

**“MAYDAY SOS PLASTICA”
Campagna 2019 promossa da Greenpeace Italia**

**“MICROPLASTICS IN MARINE WATER ALONG
THE TYRRHENIAN COAST”
Report Finale Giugno 2020**

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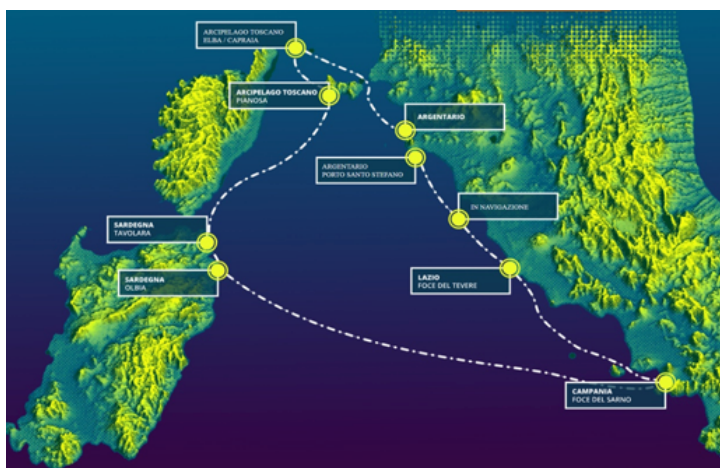
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1. Scope

The Institute for the Study of Anthropic Impact and Sustainability in the Marine Environment (IAS) of the National Research Council (CNR), hereafter CNR-IAS, has been involved, in collaboration with UNIVPM-Università Politecnica delle Marche, between May and September of 2019, in the “MAYDAY SOS Plastica” campaign promoted by Greenpeace Italia, focused on the monitoring of plastic contamination in the Mediterranean Sea with a focus on Tyrrhenian coasts. The scope has been to gather direct data and testimonies on pollution from plastic that affects our seas and to inform public opinion about this serious problem.

This tour has several goals to achieve:

- A. Establish the extent of microplastics (MPs) pollution in the Mediterranean Sea along the Italian Coast, investigating three different marine compartments: water column (surface and deeper layers), seabed and organisms.
- B. Investigate possible spots of accumulation
- C. Analyze polymeric composition of particles present in the three compartments
- D. Produce data to support the standardization and harmonization of the existing protocols to isolate and detect microplastics in water and marine organisms to enable accurate quantification, qualification and comparison between studies.
- E. Test a new method to collect samples with the scope to analyse the possible content of MPs in the water column



The present report presents the results of the campaigns. Analysis have been performed at the laboratory of CNR- IAS (Genoa, Italy).

2. *General overview*

Plastic presence in the marine ecosystems has become a world-wide threat (Macias, 2019). Plastic litter hardly biodegrades in nature in fact, weathering only breaking down large plastic objects into abundant small pieces commonly called microplastics (Andrady, 2011). This persistent form of plastic pollution is spreading out by water currents over every Ocean and Sea on Earth, from temperate to polar regions (Law et al., 2010; Cozar et al., 2004; 2017). Plastics debris once in the Ocean, change dimensional classes towards smaller dimensions, namely microplastics (MPs) and nanoplastics (NPs) (Cincinelli, 2019). MPs can be divided in “primary” or “secondary” ones. Primary MPs are added to personal care products (hand cleaners, facial cleaners and toothpaste) or as raw materials used for the fabrication of plastic products, namely plastic resin pellets or flakes and plastic powder or fluff. Secondary MPs result from the fragmentation of larger plastic materials (Duis and Coors, 2016). Plastics debris are composed by different polymer. Most popular polymers founded in sea environment are: PE (Polyethylene HA-PE and LD-PE), PP (Polypropylene), PA (Polyamides) and PVC (Polyvinyl chloride) (Suaria et al. 2016). These polymers have different chemical and physical characteristics. In 2018, global plastics production almost reached 360 million tonnes, while 62 million tonnes in Europe (Plastics Europe, 2019). More or less 8 millions of tons of this production reach the seas environments (Plastics Europe, 2019). Floating MPs can act as a vector of non-indigenous marine species and also for bacteria or virus that can be transported on the surface over long distances and inside organisms that ingest plastic mistaking food. The Mediterranean Sea is a semi-enclosed basin with coastal zones densely populated and high level of commercial and recreational marine traffic. The limited water exchange with Atlantic Ocean enable the accumulation of floating anthropogenic litter in the area (Macias, 2019).

3. Method

3.1 Sampling stations

Between May and September of 2019 our institute, CNR-IAS of Genova, and the UNIPVM- Università Politecnica delle Marche were invited to collaborate in a campaign organised by Greenpeace along the Tyrrhenian coast of Mediterranean Sea called “MAYDAY SOS Plastica”. The tour touched different Areas: Arcipelago Toscano and Corsica Channel, the stretch of coast between Rome and Naples and North West area of Sardinia (Fig. 1). In each area, different stations have been selected (Fig. 2 a-b-c, 3 and 4 a-b). Sampling in the first two areas have been performed in the period May-June 2019 whereas NW Sardinia have been sampled in the beginning of September 2019. All the sampling activities in Sardinia have been performed thanks to the support of the Tavolara - Punta Coda Cavallo Marine Protected Area.

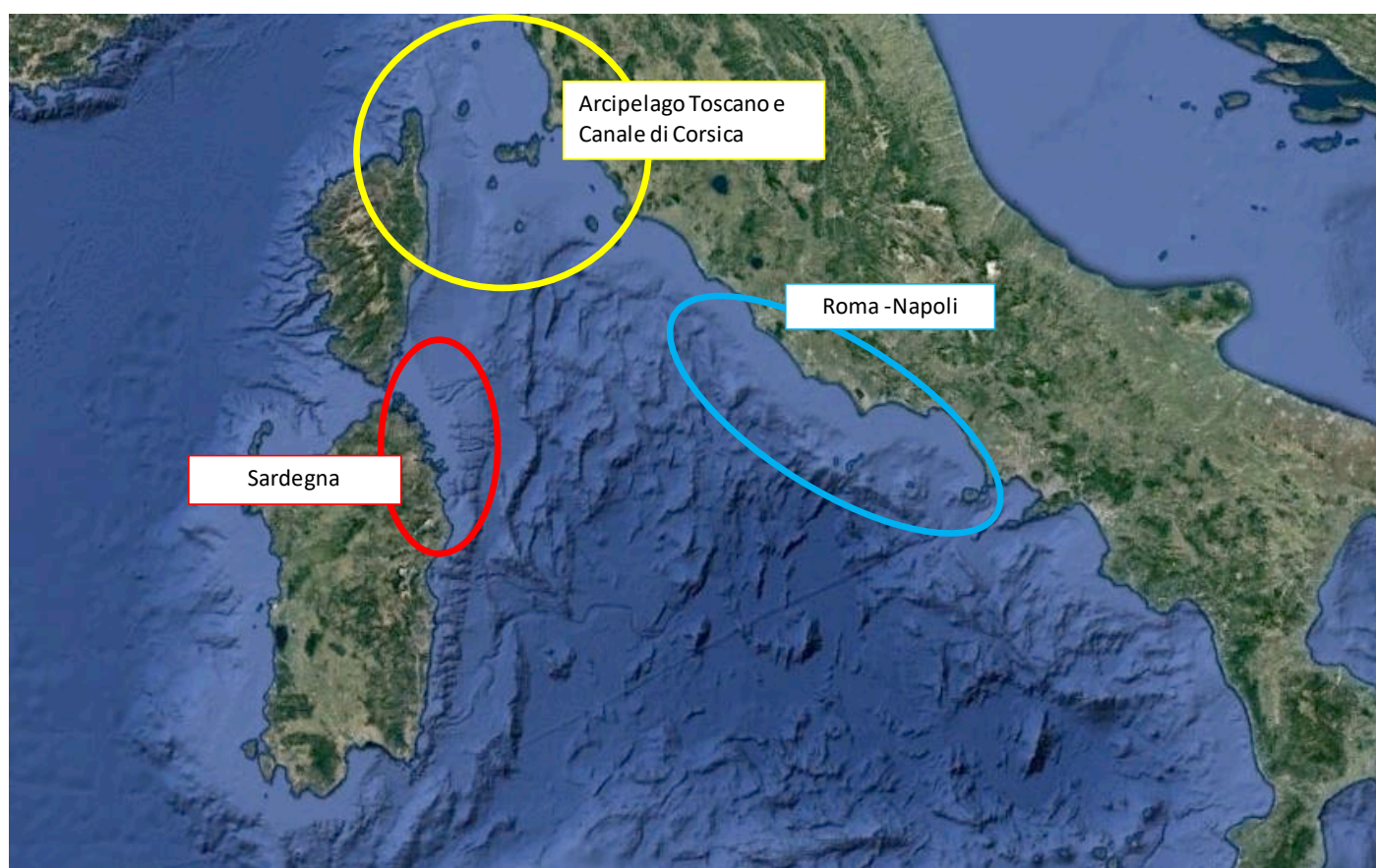


Fig.1 MAYDAY SOS Plastica Tour stations



Fig.2 a-b-c Roma-Napoli area of sampling

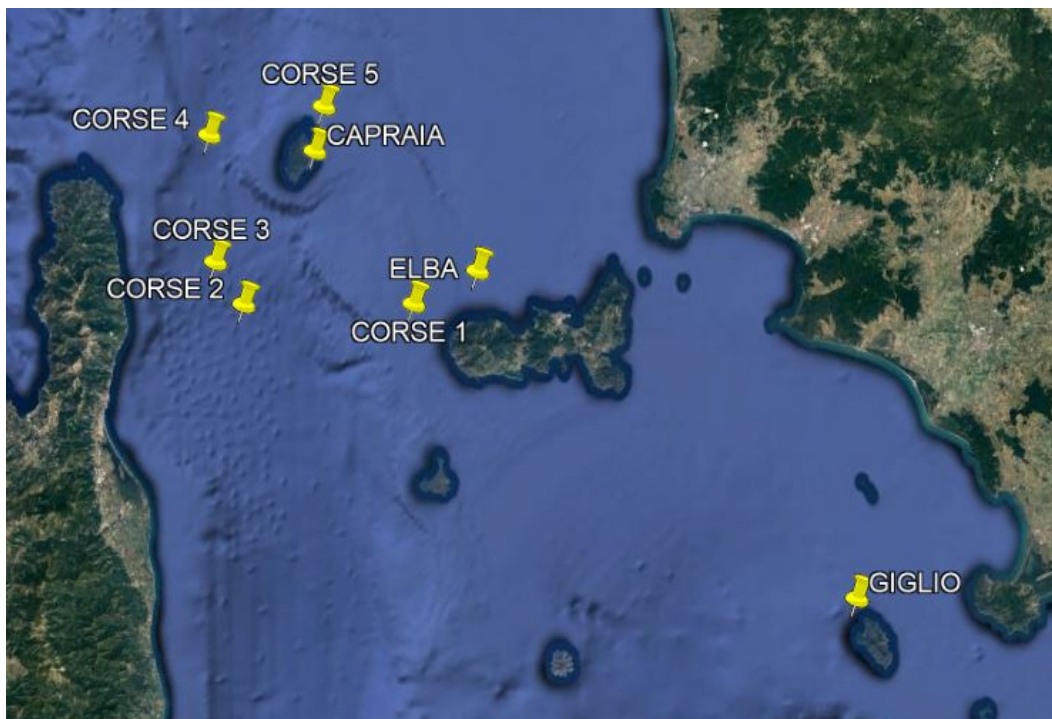


Fig. 3 Arcipelago Toscano sampling area



Fig.4 a-b Sardegna sampling area

Different types of water samples have been collected: surface water and water from deeper layers (-5 m). In total, 27 different stations have been sampled (Tab.1). In this report results from water samples are reported.

Tab.1 May DAY SOS Plastic Tour 2019

Area	Station	Date	Superficial Sampling - Manta Net Mesh size	lat.	long.
Roma-Napoli	Tevere	22/05/2019	100 µm	41.7322 N	12.1968 E
	Ventotene	23/05/2019	100 µm	40.8269 N	13.4561 E
	Ischia 1	24/05/2019	100 µm	40.8286 N	13.8251 E
	Ischia 2	24/05/2019	100 µm	40.8062 N	13.8492 E
	Ischia 3	24/05/2019	100 µm	40.7918 N	13.8478 E
	Ischia 4	24/05/2019	100 µm	40.7642 N	13.8859 E
	Portici	25/05/2019	100 µm	40.7853 N	14.2955 E
	Torre Annunziata	25/05/2019	100 µm	40.7361 N	14.3645 E
Arcipel ago Toscan	Corse 1	04/06/2019	100 µm	42.8086 N	10.0257 E
	Corse 2	04/06/2019	100 µm	42.8100 N	9.7027 E
	Corse 3	04/06/2019	100 µm	42.8677 N	9.6491 E

	Corse 4	04/06/2019	100 μm	43.0394 N	9.6304 E
	Corse 5	04/06/2019	100 μm	43.0834 N	9.8569 E
	Capraia	04/06/2019	100 μm	43,0217 N	9,8388 E
	Giglio Campese	07/06/2019	100 μm	42.3905 N	10.8558 E
	Giglio Porto	07/06/2019	100 μm	42.3812 N	10.9238 E
North West Sardinia	Olbia 1	03/09/2019	100 μm	40.9240 N	9.5594 E
	Olbia 2	03/09/2019	330 μm	40.9253 N	9.5362 E
	Olbia 3	03/09/2019	330 μm	40.9202 N	9.5314 E
	Tavolara 1	04/09/2019	100 μm	40.8929 N	9.6819 E
	Tavolara 2	04/09/2019	100 μm	40.8675 N	9.7089 E
	Tavolara 3	04/09/019	100 μm	40.8321 N	9.7057 E
	Golfo Aranci 1	05/09/2019	330 μm	40.9816 N	9.6314 E
	Golfo Aranci 2	05/09/2019	330 μm	40.9601 N	9.6424 E
	Golfo Aranci 3	05/09/2019	330 μm	40.9199 N	9.5708 E
	Golfo Aranci 4	05/09/2019	330 μm	40.8966 N	9.6843 E

3.2 Superficial sampling of microplastics with Manta net

Manta nets (100 or 330 μm mesh size) were used to collect surface water samples. In order to guarantee a real replication for each sampling site two Manta nets were used in parallel (Fig. 5). The 330 μm mesh size Manta nets have been used only in Sardinia (Olbia 2, Olbia 3 and in all the Golfo Aranci stations).

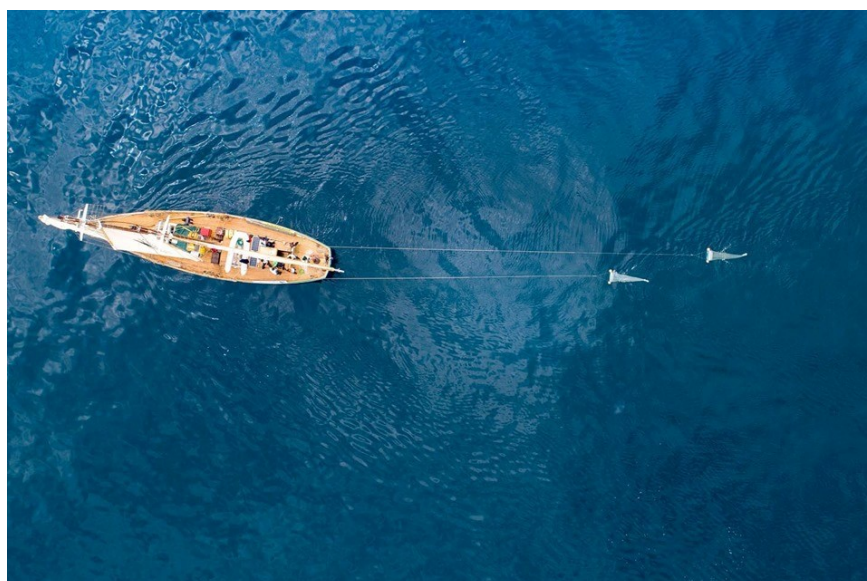


Fig.5 Double manta net. Photo by Lorenzo Moscia.

Sampling has been performed as follow (Fig.6 a-b-c-d):

1. Deploy the manta net out of the wake zone (approx. 30 m distance from the boat) to avoid turbulence effect inside the wake zone.
2. Start to move in one straight direction with a speed of approx. 1-2 knots for 10 minutes for 100 μm mesh or 15 minutes for 330 μm mesh.
3. After that time stop the boat and lift the manta net out of the water.
4. Rinse the manta net accurately using a submersible pump or other devices.
5. Safely remove the cod-end and transferred the content into 1l bottle and stored it for laboratory analysis



Fig.6 a-b-c-d Different operative steps of the Manta Net sampling. Photo by Lorenzo Moscia

3.3 Water column sampling

Water column has been sampled in two stations in the Roma-Napoli area: Torre Annunziata in front of the Sarno River mouth and in Ventotene Island.

To sample water column at a deep of -5 m under the surface, a new experimental method has been tested. The system (Fig.7) works with a pump that collect water from -5 m deep and brought together the water in a filters series column of 200 μm 80 μm and 20 μm (Fig.8).

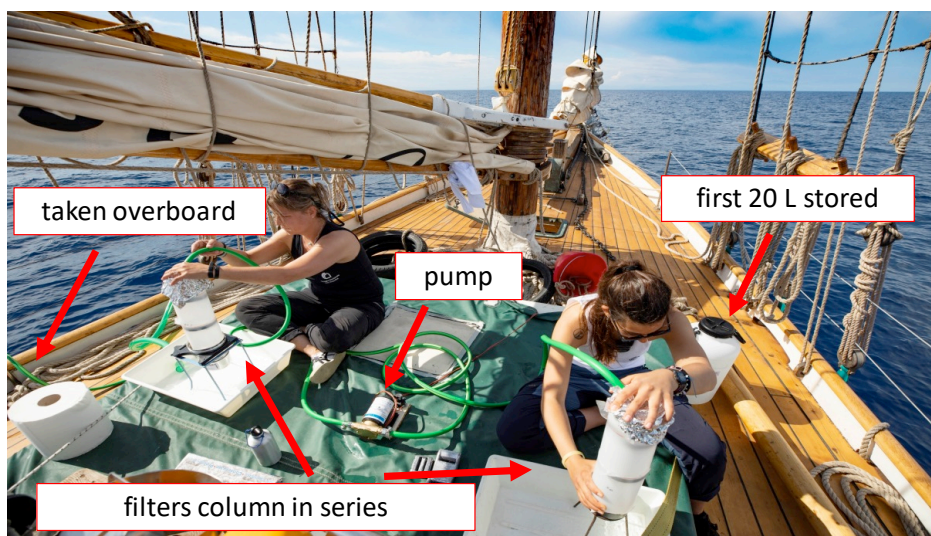


Fig.7 Testing new system to collect water column samples.

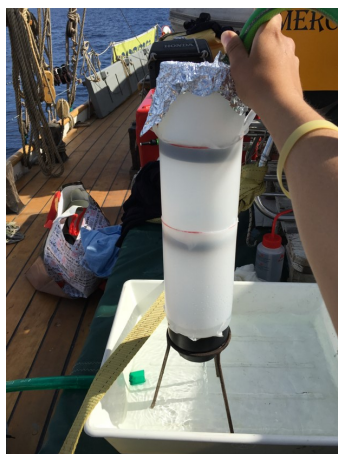


Fig.8 Filters column series.

4. Plastic identification in water sampling

MPs investigation on Manta's samples:

The water samples were analysed for their plastic content at the CNR-IAS laboratory in Genoa (Italy). All samples were visually examined and sorted under a stereomicroscope (Olympus BX41). Putative plastics were categorized according to shape and size (Fig. 9, Tab.2).

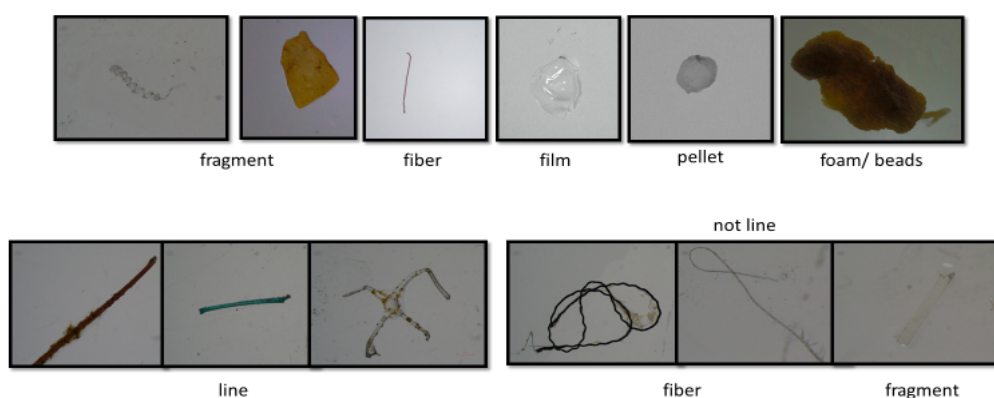


Fig.9 Different shape of microplastics classification. Selection of MPs of different size and shape from water samples analysed during laboratorial procedures.

Tab.2 Different size classes.

Size classification of plastics items			
Small microplastics	Medium microplastics	Large microplastics	Macroplastics
<1 mm	1-3 mm	3-5 mm	>5.00 mm

In order to identify the polymer composition of the items, PerkinElmer Spectrum Two Fourier Transform Infrared Spectroscopy (FT-IR) spectrometer equipped with Universal ATR (UATR) accessory with a 9-bounce diamond top plate was used (Tab.3).

Tab.3 Most frequently founded polymers.

Principal polymers	
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl chloride
EVA	Ethylene vinyl acetate
PVA	Polyvinyl acetate
PET	Polyethylene terephthalate
PS	Polystyrene
PA	Polyamide
EPDM	Ethylene-Propylene Diene Monomer

4.1 Contamination control

To mitigate sample contamination in the laboratory, all equipment and consumables were taken directly from packaging. Samples and equipment were covered where possible to minimize periods of exposure; clothing made of cotton were worn during the analysis. Filter blanks were run in parallel to verify contamination during both water sample processing. For each analysis, particles found in the blank were subtracted from those found in the samples (Fig.10).

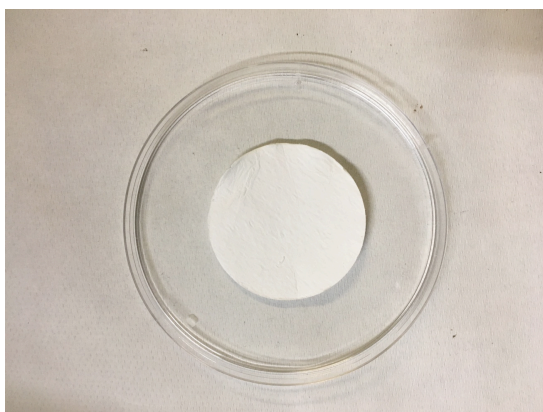


Fig.10 Filter blank

The only type of contamination founded has been fibres contamination. All fibres have been characterized for size and colour.

Concerning water column samples, a procedural field blank has been run in parallel with water sample filtration.

5. Results

Superficial sampling of microplastics with Manta net

Plastics were found at all the stations sampled. The number of plastics found in water samples was expressed as items/m³ and items/Km². The use of two Manta nets in parallel allowed to obtain a mean value. Results of the different Areas are reported in Table 4, and the following figures.

Tab.4 Average Microplastics (MPs) concentration reported both as items/m³ and items/Km²

Sample		items/m ³	items/Km ²
Roma-Napoli	Tevere	0,65	258.300,67
	Ventotene	0,12	49.550,60
	Ischia 1	0,15	58.516,97
	Ischia 2	0,17	69.604,27
	Ischia 3	0,03	11.357,70
	Ischia 4	0,08	32.600,90
	Portici	0,07	28.743,04
	Torre Annunziata	0,23	86.061,09
Arcipelago Toscano	Corse 1	0,39	155.238,28
	Corse 2	0,15	61.816,63
	Corse 3	0,21	85.336,83
	Corse 4	0,11	43.521,86
	Corse 5	0,20	81.260,11
	Capraia	0,80	321.828,08
	Giglio Campese	0,19	77.863,35
	Giglio porto	0,05	1.9366,69
Sardegna	Olbia 1	0,38	151.782,45
	Olbia 2	0,57	226.857,32
	Olbia 3	0,66	262.424,14
	Tavolara 1	0,05	19.942,02
	Tavolara 2	0,05	19.920,21
	Tavolara 3	0,10	38.574,20
	Golfo Aranci 1	0,15	61.549,44
	Golfo Aranci 2	0,09	35.700,79
	Golfo Aranci 3	0,31	12.4401,68
Golfo Aranci 4	0,11	45.988,41	

Global concentration

Microplastic concentration is diffused in all the sampling stations with a global average of $0,23 \pm 0,21$ items/m³ and $93.388,76 \pm 85.352,37$ items/Km². The high values of the standard deviation indicate a high variability among areas and stations.

Figures 11-12 allow to appreciate this variability both considering the number of microplastic present in 1 cubic meter of superficial sea water and that present in 1 Km² of water surface.

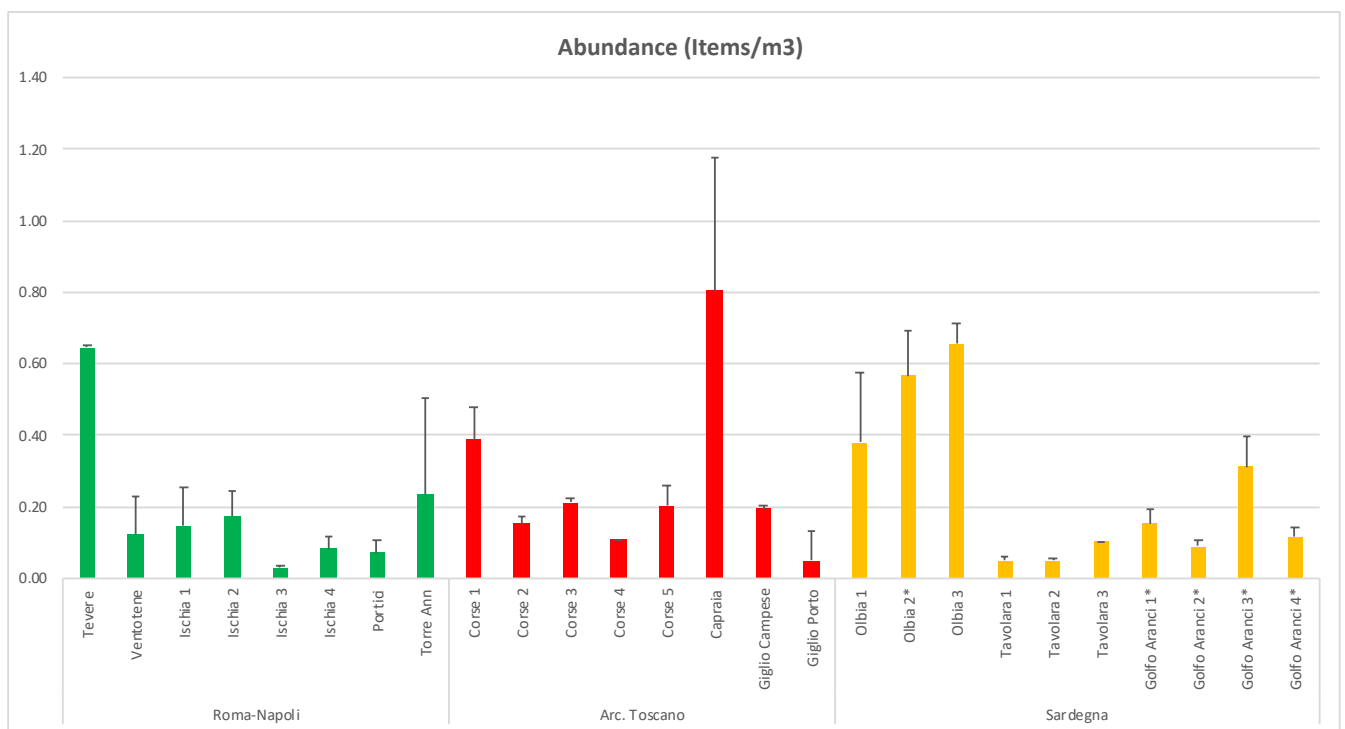


Fig.11 Concentration of microplastics items per m³ of superficial water in each station of the three different areas.

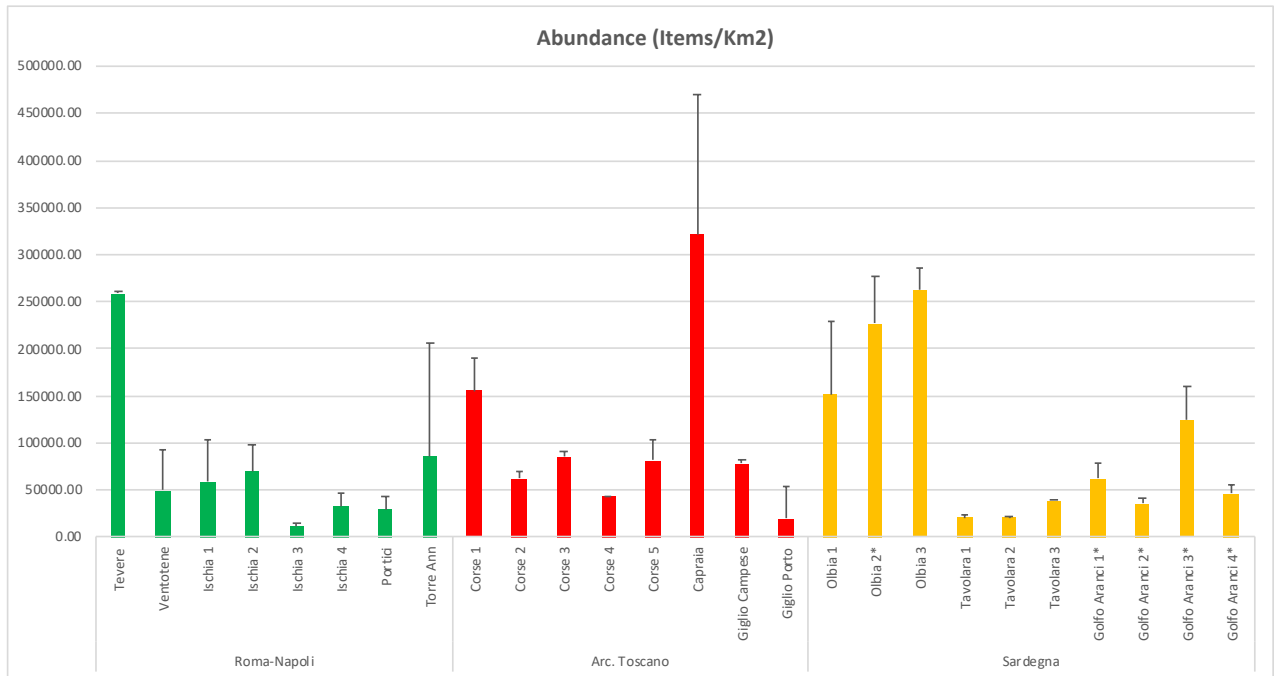


Fig.12 Concentration of microplastics items per Km² of superficial water in each station of the three different areas.

Global shape distribution

On average, the predominant shape of plastic, on a total of 2411 items founded in all the samples, are fragments with 88% fragments with different features (size and polymer composition) followed by line 3%, foam/beads 2%, film 2% and 1% of pellet (Fig.13). Fibers are not considered in the discussion due to possible contamination issue.

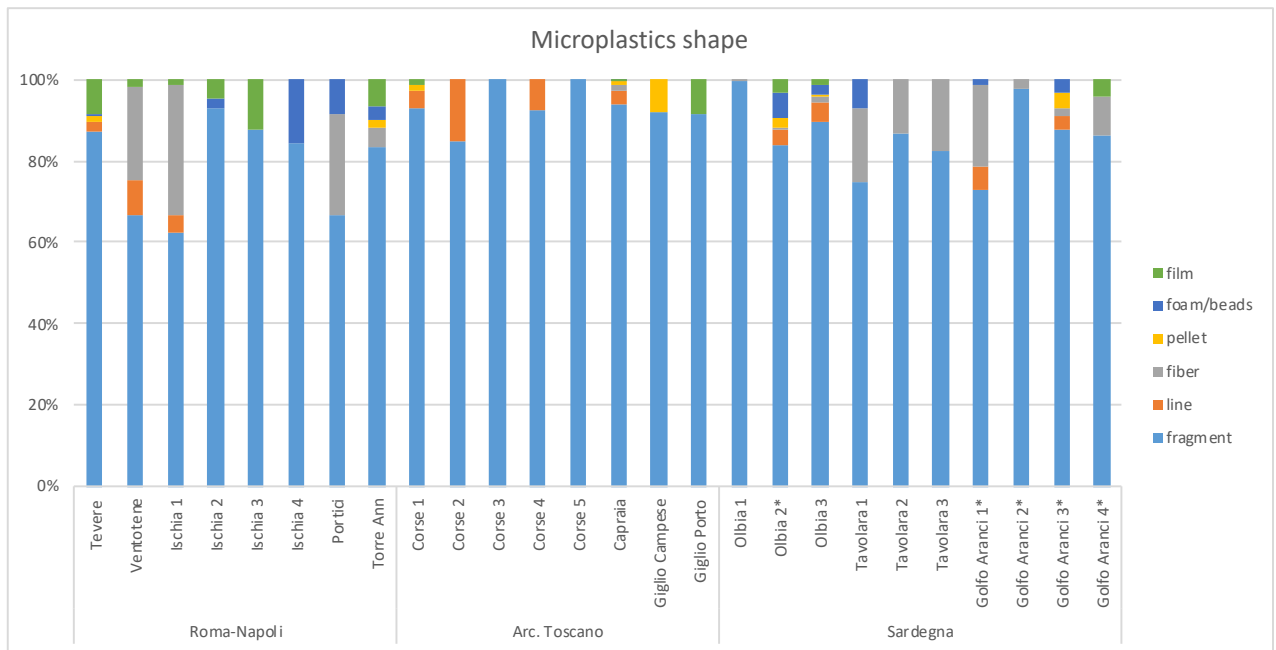


Fig.13 Shape distribution.

Global Size class

On average, the dimensional classes most represented on a total of 2332 items measured has been represented by medium MPs (1-3 mm) with 48%, followed by small MPs (<1mm) with 27% and large MPs (3-5 mm) with 15%. At last macro plastics (>5 mm) are represented for the only percentage of 10% (Fig.14).

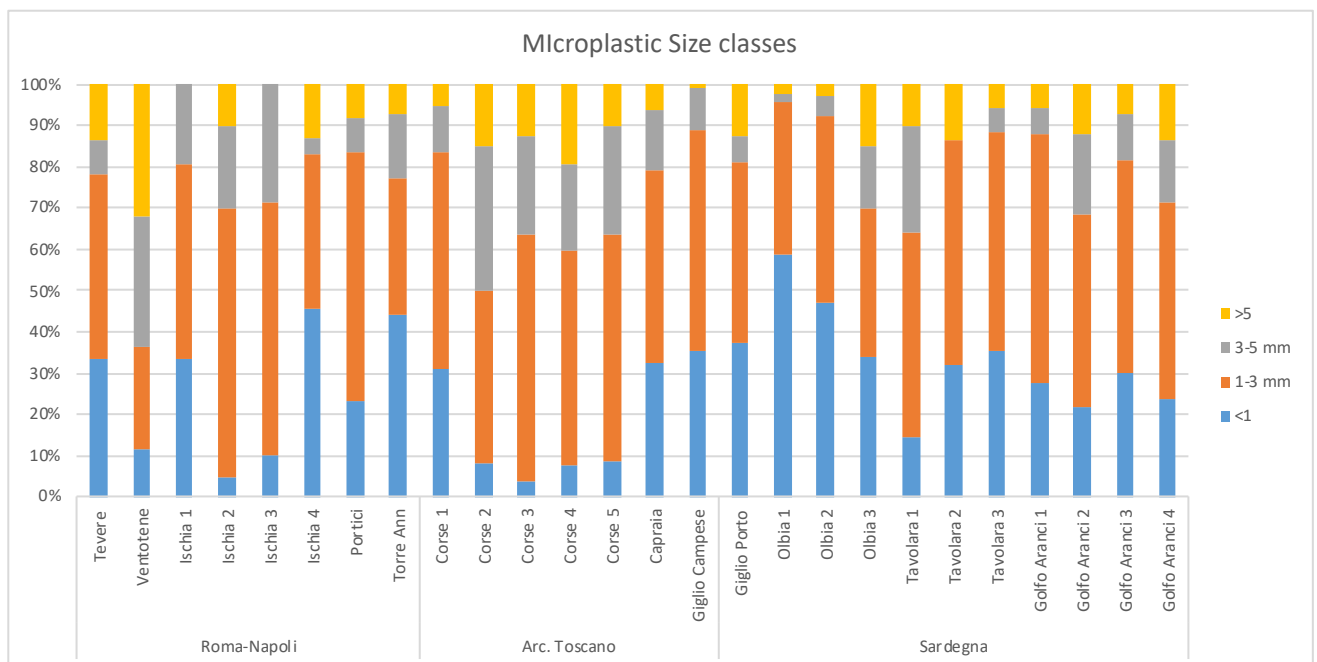


Fig.14 Size classes distribution.

Global chemical composition

On average, most founded polymers on 2212 items analysed have been: PE (Polyethylene) (64%), PP (Polypropylene) (29%), PA (Polyammide) (2%), EVA (Ethylene vinyl acetate) (1%), EPDM (Ethylene-Propylene Diene Monomer) (1%), PS (Polystyrene) (1%). Others polymers are present with a presence less than 1%: PVA (Polyvinyl acetate), PET (Polyethylene terephthalate), PMMA (Polymethyl methacrylate), Silicone, Polyacrilate, Nylon 6,6, Polyester, Poly butyl acrylate, PVC (Polyvinyl chloride) and Polyurethane (Fig.15).

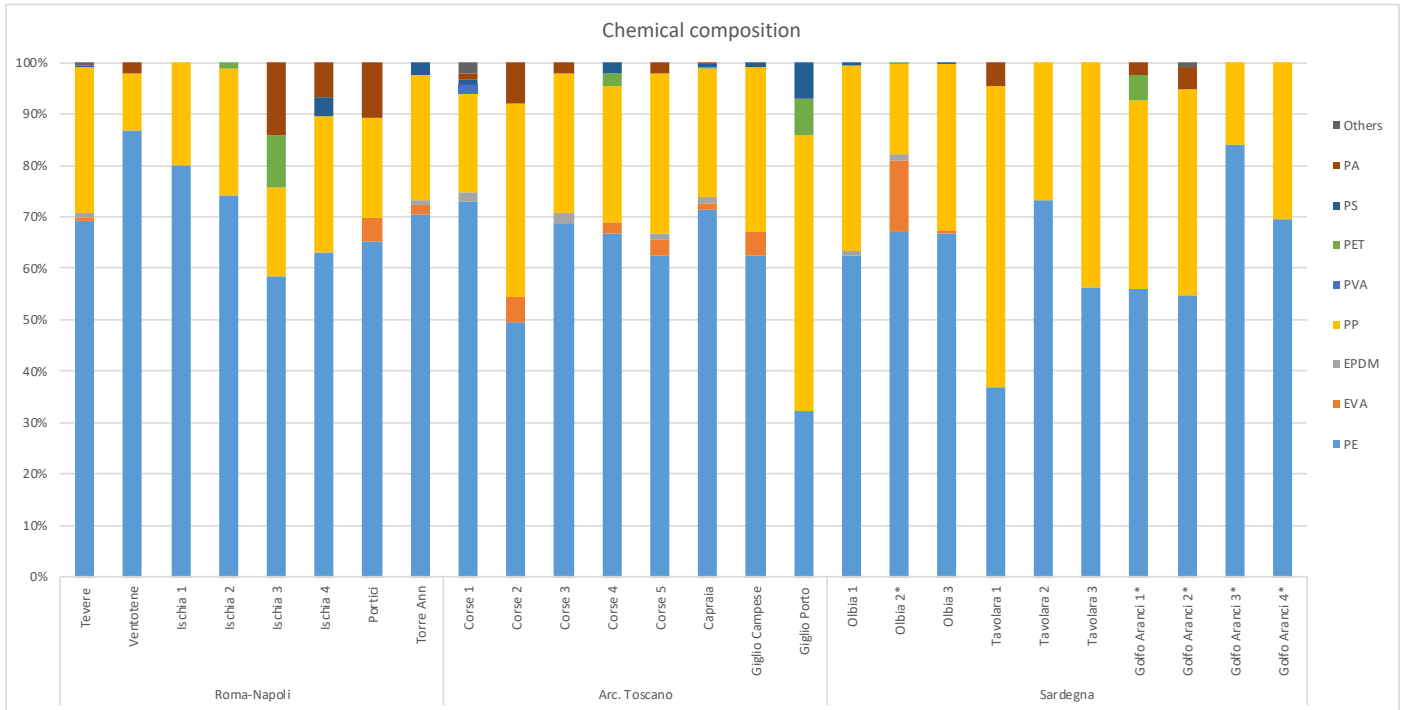


Fig.15 Chemical composition distribution.

A detailed description of results for each area is reported separately.

In figure 16-17 data of the abundance in the Napoli-Roma, Arcipelago Toscano and Corsica Channel, and North West Sardinia are reported.

As previously mentioned the presence of plastic was recorded in all the stations. In the **Roma-Napoli area** (Fig.16-17) the most impacted are the station sampled at the Tevere river mouth and Torre Annunziata close to the Sarno river mouth with an amount respectively of $25.8300,67 \pm 1835,64$ items/km² [$0,65 \pm 0,00$ items/m³] for Tevere, and $86.061,09 \pm 11.9298,68$ items/km² [$0,23 \pm 0,27$ items/m³] for Torre Annunziata station. The less contaminated station was Ischia3 with an abundance of MPs equal to $11.357,70 \pm 3.212,44$ items/km² [$0,03 \pm 0,01$ items/m³].

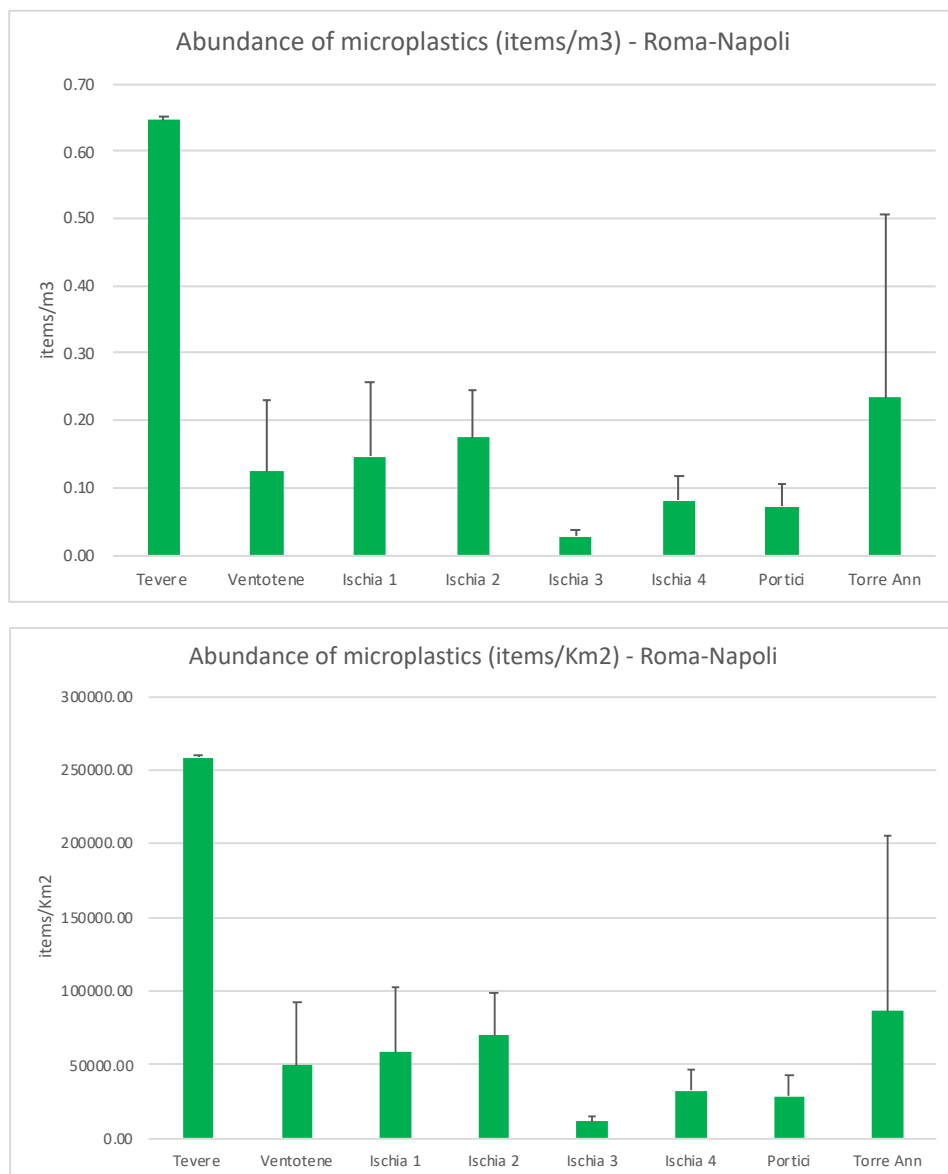


Fig.16-17 Concentration of microplastics in Roma-Napoli.

In the **Arcipelago Toscano area** (Fig.18-19), the Corse1 station has been the most impacted of the Corsica Channel with $155.238,28 \pm 35.193,45$ items/km² [$0,39 \pm 0,09$ items/m³], but the station showing the highest abundance of MPs resulted to be Capraia with an amount of $321.828,08 \pm 148.223,60$ items/km² [$0,80 \pm 0,37$ items/m³]. On the contrary, Giglio Porto with $19.366,69 \pm 3.815,40$ [$0,05 \pm 0,01$ items/m³] has been the station with the lowest number of items for Arcipelago Toscano zone.

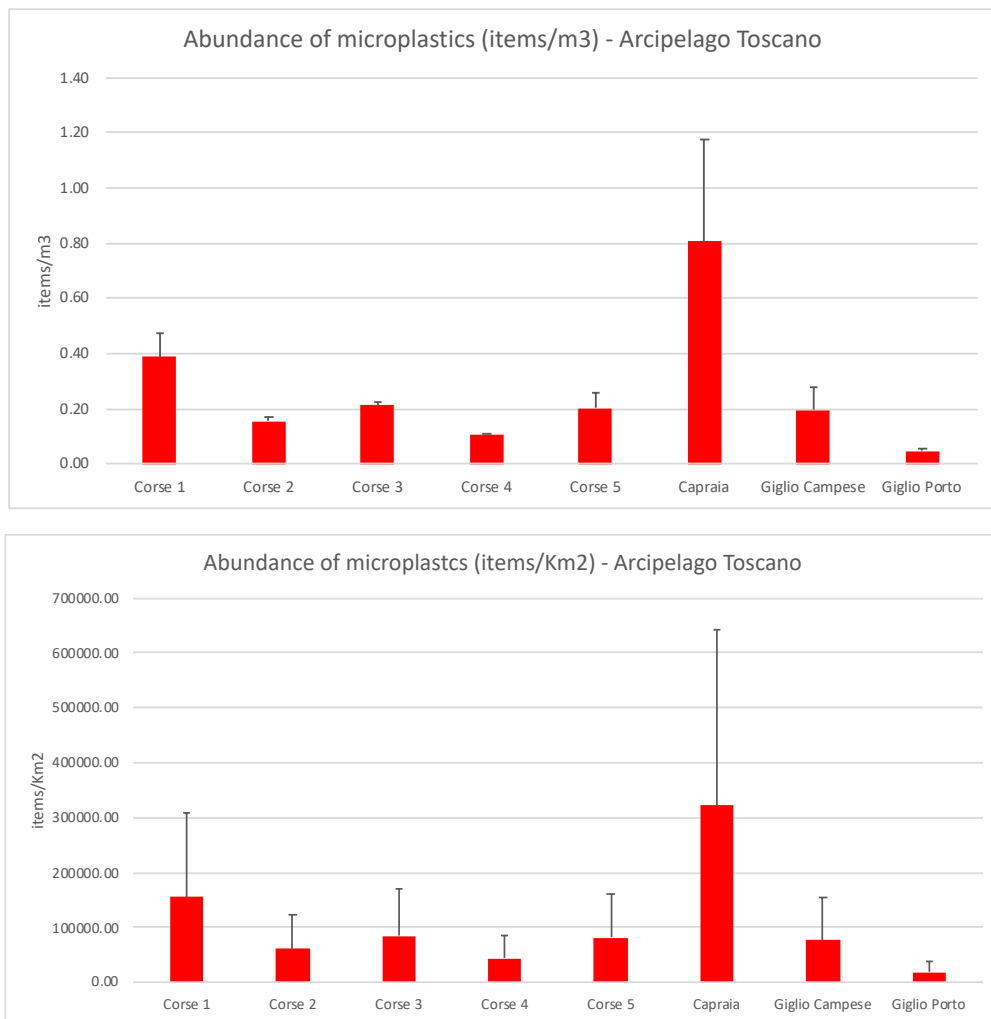


Fig.18-19 Concentration of microplastics in Arcipelago Toscano.

In **Sardegna area** (Fig.20-21) the most impacted area has been the Port of Olbia along the entering canal and in the interior zone of de basin with: Olbia1 151.782,45 ± 77.415,76 items/km² [0,38 ± 0,19 items/m³], Olbia2 226.857,32 ± 49.094,17 items/km² [0,57 ± 0,12 items/m³] and Olbia3 262.424,14 ± 23.195,24 [0,66 (± 0,06 STD) items/m³]. The other stations showed relatively lower number of MPs: Tavolara1 19.942,02 ± 3525,28 [0,05 ± 0,01 items/m³], Tavolara2 19.920,21 ± 1878,10 [0,05 ± 0,00 items/m³].

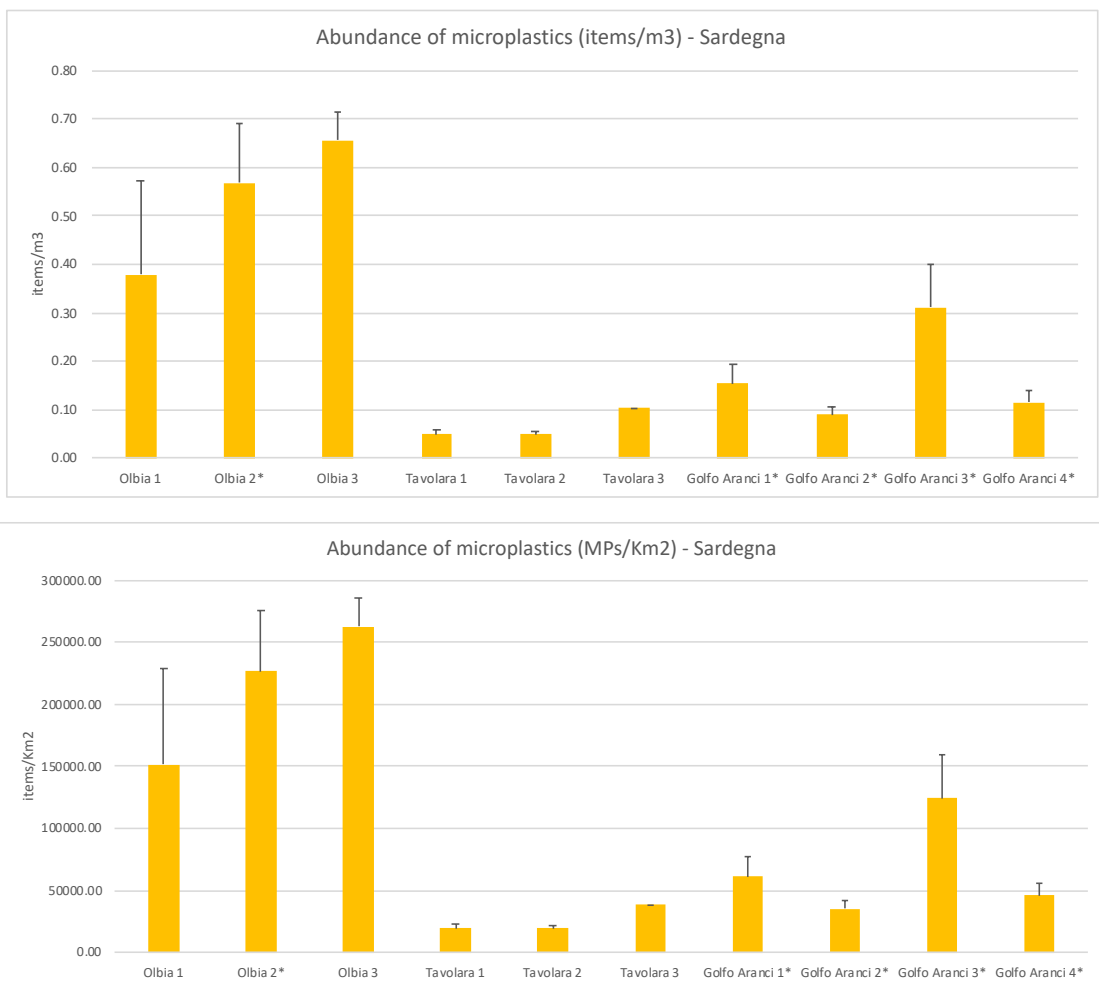


Fig.20-21 Concentration of microplastics in Sardegna area

4.2 Shape of Microplastics

In Roma-Napoli area (Fig. 22), fragments are globally the most representative type of plastic found in all the stations with number exceeding 50%. Films, in Tevere station reach a 8,5% of abundance as for foam/beads in Ischia 4 reach 15%. Lines and pellets are poorly represented. In the Arcipelago Toscano area (Fig. 23) fragments predominate again with the 100% of abundance found in the sample from Corse 5 Station. Fragments are followed by lines represented by 15% of abundance in Corse 2 station. Capraia station showed the highest level of MPs abundance with $321828,08 \pm 148223,60$ STD items/km² 94% of those are fragments followed by 3% lines, 2% fibres and 0,5% pellets (beads/foam and film are represented with a percentage lower than 0,5%). In the last macro area, the NW Sardinian coasts (Fig. 24) fragments represent 100% of items found in Olbia 1 station; followed by fibres (even if data on fibers should be verified) that in Golfo Aranci reach 20% of the total; line, foam/beads, films and pellets are poorly represented.

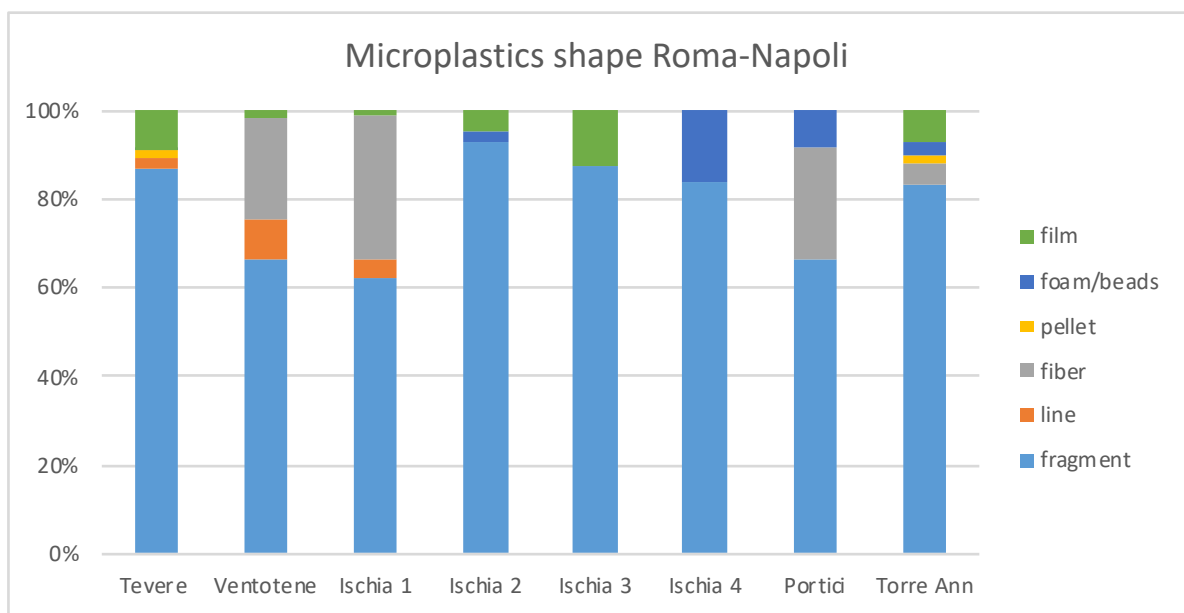


Fig.22 Percentage distribution of Microplastics shape in the Roma-Napoli area

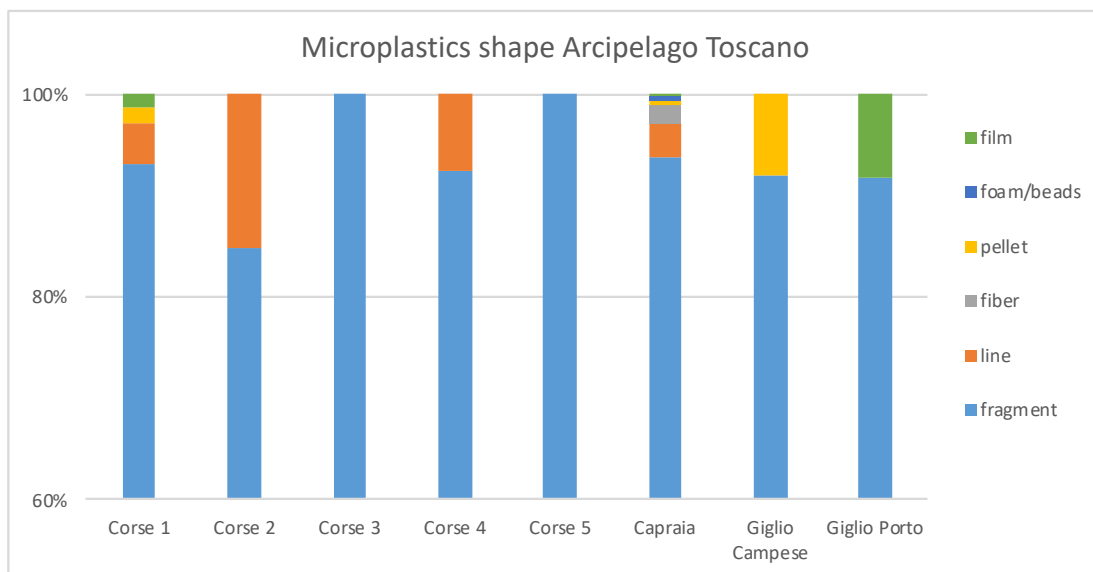


Fig.23 Percentage distribution of Microplastics shape in the Arcipelago Toscano area

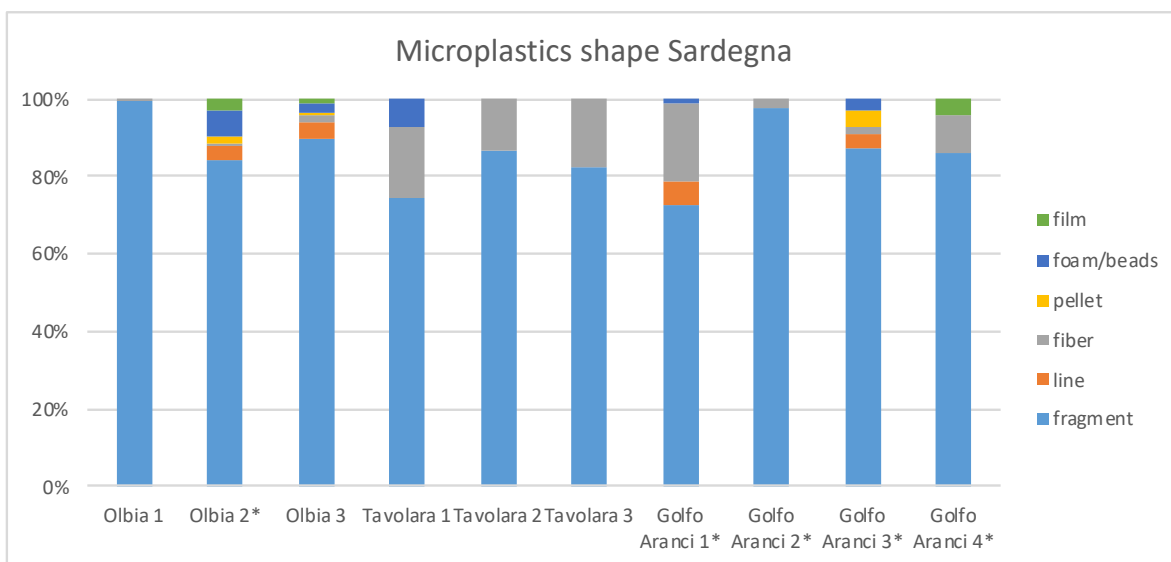


Fig.23 Percentage distribution of Microplastics shape in the Sardegna area

4.3 Size of plastics

Considering the size of MPs found on water samples most of them fall in the the medium microplastics size range (1-3 mm) with an average abundance of 48%. In particular in the Roma-Napoli area, in the Tevere station (258.300,67 ±1835,64 items/km²) most of the MPs fall in two size classes: 44,7 % of small MPs (<1 mm) and 33,4 % of medium MPs (1-3 mm) the same trend can be observed in Torre Annunziata and Ischia 4, where an higer amount of small MPs (<1 mm) compared to medium ones (1-3 mm) has been recorded (44,2 vs 33,2 % and 45,3 vs 37,8 , respectively). In Capraia station, the one most impacted from plastic presence, 47% of medium MPs (1-3 mm), a 32% of small ones (<1 mm), 14% of large MPs (3-5 mm) and a 6% of macroplastics (>5 mm) have been found. In Figure 24-25-26 it is possible to observe a detail of all zones distribution classes of size.

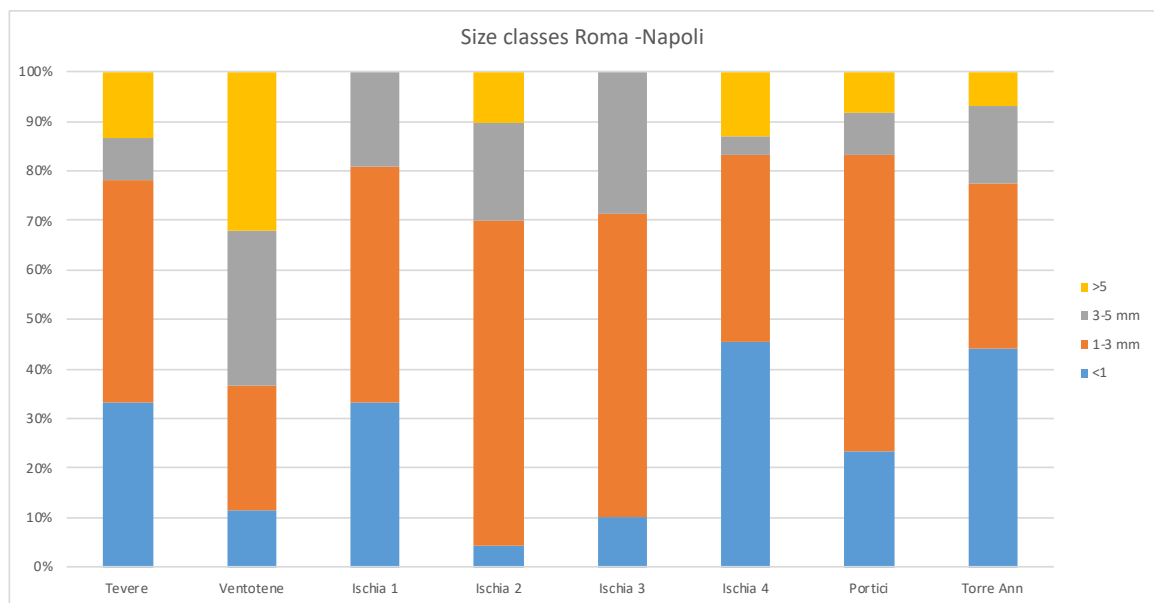


Fig.24 Percentage distribution of Microplastics size classes in the Roma-Napoli area

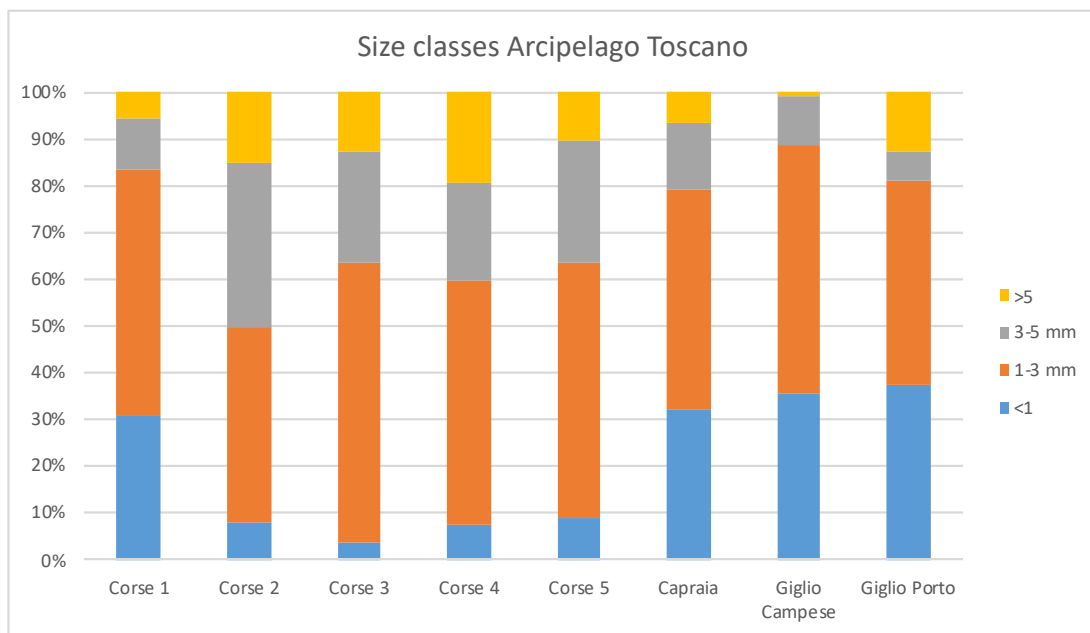


Fig.25 Percentage distribution of Microplastics size classes in the Arcipelago Toscano area

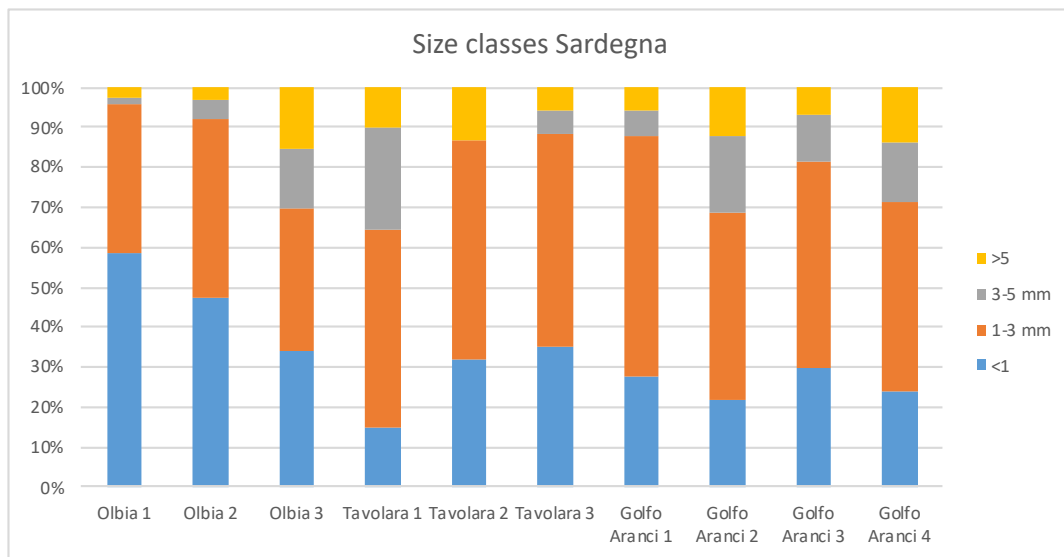


Fig.26 Percentage distribution of Microplastics size classes in the Sardegna area

4.4 Chemical composition

In general, polyethylene (PE) is the main polymer found in the superficial water samples, followed polypropylene (PP). The specific case of Roma-Napoli area describes perfectly this distribution (Fig.27). The Capraia station it's composed from 71% PE, 25% PP, on an equal footing of 1% in EVA and EPDM and other polymers which presence is lesser than 1% (Fig.28). Sardegna area globally presents a higher presence of PP in the samples with a case, in Tavolara1, where the presence of PP (59%) overcome the PE one (37%) (Fig.29).

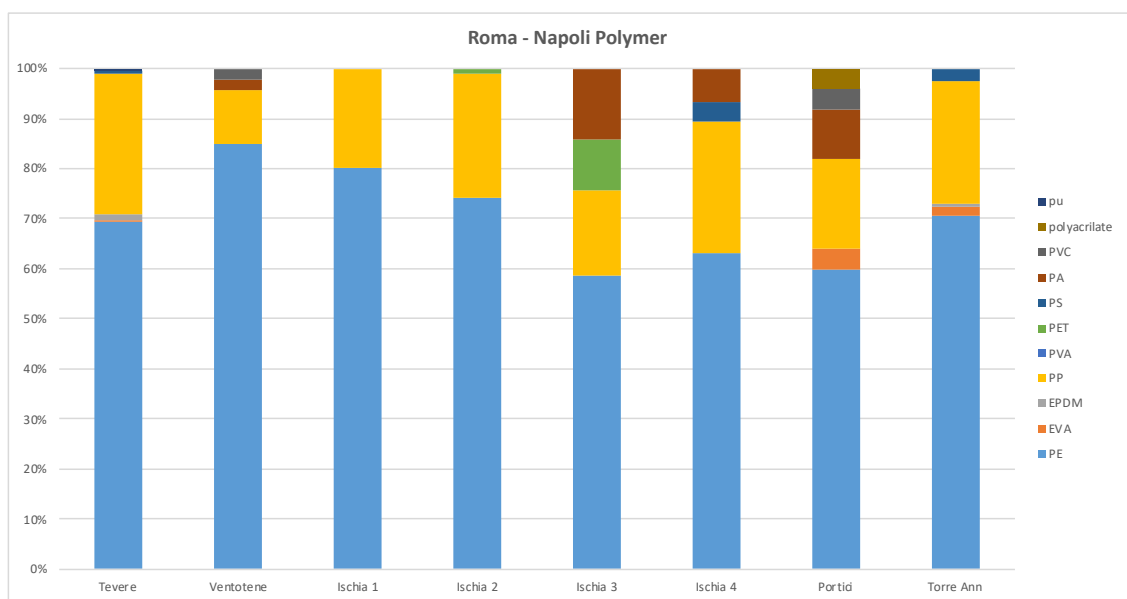


Fig.27 Percentage distribution of Microplastics Chemical composition in the Roma-Napoli area

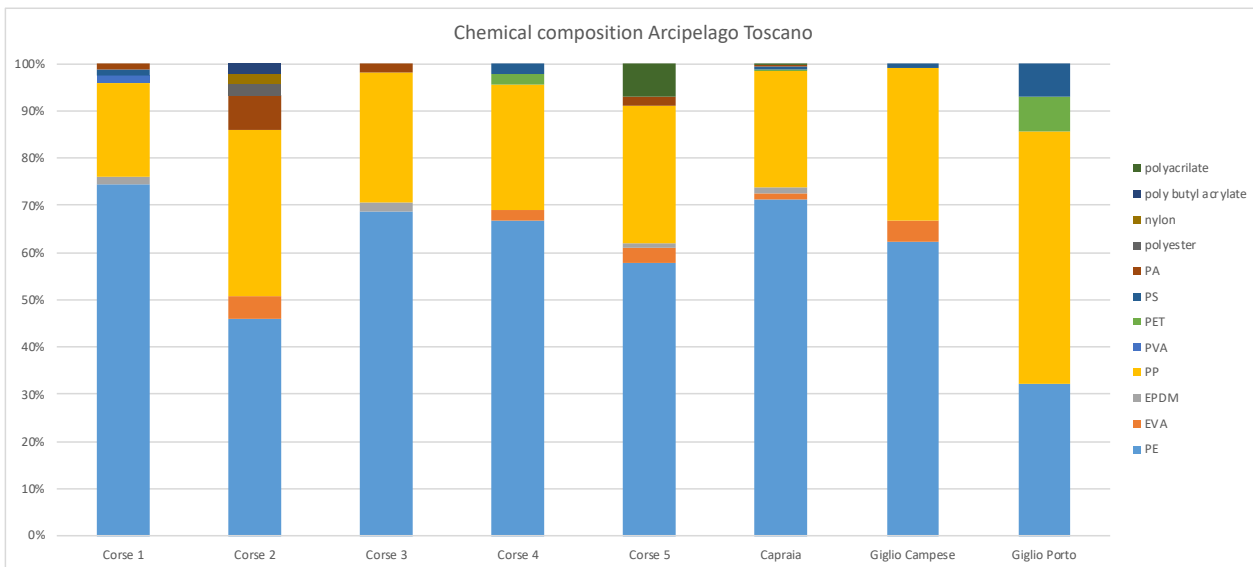


Fig.28 Percentage distribution of Microplastics Chemical composition in the Arcipelago Toscano area

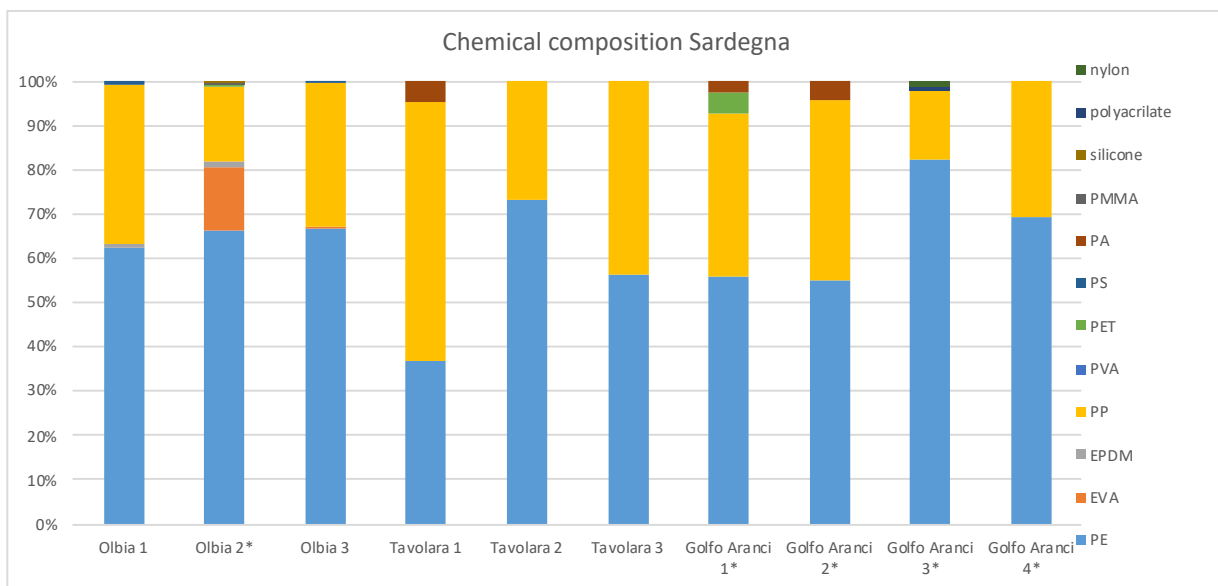


Fig.29 Percentage distribution of Microplastics Chemical composition in the Sardegna area

Water column

Results of MPs in water samples collected at 5m depth and filtered through a filtration column equipped with 200, 80 and 20 μm mesh size filters are reported in Fig. 30. Samples from Torre Annunziata has been filtered through the filtering column equipped with only 200 and 80 μm mesh size filters. In fact, due to high organic matter content coming from the Sarno River the 20 μm clogged immediately.

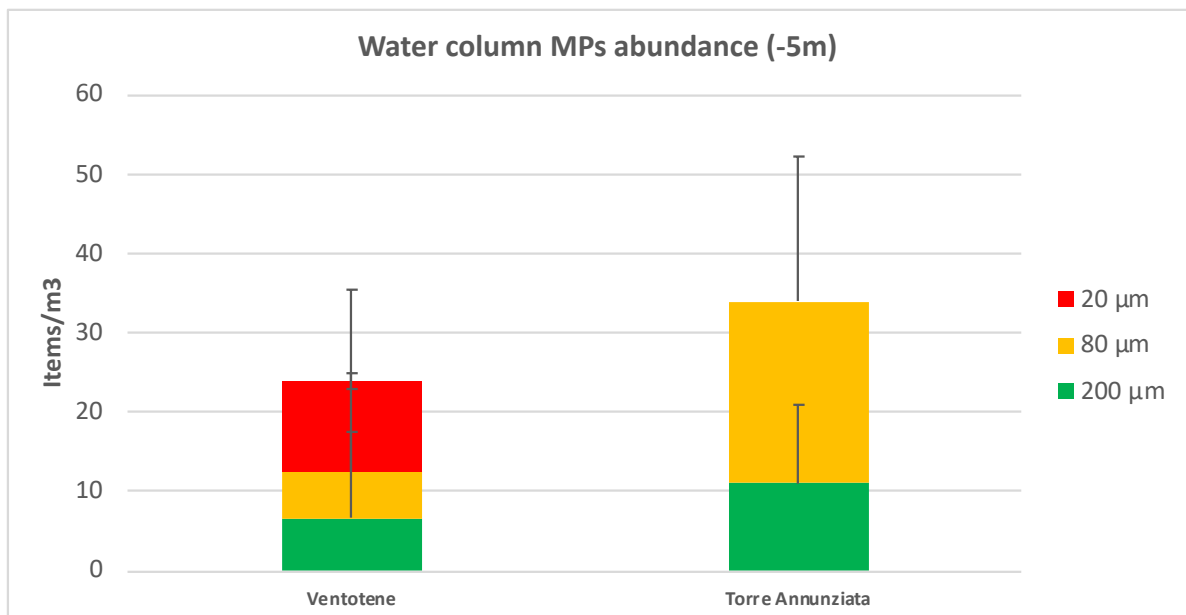


Fig.30: MPs abundance in -5 m water depth filtered through different mesh size.

It is evident a significant abundance of MPs in both samples. In detail, sample from Ventotene Island showed a cumulative abundance of MPs of 23,9 items/m³ coming from the sequential filtration of the water through the different filters (200 μm : 11.3, 80 μm : 6 and 20 μm : 6.65 items/m³). In Torre Annunziata, although the thinner filter (20 μm) has not been used (causing the loss of < 80 μm) the cumulative abundance of MPs resulted to be 34 items/m³ (200 μm : 23, 80 μm : 11 items/m³).

Microplastic found in the two samples have been classified as fragments and fibers (Fig. 31). In the sample from Ventotene, the percentage of fragments decreases consistently with the decrease of the filter mesh size with a contemporary increase of the number of microfibers (MFs). In detail, it is possible to observe that microplastic and microfibers found in the different samples are: 200 μm : MPs 60%, MFs 40%; 80 μm : MPs 41.6%, MFs 58.4%; 20 μm : MPs 17.1%, MFs 82.9%. On the contrary, samples collected in Torre Annunziata in front of the Sarno River mouth showed a ratio Microplastic/Microfibers independent from the mesh size filter with an equal percentage of MPs and MFs, 72.2 and 27.8 %.

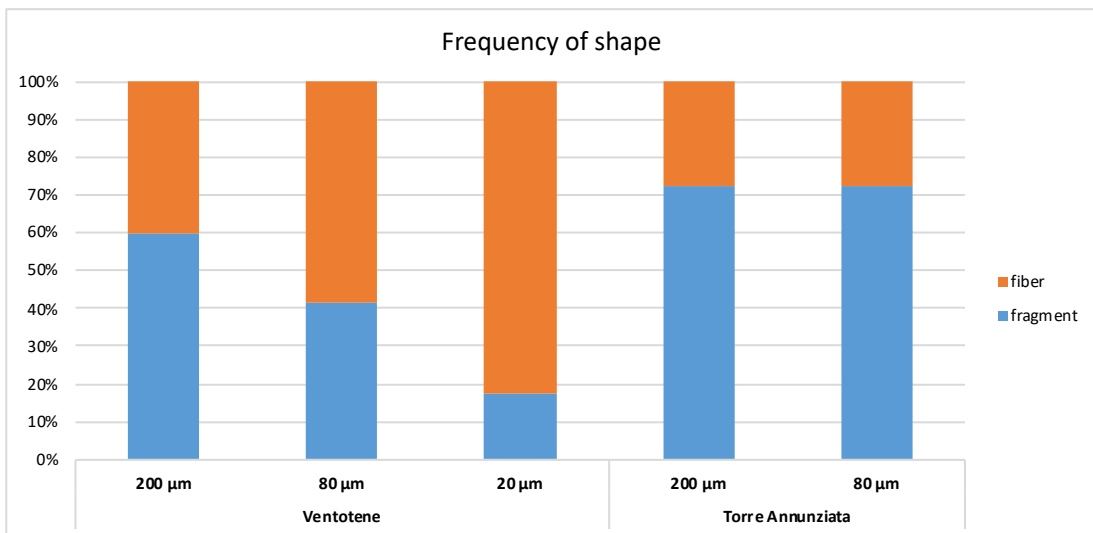


Fig.31: MPs shape distribution in -5 m water depth filtered through different mesh size.

At the moment, fibers polymeric composition has not been identified for this reason in figure 32 the cumulative abundance is reported separating microplastic (MPs) and microfibers (MFs).

In Ventotene the number of item/m³ was 7.3 for MPs and 16.7 for MFs; in Torre Annunziata 19 MPs and 15 MFs per cubic meter of water column filtration.

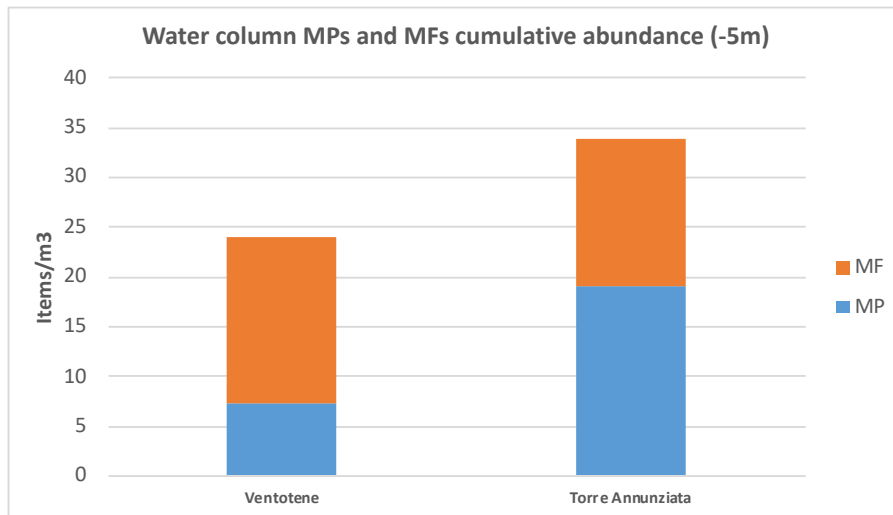


Fig.32: microplastic and microfibers cumulative abundance in Ventotene and Torre Annunziata

6. Conclusion

Microplastics have been found in all the sampled stations, with of $0,23 \pm 0,21$ items/ m^3 and $93.388,76 \pm 85.352,37$ items/ Km^2 as mean value.

This value is in the same order of magnitude than those reported by previous studies in Mediterranean regions ($0,15$ items/ m^3 , de Lucia et al. 2014; $0,31$ items/ m^3 , Fossi et al. 2016) and is, with the exception of some station, in line also with the results from the 2017 Tour “Less Plastic More Mediterranean”.

The Mediterranean basin is an enclosed area of sea, the only two open links with the Oceans are the strait of Gibraltar and Suez Canal. Both channels with an important entry of water bodies, rather than an exit. The important currents inside the Mediterranean Sea create some ‘hot spots’ of interest for plastic debris accumulation (UNEP, 2016). Areas like port or particularly coastline structures can turn into sizable point of accumulation. This hypothesis has been supported by the results of plastic content in this work.

The majority of MPs has been founded in Capraia island with $321.828,08 \pm 148.223,60$ items/ km^2 [$0,80 \pm 0,37$ items/ m^3], a point interested from the Corsica channel current, known as Tyrrhenian Current (TC). This current run along the Italians coasts from the south to the north arriving in the Ligurian Sea. During its passage the current accumulate debris with different origins and converge in that point giving rise to a possible hotspot. Data from the Capraia confirm the presence of temporary accumulation area of microplastic caused by the presence of the so called Capraia gyre a zone characterized by anticyclonic circulation; even if this structure are not comparable to the main ocean gyres, that are stable and permanent structure, these temporary accumulation patterns can be induced by seasonal circulation features (Fossi et al. 2017). Similar findings have been reported also by Suaria et al., 2016.

The NW Sardinia area showed interesting results. The area at the moment of sampling was characterized by a surface current entering the port channel causing an increase of MP accumulation in the two sampling sites located in the inner part of the Port: Olbia1 $151.782,45 \pm 77.415,76$ items/ km^2 [$0,38 \pm 0,19$ items/ m^3], Olbia2 $226.857,32 \pm 49.094,17$ STD items/ km^2 [$0,57 \pm 0,12$ items/ m^3] and the higher concentration in Olbia3 $262.424,14 \pm 23.195,24$ [$0,66 \pm 0,06$ STD items/ m^3] (Fig.4a).

A similar MP abundance has been observed in the area close to the Tevere River mouth with a concentration of $258.300,67 \pm 1835,64$ items/ km^2 [$0,65 \pm 0,00$ items/ m^3].

Samples have been collected at the mouth of one of the most impacted River of our country (de Lucia et al. 2018).

The shapes of MPs founded are not well distributed in the different typologies but most of them (88%) are fragments, followed by 4% fibres, and other shapes.

Concerning MPs size, most of them fall in the medium microplastics class (1-3 mm) with a 48% followed by small microplastics (< 1mm) 27%, 15% of large microplastics (3-5 mm) and a 10% of macro plastics (> 5mm) of items measured.

This finding confirms MPs (items smaller than 5mm) as the most abundant type of marine debris in sea water (Collignon et al. 2012; Desforges et al. 2014; Lusher et al. 2014; Moore et al. 2001).

Chemical characterisation of MPs pointed out that the majority is made of polyethylene (PE) (64%) and polypropylene (PP) (29%) followed by PA (Polyammide) (2%), EVA (Ethylene vinyl acetate) (1%), EPDM (Ethylene-Propylene Diene Monomer) (1%), PS (Polystyrene). This finding reflects the global demand of plastic polymers reported by Plastic Europe in 2019; in fact in 2018 the European plastic demand in 2018 was 51,2 Mt of which almost 50% was made up of polyethylene and polypropylene (Fig. 32) representing the materials most used in packaging.

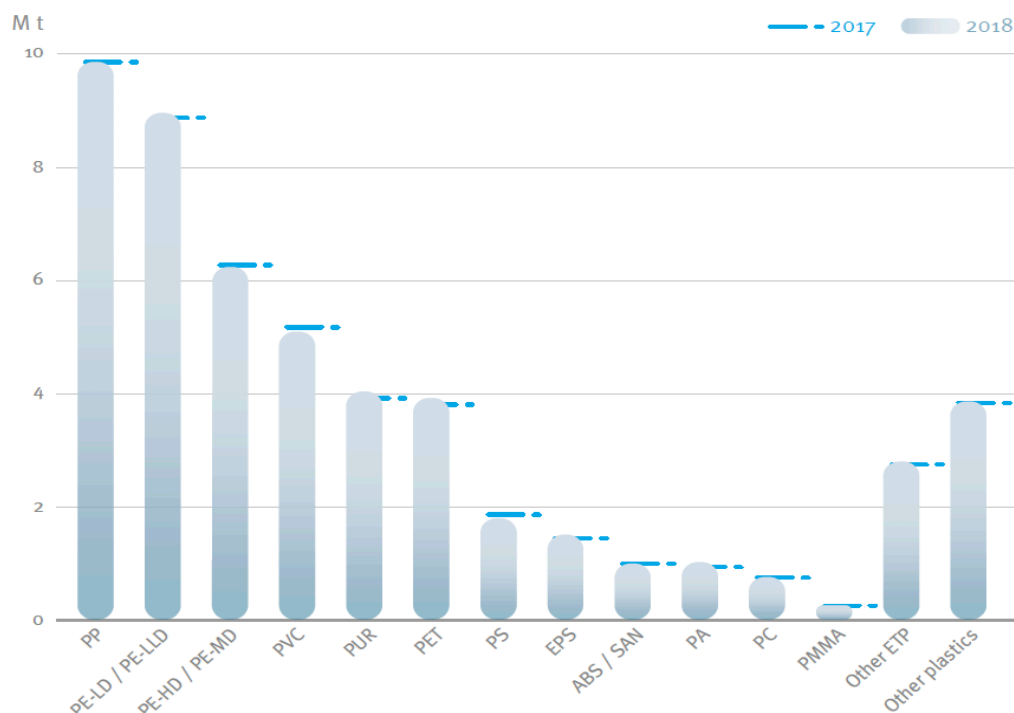


Fig.32: European plastic demand by resin type in 2018 (Plastic Europe, 2019).

Furthermore, these polymers are less dense than seawater and may remain longer in the first layer of the water as it has been recently confirmed by Erni-Cassola et al. (2019) in a meta-analysis of microplastic polymer distribution. On the contrary, high density polymers, like PVC may be mostly found in sediments (Fabbri et al. 2000).

The results obtained filtering sea water of the water column from 5 meters depth are very interesting and innovative.

The abundance of microplastic found in Ventotene Island and Torre Annunziata vary of two order of magnitude: 0,12 vs. 23,97 items/m³ and 0.23 vs. 34 items/m³ respectively with a different contribution by each mesh size filter (Fig. 30).

In this study, due to Instrumental limits, microfibers have not been characterized. Despite that, even if we consider Suaria et al. (2020) findings indicating that synthetic polymers account for only the 8.2% of fibers extracted from surface water samples in open ocean, the number of particles found in the water column from Ventotene and Torre Annunziata still remain one order of magnitude higher than that from the sea surface: 7.3 and 19 items/m³.

These results indicate that superficial water sampling may produce data with lower ecological relevance supporting the idea that the dynamic of microplastics in the water column still need to be better understood and a real picture of the actual contamination of microplastic in the marine ecosystem is far to be obtained.

Furthermore, the results obtained in this study suggested that use of different mesh size nets is able to influence the character of captured microplastic and, in particular, on their size indicating that indicates that the use of thinner mesh size nets may give more ecologically relevant results, considering that size and shape of microparticles strongly influence the likelihood of ingestion, and that MPs of lower sizes are those mainly ingested by marine organism (Wright et al. 2013, Lehtiniemi et al. 2018; Avio et al. 2020).

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