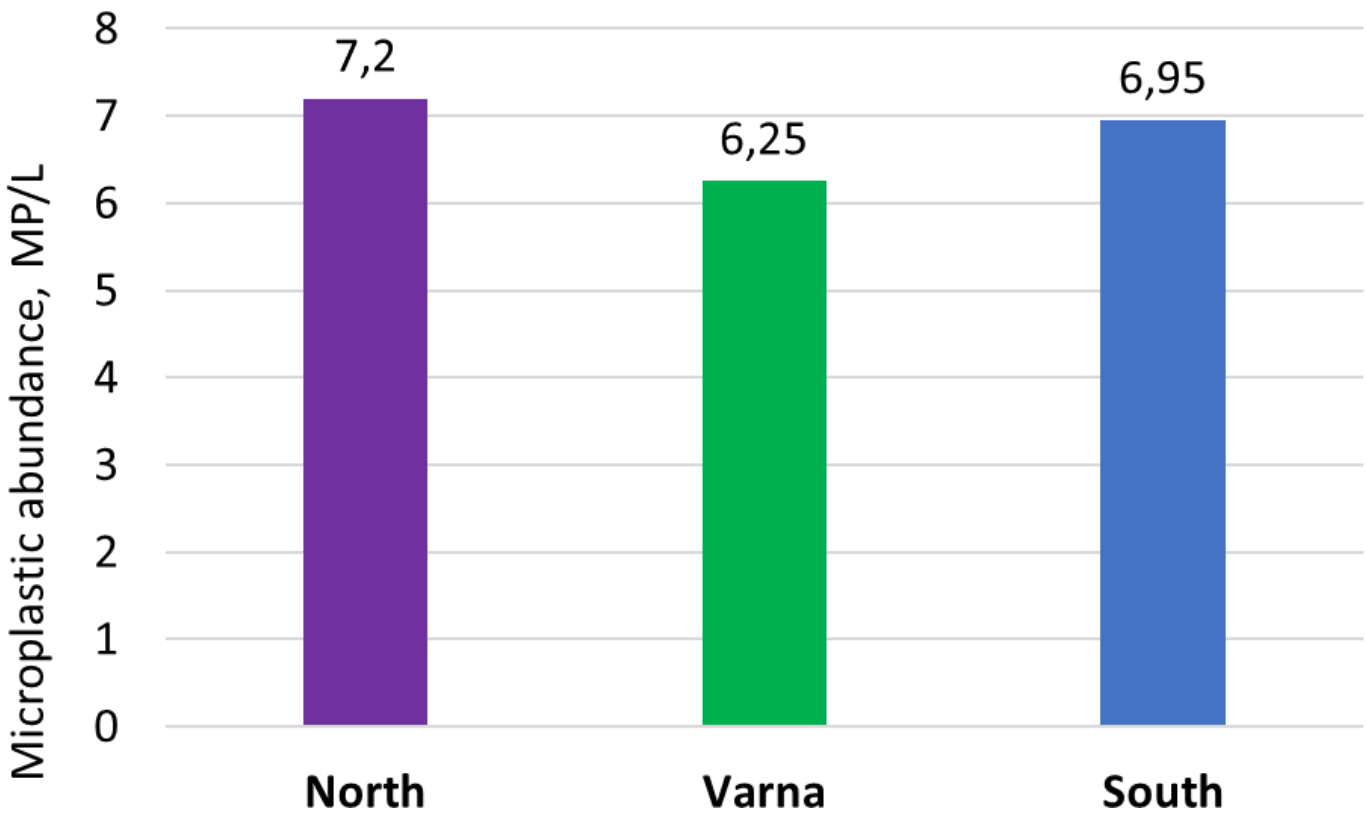
References:

Aytan, U., Valente, A., Senturk, Y., Usta, R., Sahin, F. B. E., Mazlum, R. E., & Agirbas, E. (2016). First evaluation of neustonic microplastics in Black Sea waters. Marine environmental research, 119, 22-30.

Berov D., Klayn S. 2020. Microplastics and floating litter pollution in Bulgarian Black Sea coastal waters. Marine Pollution Bulletin, 156: 111225, doi: 10.1016/j.marpolbul.2020.111225

Results

Distribution of microplastics pollution on the Bulgarian coast



- All along the studied coastline
- No difference in the contamination levels

Results

- Spring 2021 sampling campaign

Composition of microplastics polymers according to their **form type**

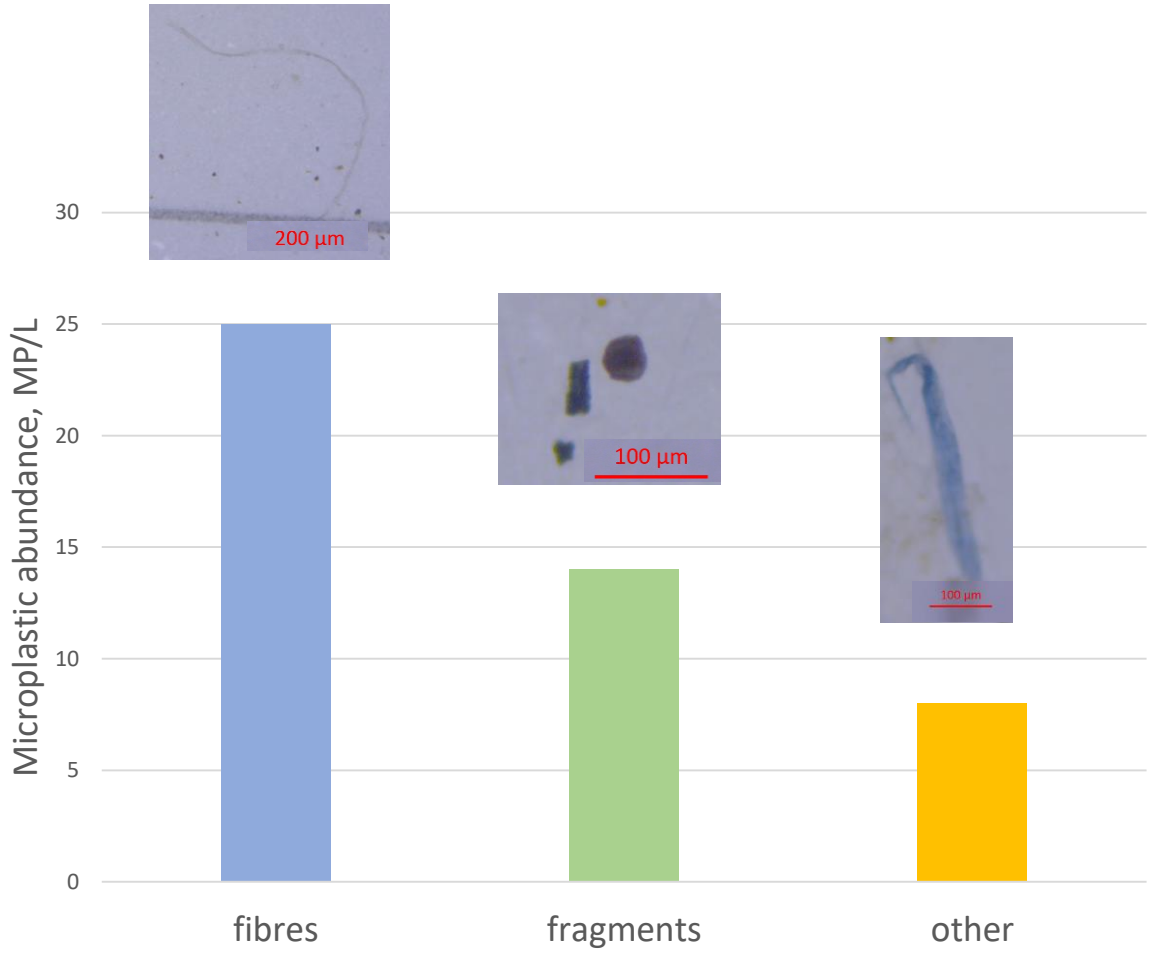


Figure 1. Morphological types of MP particles in studied samples

- The criteria for visual identification and classification of plastics were based on Hidalgo-Ruz et al. (2012) and Kovač Viršek et al. (2016).
- Abundance of MPs form types was significantly different, whereas the majority of the MPs were fibers (53.5%), followed by fragments (30%).
- The most common form type of MPs found in this study, fibers, is consistent with the global trend reported for coastal waters worldwide (*Dehm et al., 2020*).
- Fibers were the primary shapes along the south eastern coast of the Black Sea (average ~ 49.4%) - *Aytan et al., 2016*

References:

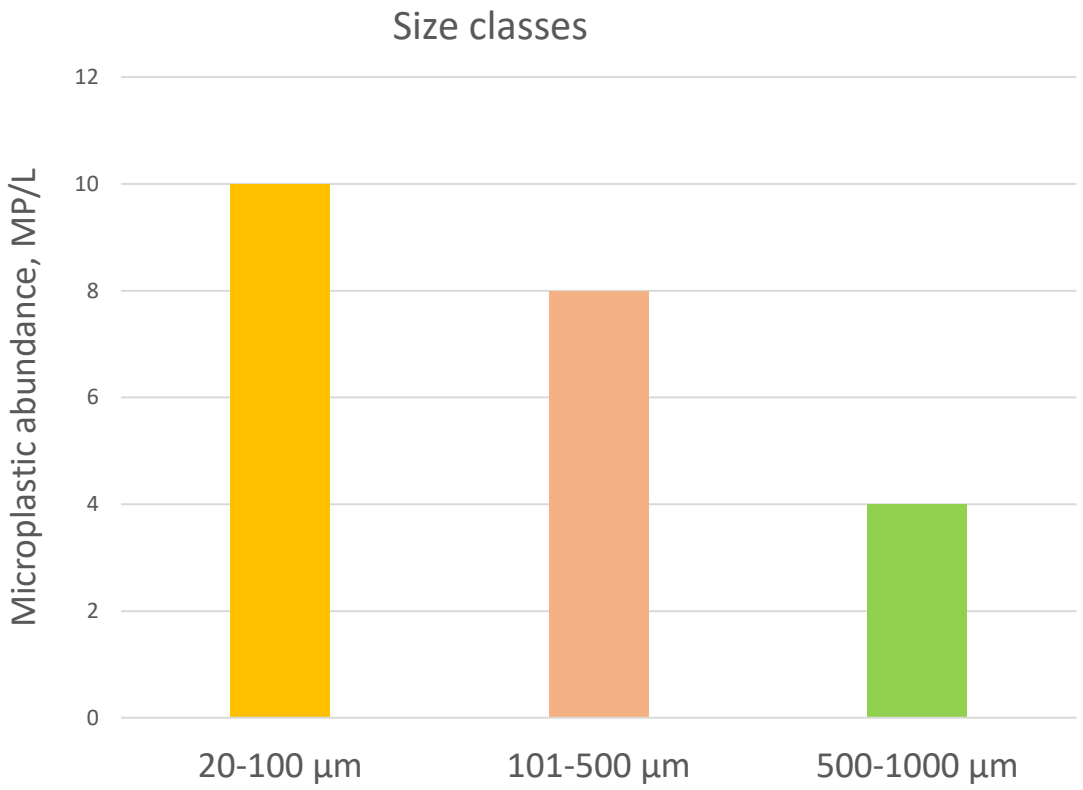
J Dehm, S Singh, M Ferreira, S Piovano, Microplastics in subsurface coastal waters along the southern coast of Viti Levu in Fiji, South Pacific, Marine Pollution Bulletin 156, 111239

Aytan, U., Valente, A., Senturk, Y., Usta, R., Sahin, F. B. E., Mazlum, R. E., & Agirbas, E. (2016). First evaluation of neustonic microplastics in Black Sea waters. Marine environmental research, 119, 22-30.

Pojar, I., Stock, F., 2019. Microplastics in surface waters from the northwestern Black Sea: an abundance and composition approach. In: Geophysical Research Abstracts. Presented at the EGU General Assembly 2019, (pp. EGU2019-8357).

Results

Composition of microplastics polymers according to their **size classes**:



- Among the different size ranges (20–100 µm, 101–500 µm and 500-1000 µm) of microplastic particles, the size range of 20–100 µm contributed to the highest abundance by number (45.5%).
- Edo et al. observed that the microplastic abundance decreased with decreasing size (in the range from 5 to 1 mm size classes) (*Edo et al., 2019*).

Figure 2. Size classes of MP particles (fragments and other*) in studied samples

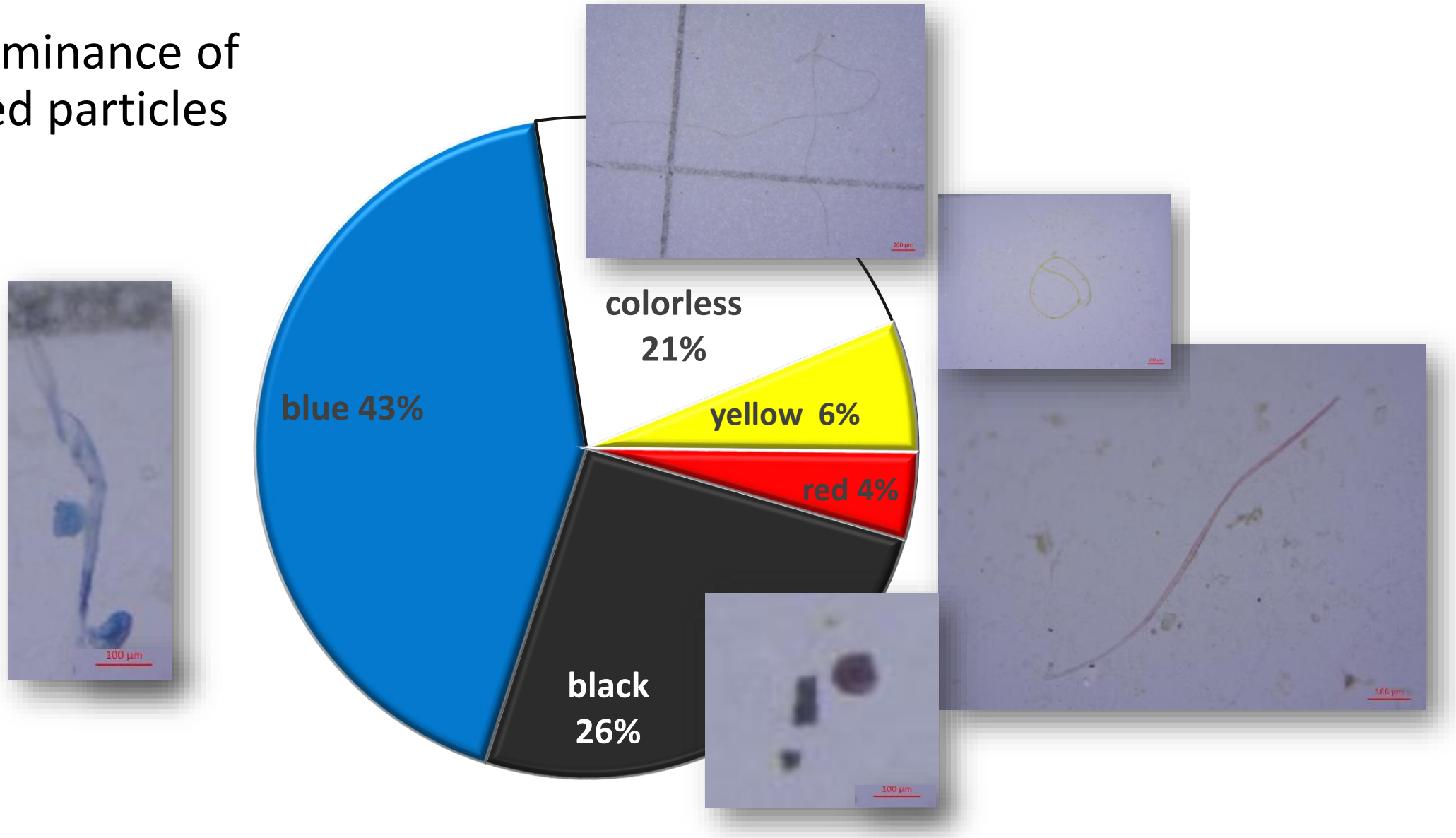
** Ferret diam. not useful for fibers' length measurement*

C. Edo, M. Tamayo-Belda, S. Martínez-Campos, K. Martín Betancor, M. González-Pleiter, G. Pulido-Reyes, C. García-Ruiz, F. Zapata, F. Leganés, F. Fernández-Piñas, R. Rosal, Occurrence and identification of microplastics along a beach in the Biosphere Reserve of Lanzarote, Mar. Pollut. Bull., 143 (2019) 220–227.

Results

Composition of microplastics polymers according to their **color classes**:

- Predominance of colored particles



Discussion & Conclusions

- Most often morphological types and size classes

✓ avoiding in-house contamination → blank samples

✓similar to other Black Sea studies (Aytan et al., 2016; Berov &Klayn, 2020)

- Characterization by color

Blue > Black (dark) > colorless > other colors

✓ possible sources: PE bags, plastic bottles, bottle caps, packaging etc. (Simeonova & Chuturkova, 2020)

Discussion & Conclusions

- The confirmation of the possible sources of pollution - further analyses, e.g. FTIR spectrometry

✓ lack of spectroscopic validation of microplastic identity - drawback of the present study

✓could have resulted in an overestimation of the reported concentrations

- Fibrous particles may have a greater tendency for entanglement within complex feeding structures
- Accurately quantifying the concentrations of any types of MPs

✓critical for planning relevant MP toxicology studies

✓bridging the gap between laboratory and field studies of ecological risk.

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- The lack of sufficient data about MPs in the Black Sea waters makes it difficult to compare results in this region.
- Further studies are needed to evaluate spatial distribution of this particles in the Black Sea and their effects on marine organisms.

Thank you for your attention !!!

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