First detection and quantification of microplastics down to 100 µm in the southern Tyrrhenian Sea and their possible uptake by different fish species

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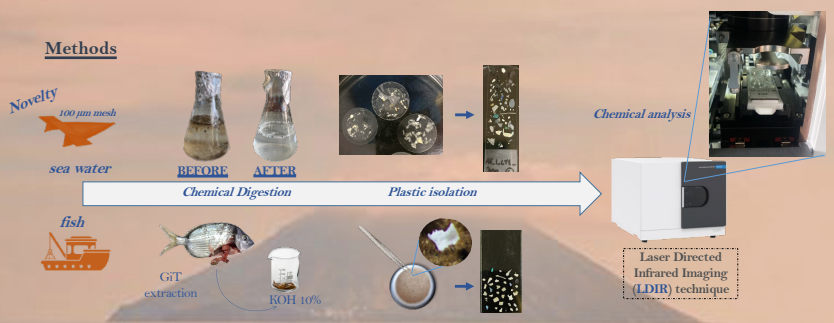
Introduction

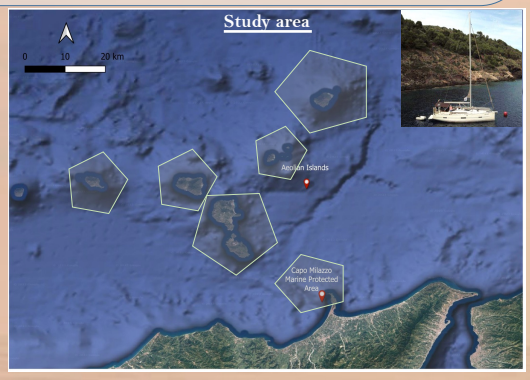
Microplastic (MP) pollution is a global issue affecting most of the world's oceans and among them the Mediterranean Sea is recognized as a particularly significant hotspot. In recent decades, several studies have been conducted in the Mediterranean Sea to assess the presence, distribution and impact of MPs. However, most research has focused on MPs larger than 300 µm, neglecting the smaller fraction. Particle size plays a crucial role in the marine environment as it can influence the buoyancy of particles and thus the vertical distribution, as well as the bioavailability of particles to marine organisms. Indeed, MPs present along the entire water column can be easily ingested by marine organisms at all levels of the trophic web.

Therefore, the purpose of the present study was to:

i) perform the first assessment of sea surface MPs down to 100 µm around the Aeolian Islands (AEI) and the Marine Protected Area of Capo Milazzo (MPACM)
ii) assess for the first time the floating litter in the young MPACM
iii) investigate in the study area the possible ingestion of MPs by several bioindicator fish species not yet explored (*Boops boops, Diplodus sargus, Auxis rochei, Mullus surmuletus*) according to ecological and biological criterias [1].

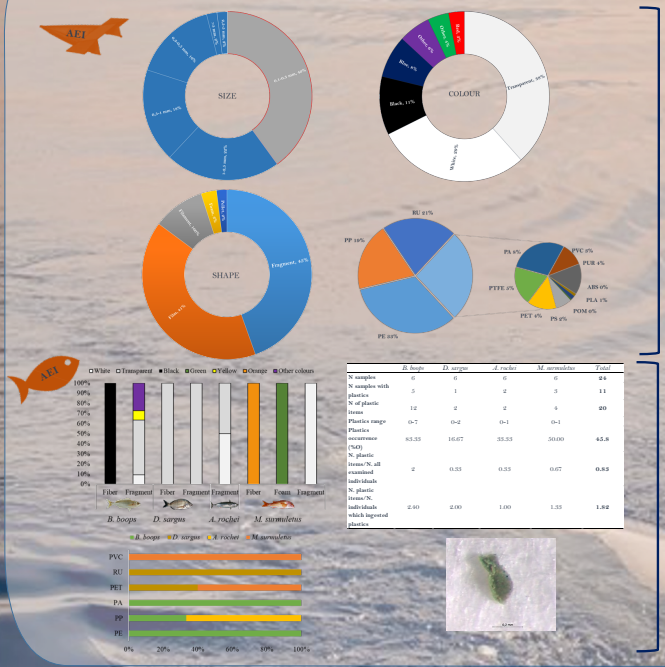
Methods





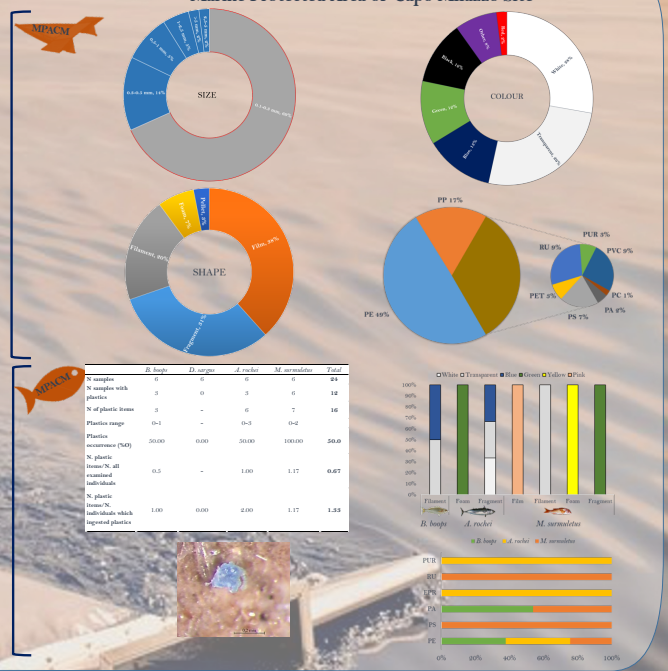
Results

Aeolian Islands Site



	B. boops	*D. sargus*	*A. rochei*	*M. surmuletus*	*Total*
N samples	6	6	6	6	**24**
N samples with plastics	5	1	2	3	**11**
N of plastic items	12	2	2	4	**20**
Plastics range	0-7	0-2	0-1	0-1	
Plastics occurrence (%O)	83.33	16.67	33.33	50.00	**45.8**
N. plastic items/N. all examined individuals	2	0.33	0.33	0.67	**0.83**
N. plastic items/N. individuals which ingested plastics	2.40	2.00	1.00	1.33	**1.82**

Marine Protected Area of Capo Milazzo Site



	B. boops	*D. sargus*	*A. rochei*	*M. surmuletus*	*Total*
N samples	6	6	6	6	**24**
N samples with plastics	3	0	3	6	**12**
N of plastic items	3	-	6	7	**16**
Plastics range	0-1	-	0-3	0-2	
Plastics occurrence (%O)	50.00	0.00	50.00	100.00	**50.0**
N. plastic items/N. all examined individuals	0.5	-	1.00	1.17	**0.67**
N. plastic items/N. individuals which ingested plastics	1.00	0.00	2.00	1.17	**1.33**

Discussion

A total of 7565 (mean ± SD, 0.31 ± 0.40 items/m²) and 4492 items (mean ± SD, 0.21 ± 0.13 items/m²) were isolated from sea surface water samples collected in the AEI and within the MPACM (primary investigation), respectively. **The most common size fraction observed was between 0.1 and 0.3 mm (AEI 40%; 69% MPACM) in both sites**. According to the shape, fragments (AEI 45%; MPACM 31%) and film (EAI 41%; MPACM 39%) were the most abundant while based on the colour, light-coloured plastic such as transparent (AEI 38%; MPACM 26%) and white (AEI 29%; MPACM 28%) dominated over other colours.

From the total particle count of the floating items, 20% were chemically analyzed by LDIR. Polyolefins (polyethylene and polypropylene) were the most frequent polymer observed as already confirmed by other studies from Mediterranean regions [2-3]. To the best of our knowledge, this investigation reports, for the first time, evidence of plastic ingestion by fish species of commercial importance not yet studied within the sites. In particular, ingestion of plastics has been reported for all AEI species and for 3 of the 4 AMPCM selected species.

A total of **20 particles were isolated from 11 GITs samples from the AEI** (O%= 45.83): 12 items in *B. boops* (O%= 83.33), 2 items in *D. sargus* (O%= 16.66), 2 in *A. rochei* (O%= 33.33) and 4 in *M. surmuletus* (O%= 50). A total of **16 items were found in 12 GITs from the MPACM** (O%= 50): 3 in *B. boops* (%O = 50), 3 in *A. rochei* (%O = 50) and 7 in *M. surmuletus* (%O = 100). The frequency of occurrence observed in this investigation, is consistent with data previously observed on the same species from the Mediterranean Sea [4-5], confirming how the biology and ecology of species may affect plastic ingestion [6]

Classification by shape, colour and chemical nature showed a heterogeneity of data across both sites and matrices. These findings, including sea surface and target species are strictly related to anthropic pressure in the study area, linked to fishing activity, seasonal tourism both from land and sea and maritime traffic. Although, the MPACM showed lower MPs contamination levels than AEI, the data suggest the impact of Milazzo's anthropized coastlines. This integrated approach provided data on the presence and distribution of MPs down to 100 µm in different marine environmental matrices suggesting the need for improved investigation of invisible and hazardous plastics fraction.

References

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