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Baseline

Plastic litter in sediments from a marine area likely to become protected (Aeolian Archipelago's islands, Tyrrhenian sea)

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ABSTRACT

This research aims to define for the first time levels and patterns of different litter groups (macro, meso and microplastics) in sediments from a marine area designed for the institution of a new marine protected area (Aeolian Archipelago, Italy). Microplastics resulted the principal group and found in all samples analyzed, with shape and colours variable between different sampling sites. MPs levels measured in this study are similar to values recorded in harbour sites and lower than reported in Adriatic Sea, while macroplastics levels are notably lower than in harbor sites. Sediment grain-size and island extent resulted not significant in determining levels and distribution of plastic debris among islands. In the future, following the establishment of the MPA in the study area, these basic data will be useful to check for potential protective effects on the levels and distribution of plastic debris.

In the last decade, an emerging anthropogenic pollution affecting marine environment was discovered: small, plastic litter. Among this class, those with the greatest toxicological importance are the microplastics (MPs, diameter within 5000–1.0 μm) intentionally produced in a small-scaled dimensional range or derived from the fragmentation of macroplastics (macroPs, diameter > 25.0 mm) and mesoplastics (MesoPs 25.0–5.0 mm) (JRC EU, 2013). MPs can accumulate in marine sediments, become available to biota (Fossi et al., 2014) and be transferred along the marine food web (Romeo et al., 2015a). Furthermore, MPs can release plastic additives and could adsorb environmental pollutants on their hydrophobic surface (Pedà et al., 2016). Marine Strategy Framework Directive (MSFD), aimed to protect more effectively the marine environment across Europe, listed marine litter as a key descriptor (D10) for good environmental status (GES) determination (EU, 2008), but some EU Countries do not yet include sediment litter monitoring in their routines (Alomar et al., 2016). In spite of this and of the importance of MPs in marine sediments, factors affecting their distribution are not yet completely cleared and at the best of our knowledge no data are reported by the literature on the MPs in sediments samples from Tyrrhenian Sea and from the Aeolian Archipelago (central Mediterranean Sea, south Tyrrhenian Sea). Furthermore, the Aeolian Archipelago has been designated for the establishment of a marine protected area (MPA) (L. 979/82); at the best of our knowledge, MPs baselines in sediments before the institution of a new MPA have never be done, while this data could represent a useful literature base to perform temporal trend analyses after MPA institution and to define its effectiveness on MPs. Considering the frame presented above, the main aim of this study was to define levels and patterns of litter in sediments from the Aeolian Archipelago.

Surface sediment samples were collected in triplicates from eight sampling sites located in different islands of the Aeolian Archipelago

Table 1
Considered shape, colour and dimensional classes in litter analyses. Abbreviations in brackets.

Shape categories	Colour categories	Dimensional classes
Filament (FI)	White (W)	>2.5 cm (MacroPs)
Film (FILM)	Clear (C)	2.5 cm–5.1 mm (MesoPs)
Fragment (FR)	Red (R)	5.0 mm–4.1 mm (C1)
Granule (G)	Orange (O)	4.0 mm–2.1 mm (C2)
Pellet (P)	Blue (BE)	2.0 mm–1.1 mm (C3)
Foam (FO)	Black (BK)	1.0 mm–63 μm (C4)
Unrecognized plastic piece (UN)	Gray (GY)	
	Brown (BN)	
	Green (GN)	
	Pink (P)	
	Tan (T)	
	Yellow (Y)	

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Table 2
Number of litter recovered in sediment, expressed as total number of each litter classes recovered per kg d.w. of sediment for each island (mean ± SD).

Island	Macro Ps	Meso Ps	MPs				
			Total	C1	C2	C3	C4
B Alicudi	0.0	23.9 ± 3.9	347.9 ± 87.4	28.1 ± 7.3	143.1 ± 43.9	81.4 ± 23.9	95.4 ± 29.4
Filicudi	0.0	25.1 ± 35.9	186.2 ± 161.1	15.5 ± 15.1	49.7 ± 47.2	46.5 ± 42.3	72.9 ± 72.6
Vulcano	0.0	20.4 ± 22.5	534.8 ± 24.3	36.3 ± 1.6	126.9 ± 6.2	145.0 ± 7.2	226.6 ± 11.3
Lipari	0.0	46.4 ± 36.9	678.7 ± 345.8	28.8 ± 14.3	271.9 ± 113.4	156.8 ± 102.4	219.6 ± 124.1
Panarea	0.0	22.3 ± 13	484.2 ± 124.4	17.1 ± 4.3	113.9 ± 34.2	119.6 ± 33.9	233.5 ± 58.2
Stromboli	0.0	11.9 ± 7.8	151.0 ± 34.0	2.6 ± 0.9	53.0 ± 12.4	42.4 ± 13.5	53.0 ± 14.3
Salina	1.8 ± 4.3	14.7 ± 11.9	219.1 ± 198.7	9.7 ± 5.9	43.7 ± 36.4	87.3 ± 88.3	78.5 ± 68.1

(38° 29′ 36″ N 14° 55′ 31″ E) (Lipari, Vulcano, Salina, Stromboli, Panarea, Filicudi, Alicudi and other smaller islets). Undisturbed sediment (5 cm depth) was collected at −30 m by scientific scuba divers, using wide mouth glass jars. All replicates were taken approximately within a radius of 1 m and collected samples were stored frozen at −15 °C until analyses (Galgani et al., 2013 adapted).

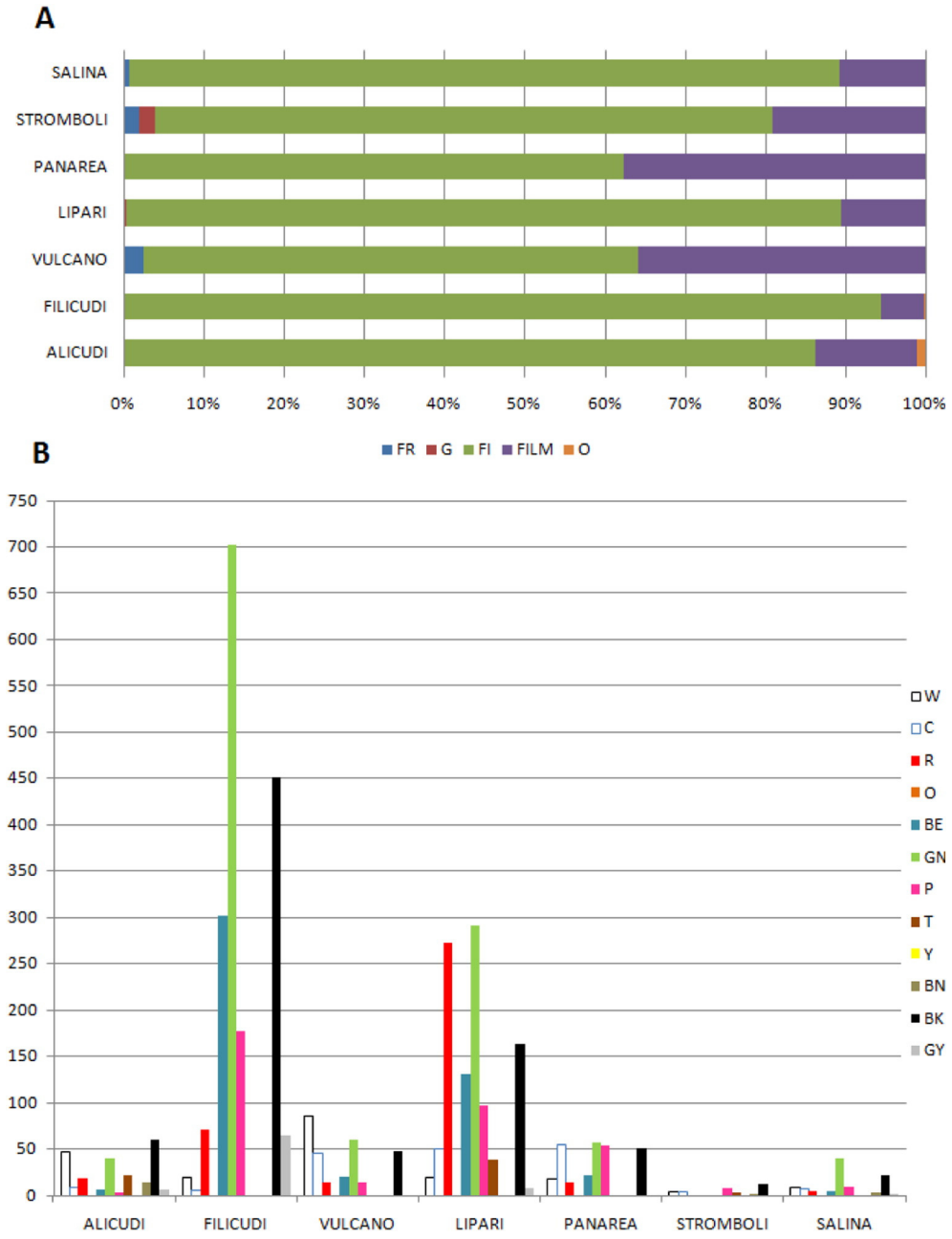

Fig. 1. Shapes and colours fingerprints of Aeolian Islands MPs in sediments. Panel A. Average values of different MPs shapes. Five different classes of MPs shapes for each sampling sites is reporteds as average (n = 3) value (n./kg d.w.) expressed as percentage of the total number of MPs collected in each sampling site. Panel B. Average number of MPs grouped by colours in each island. Data are reported as number/kg d.w. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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