



# Marine litter monitoring and assessment in the Tuscan Archipelago National Park: outputs and results

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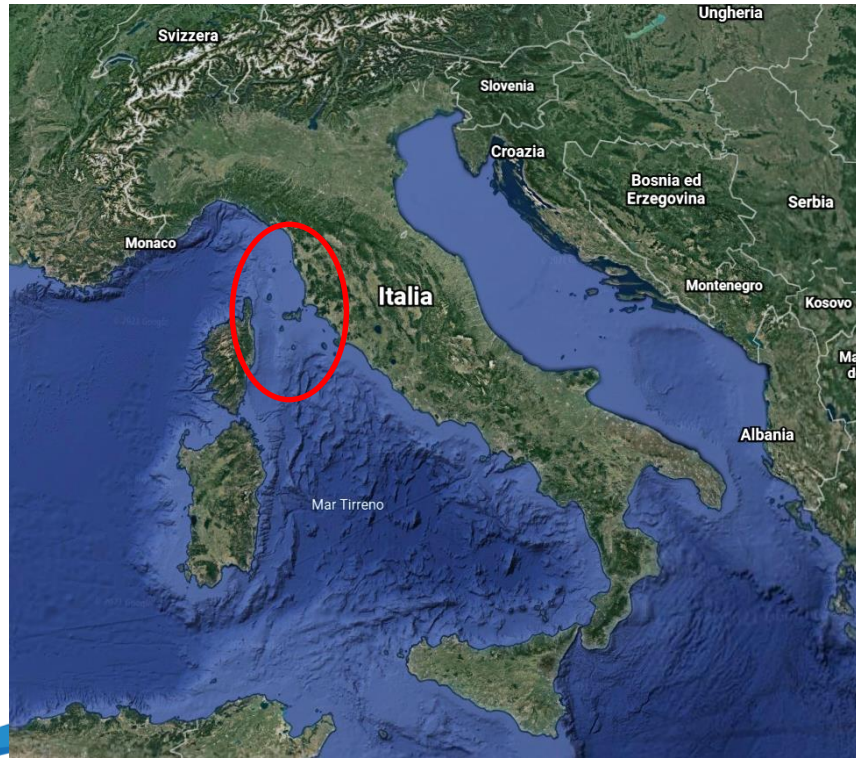
*Plastic Busters MPAs Capitalization event | 12 October 2021*



Project co-financed by the European Regional Development Fund



# Tuscan Archipelago National Park



TERS





# Tuscan Archipelago National Park Activities

**Partners involved:** ISPRA, UNISI, PNAT, IFREMER, OEC

## Marine litter distribution model



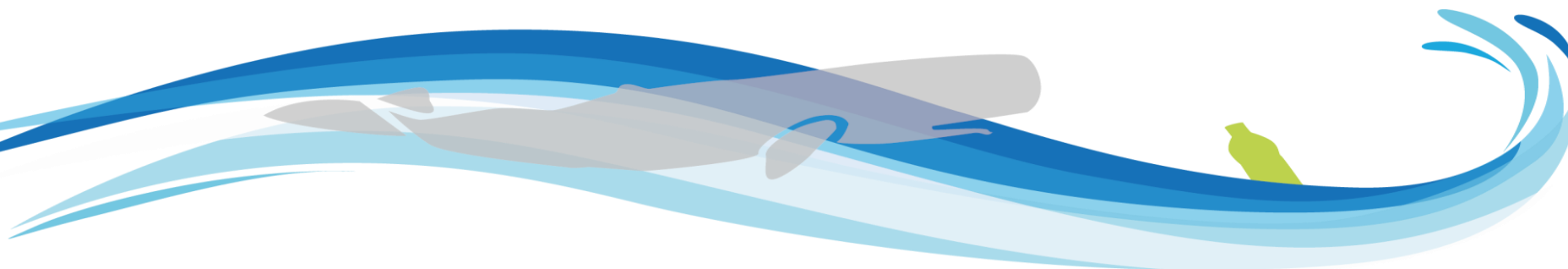
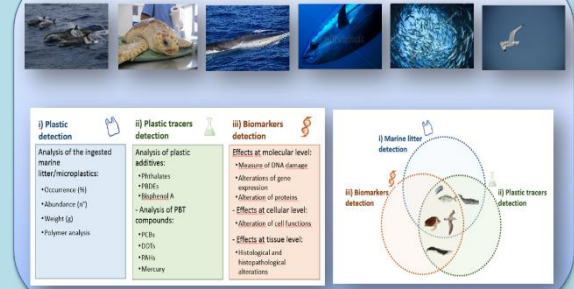
## Macrolitter sea surface



## Microlitter sea surface

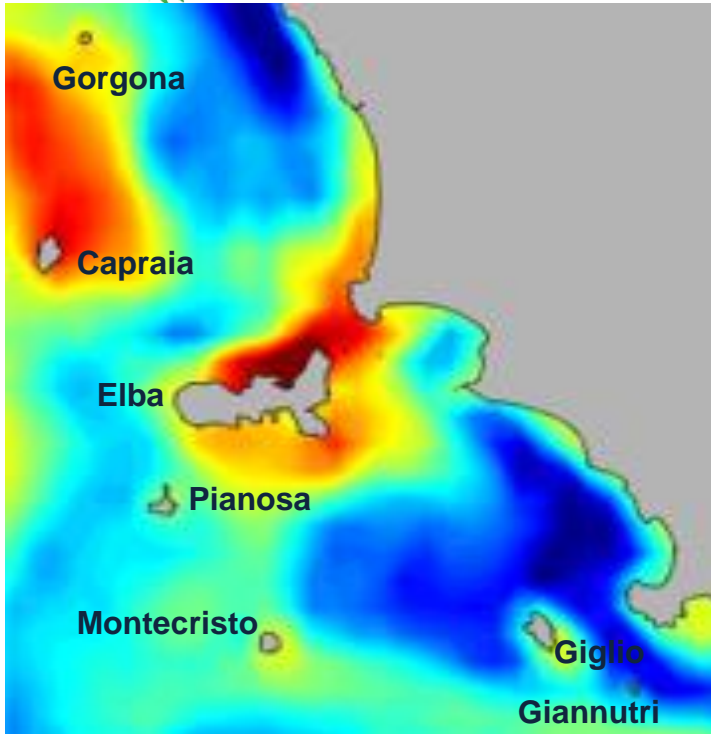


## MARINE LITTER IMPACTS ON BIOTA

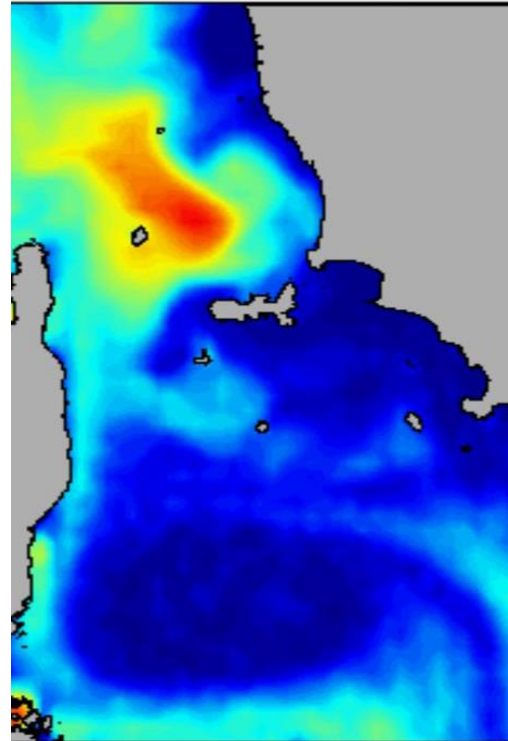


# Experimental design:

## *Validated ML Forecasting Model Sources Identification*



concentration index (me  
0718 - 20190722 (ISPRA)



The model allows to identify several structures (potential “Hot/Cold Spot areas”) around the islands:

- *Gorgona*
- *Capraia*
- *Elba*
- *Pianosa*
- *Montecristo*
- *Giglio*
- *Giannutri*

Tyrrhenian Sea - ROMS <http://www.lamma.rete.toscana.it/mare/modelli/correnti>

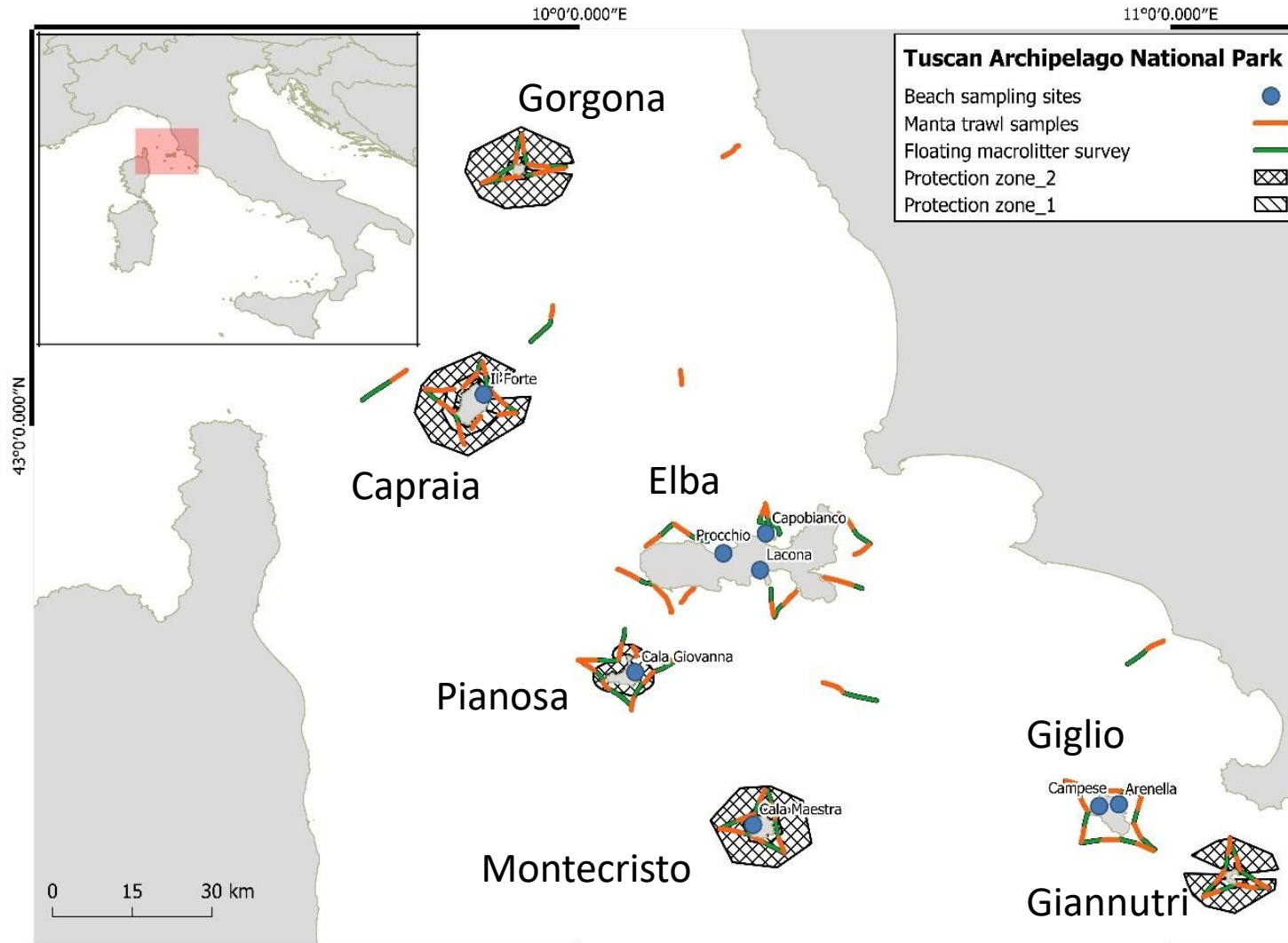
**Interreg**   
*Mediterranean*

**PLASTIC BUSTERS**  
MPAs

Project co-financed by the European  
Regional Development Fund



# Plastic Busters MPAs: Tuscan Archipelago National Park Activities



**PLASTIC BUSTERS MPAS**  
*Marine litter research expedition*  
TUSCAN ARCHIPELAGO NATIONAL PARK  
8 July - 23 July

**7 ISLANDS MONITORED IN 15 DAYS**  
**19 RESEARCHERS FROM 7 MED INSTITUTIONS**

Summary of the activities:

- 71 manta-trawls
- 131 floating marine litter surveys
- 11 cetacean skin biopsies
- 120 mussel samples
- 20 pools of neustonic indicators
- 100 fish samples

With the collaboration of UNISI, ISPRA, Ifremer, OEC, PNAT, Pelagos Secretariat and LaMMA

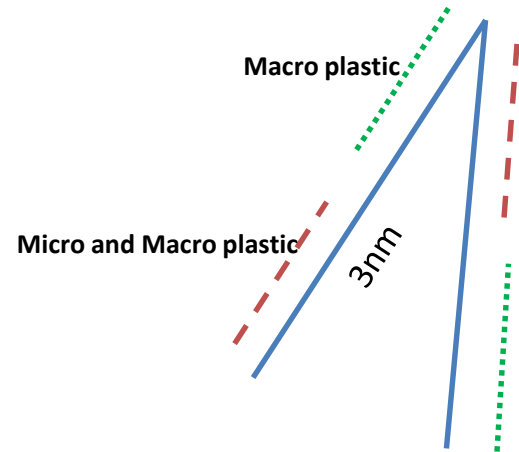
**Interreg Mediterranean**  
PLASTIC BUSTERS MPAS  
Project co-financed by the European Regional Development Fund





# Experimental design:

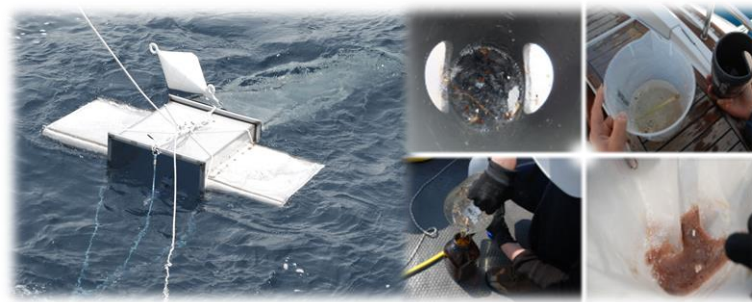
## *Simultaneous monitoring of Floating Micro- and Macro-litter*



Criteria for sampling:

- **INSIDE/OUTSIDE** the MPA
- **Level of protection**
- **Off-shore/In-shore waters**

### Floating Microplastics



**Manta trawl** equipped with a flowmeter

Mouth opening: **60 x 15 cm**

Mesh size: **330 µm**

Time: **30 minutes** (1.5 - 2 knots)

### Floating Macro Marine Litter



**Visual observation** from the bow

**Fixed Width Strip Transect method**

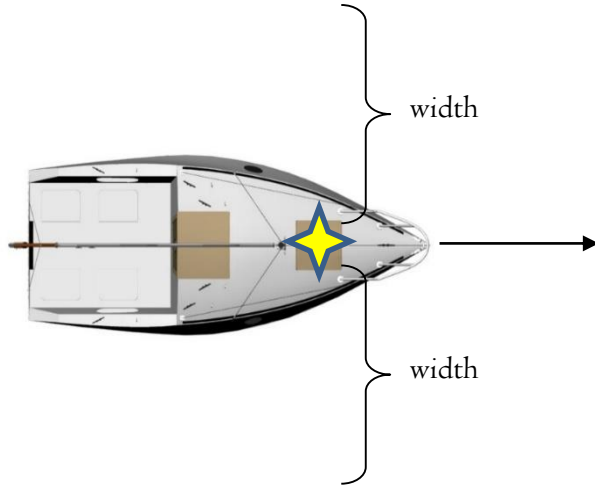
**MEDSEALITTER**

Strip width: **10 m**

Time: **30 minutes**



# Monitoring of Floating Macro-Litter (FMML)



Visual observation from the bow

Fixed Width Strip Transect method

MEDSEALITTER

Strip width: 6 m

Time: 30 minutes



## Floating MACROLITTER

|  |  |                            |
|--|--|----------------------------|
| ID CODE:                                       |  | Floating MICROLITTER code: |
| Sampling date:                                 |  |                            |
| Observer Name:                                 |  |                            |
| VESSEL CHARACTERISTICS                         |  |                            |
| Vessel name                                    | Name of the vessel   |                            |
| Type of vessel                                 | Type e.g. research, fishing, hired, regular ferry etc.   |                            |
| Vessel length and weight                       | Length of the vessel (m) (optional)<br>Gross weight of the vessel (kg) (optional)  |                            |
| VISUAL SURVEY TRANSECT DETAILS                 |  |                            |
| Latitude/longitude start                       | Recorded as $\phi_{start}$ , $\lambda_{start}$ degrees at the start of the sample unit   |                            |
| Latitude/longitude end                         | Recorded as $\phi_{end}$ , $\lambda_{end}$ degrees at the end of the sample unit   |                            |
| Time start                                     | Recorded as $h_{start}$ , $m_{start}$ at the start of the sample unit  |                            |
| Time end                                       | Recorded as $h_{end}$ , $m_{end}$ at the end of the sample unit  |                            |
| Coordinates system                             | Datum and coordinate system employed   |                            |
| Vessel speed                                   | Average ship speed in knots  |                            |
| Observation height                             | Observation elevation above the sea  |                            |
| Observation ZONE                               |  |                            |
| Distance covered                               | Total distance covered by the transect (m)   |                            |
| Time start/end                                 | Time over which the survey took place  |                            |
| Surface covered                                | Area covered by the vessel (km <sup>2</sup> )  |                            |
| ENVIRONMENTAL PARAMETERS - OBSERVATION DETAILS |  |                            |
| Wind speed                                     | Recorded in (Beaufort)   |                            |
| Wind direction                                 | Tick more than one boxes e.g. for SE wind<br><input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W |                            |
| Sea surface salinity                           | Expressed in ‰ when reporting  |                            |
| Viewing quality                                | Good/Moderate/Poor; in the latter two case state cause (e.g. fog)  |                            |
| Sea state                                      | Expressed in accordance with the Douglas Sea Scale (0-9)   |                            |
| NOTES  |  |                            |

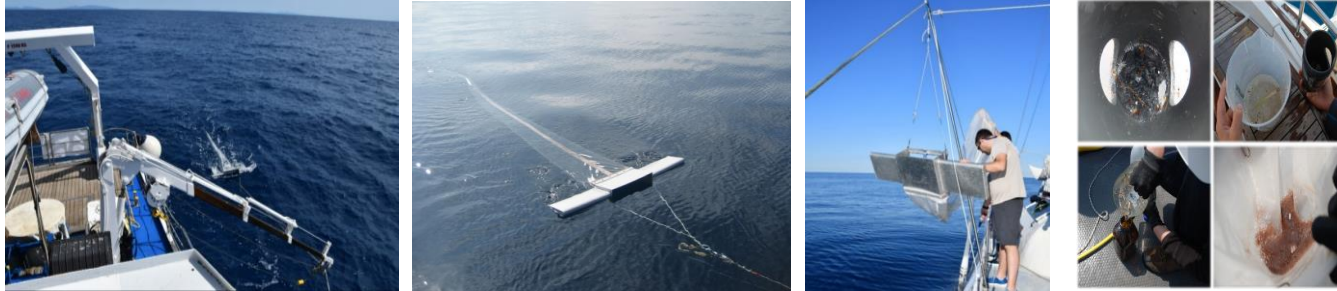


| TYPE OF MATERIAL             |      |      |
|------------------------------|------|------|
| ARTIFICIAL POLYMER MATERIALS |      |      |
| 01                           | 02   | 03   |
| 04                           | 05   | 06   |
| 07                           | 08   | 09   |
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| 997                          | 998  | 999  |
| 1000                         | 1001 | 1002 |

Note and remarks:



# Monitoring of Floating Microplastics



**Manta trawl** equipped with a flowmeter

Mouth opening: **60 x 15 cm**

Mesh size: **330 µm**

Time: **30 minutes** (1.5 - 2 knots)



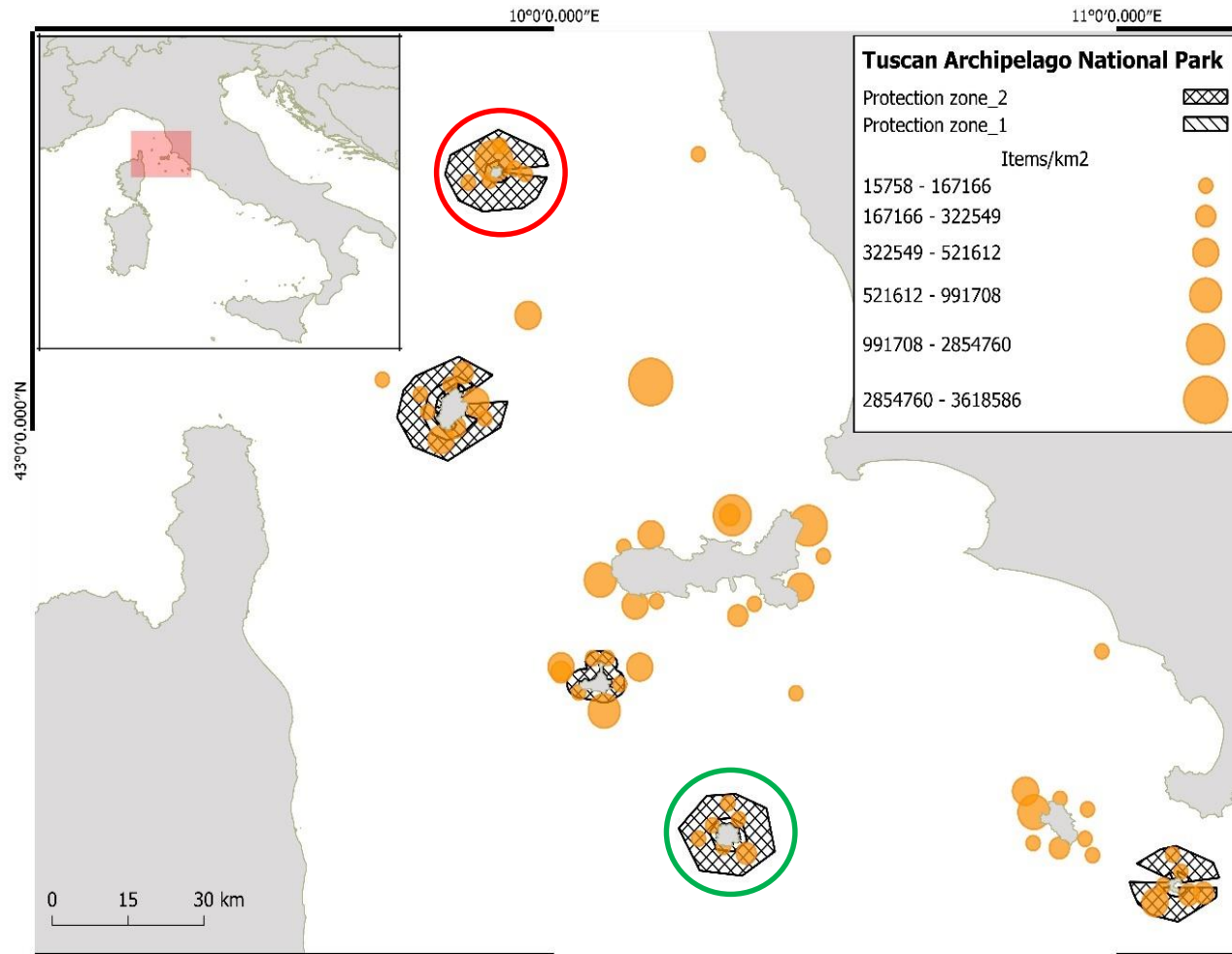
## Floating MICROLITTER

|  |                 |  |                |      |
|--|-----------------|--|----------------|------|
| ID code:   |                 | Floating MACROLITTER code:                           |                |      |
| Sampling date:   |                 |  |                |      |
| <input type="checkbox"/> Surface waters (s)(Manta trawl) |                 | <input type="checkbox"/> Water column (wc) (WP2 net) |                |      |
| Sampling site:   | Latitude        |  | Longitude      | Time |
|  | Start           |  |                |      |
|  | End             |  |                |      |
| Vessel speed:  |                 |  |                |      |
| Duration of the trawl:                                   |                 |  |                |      |
| Weather condition  | Sea:            |  | Sky:           |      |
|  | Water temp.:    |  | Wind:          |      |
| Bathymetry (m):  |                 |  |                |      |
| Flowmeter  | Start:          |  | End:           |      |
| Depth reached (wc):                                      |                 |  |                |      |
| Frozen sample  | Contaminants    |  |                |      |
| Fixed sample   | Ethanol _____ % |  |                |      |
|  | Volume          |  |                |      |
| Biota/Neuston  | ID code :       |  | N°. ind. pool: |      |





# PNAT campaign as a whole: Sea surface Micro-Litter



N°. 71 samples

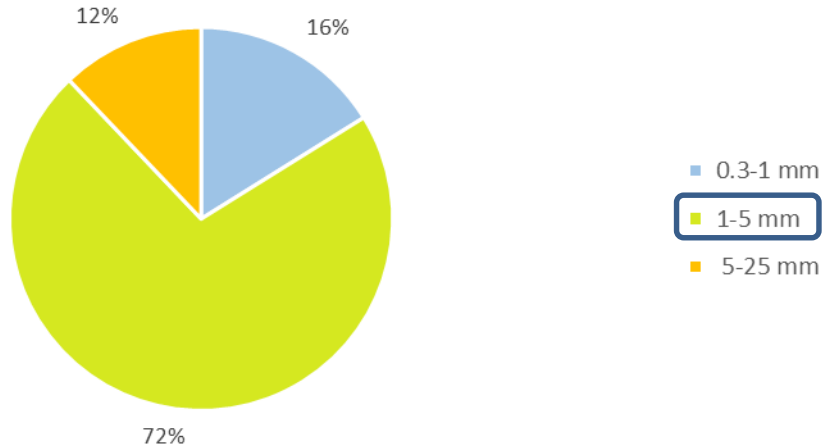
40,225 items isolated

Mean concentration: 298,750 items/km<sup>2</sup>

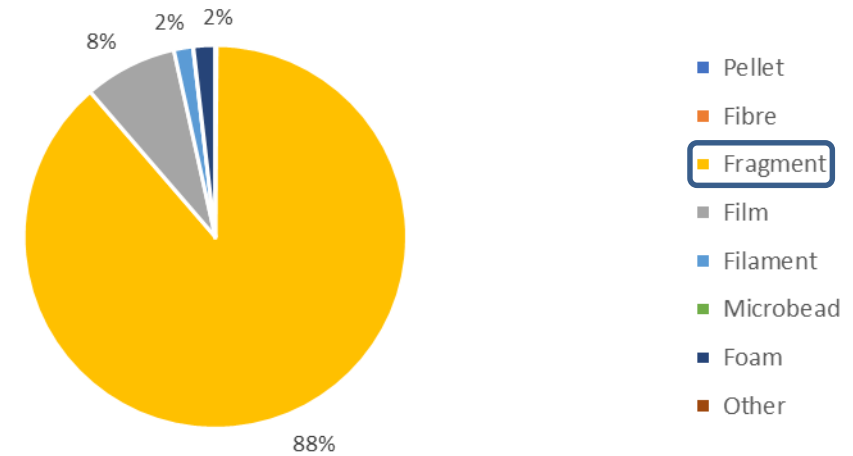


# PNAT : Micro-Litter shape, colours and dimension

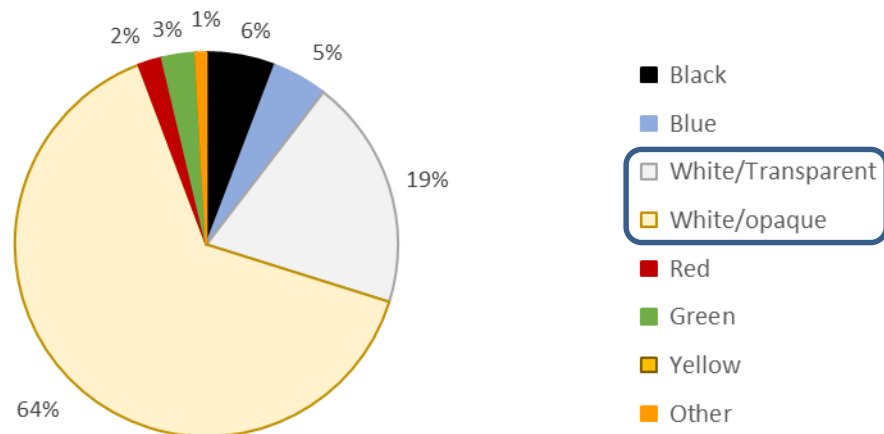
PNAT: floating meso and microlitter size classes



PNAT: floating microlitter types

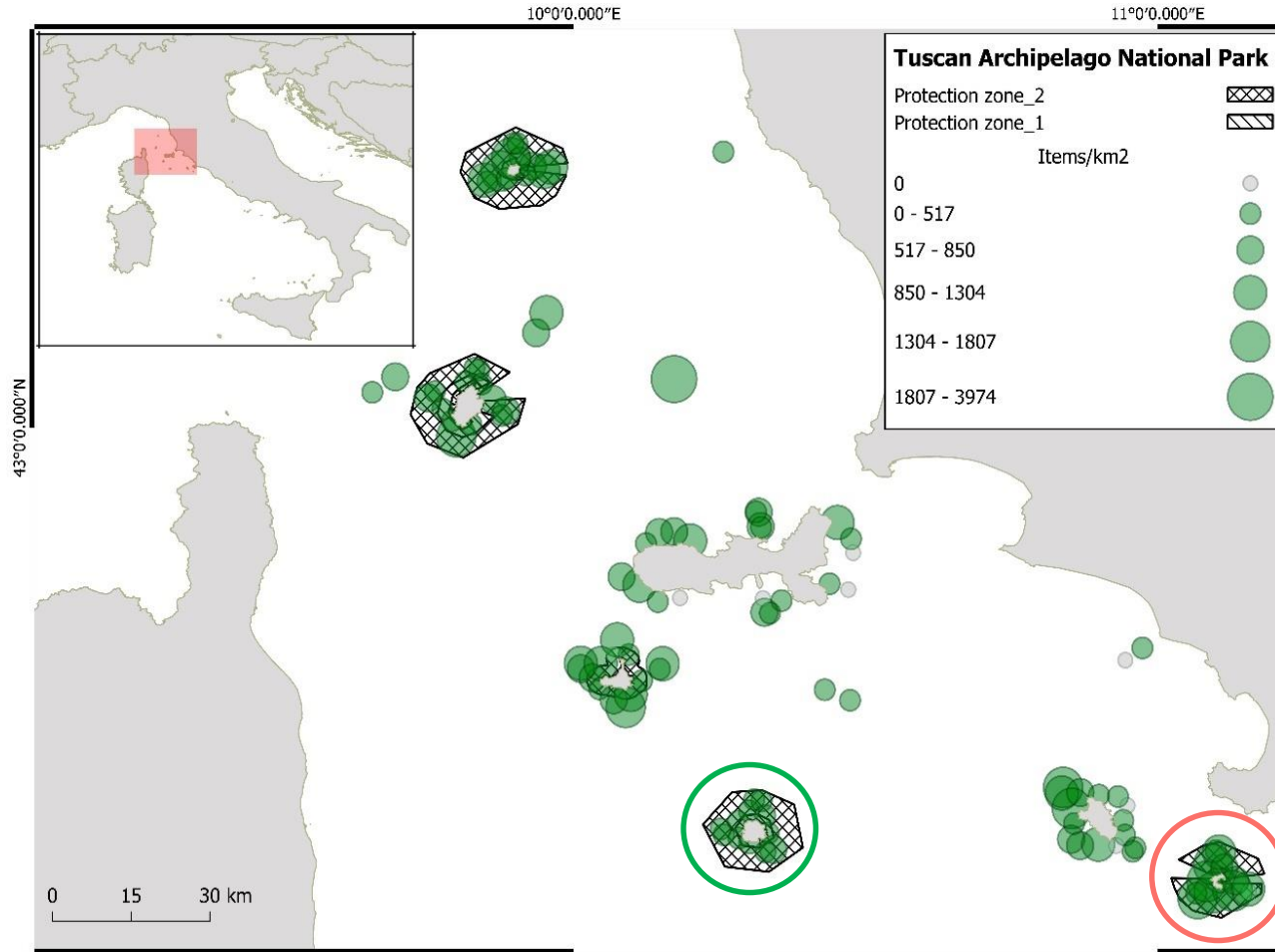


PNAT: floating microlitter colors





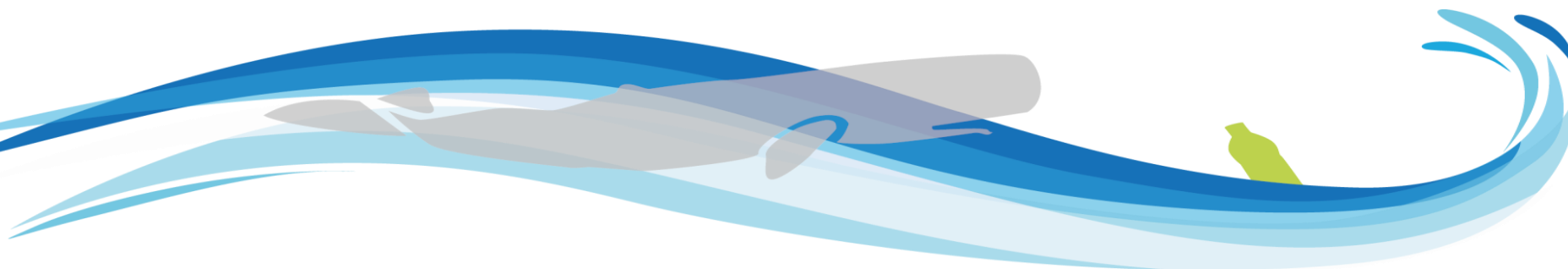
# PNAT campaign as a whole: Sea surface Macro-Litter



1458 items counted

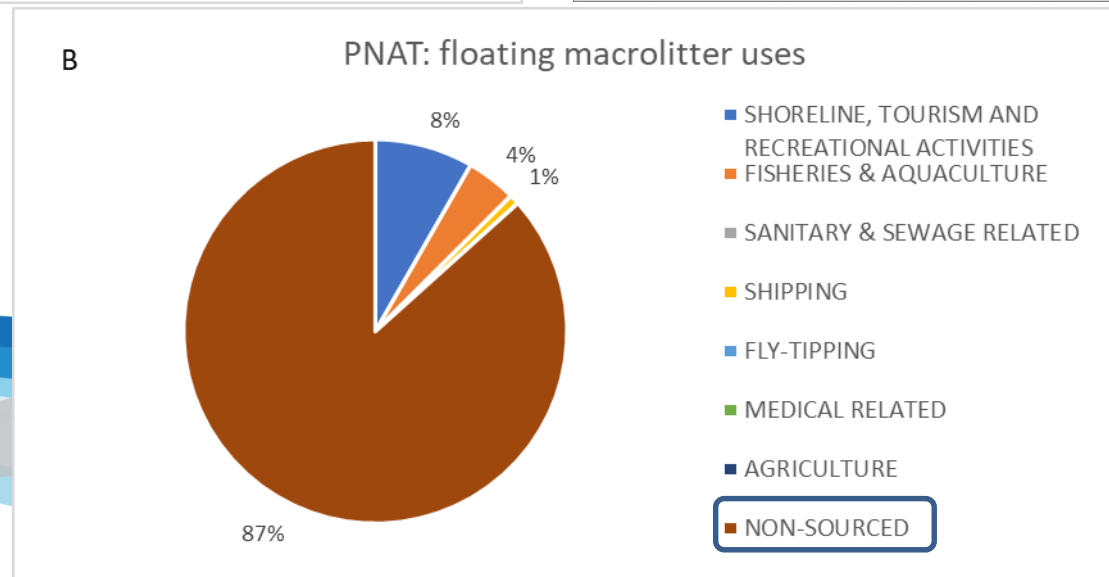
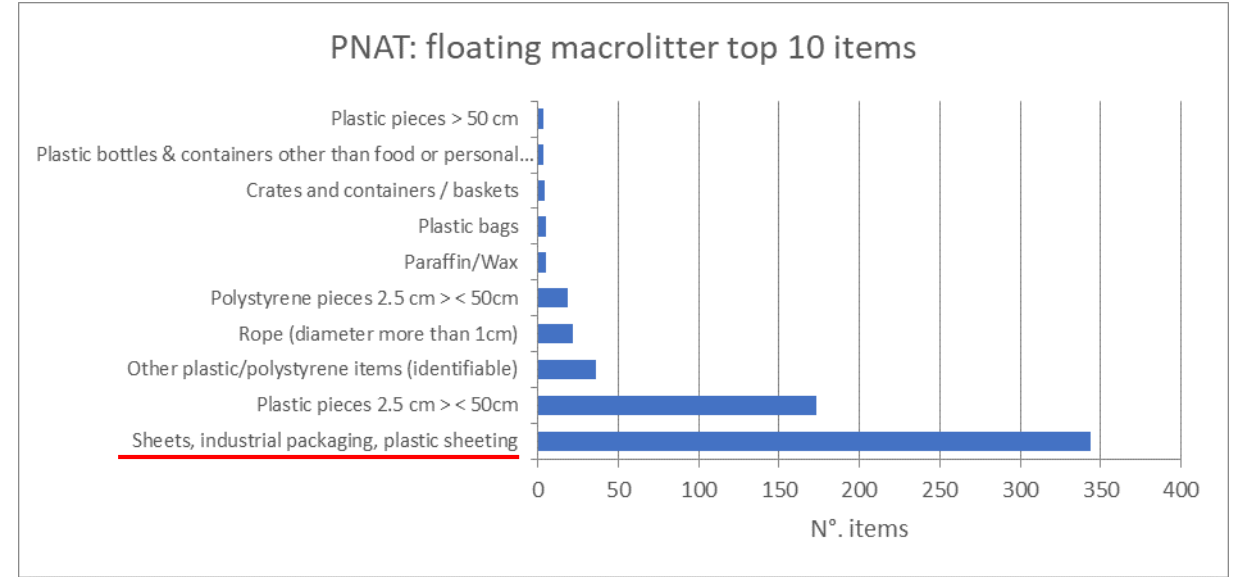
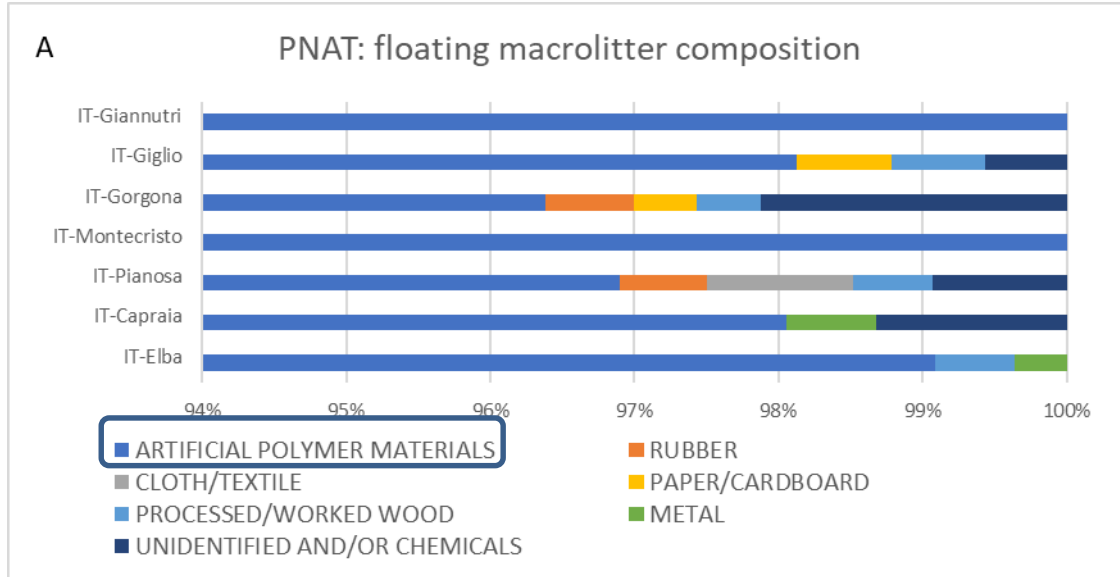
Litter observed in **92%** of transects (123/133)

| Island                | Average litter<br>(items/km2) |
|-----------------------|-------------------------------|
| IT-Capraia            | 523.0 ± 393.5                 |
| IT-Elba               | 430.4 ± 388.8                 |
| <b>IT-Giannutri</b>   | <b>1040.3 ± 648.3</b>         |
| IT-Giglio             | 607.3 ± 525.4                 |
| IT-Gorgona            | 727.6 ± 611.4                 |
| <b>IT-Montecristo</b> | <b>264.9 ± 210.9</b>          |
| IT-Pianosa            | 748.3 ± 522.3                 |



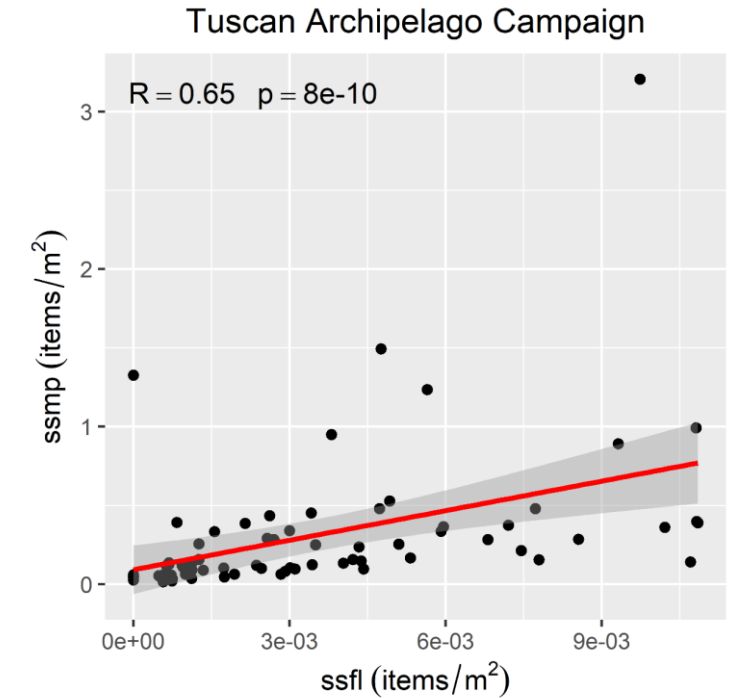
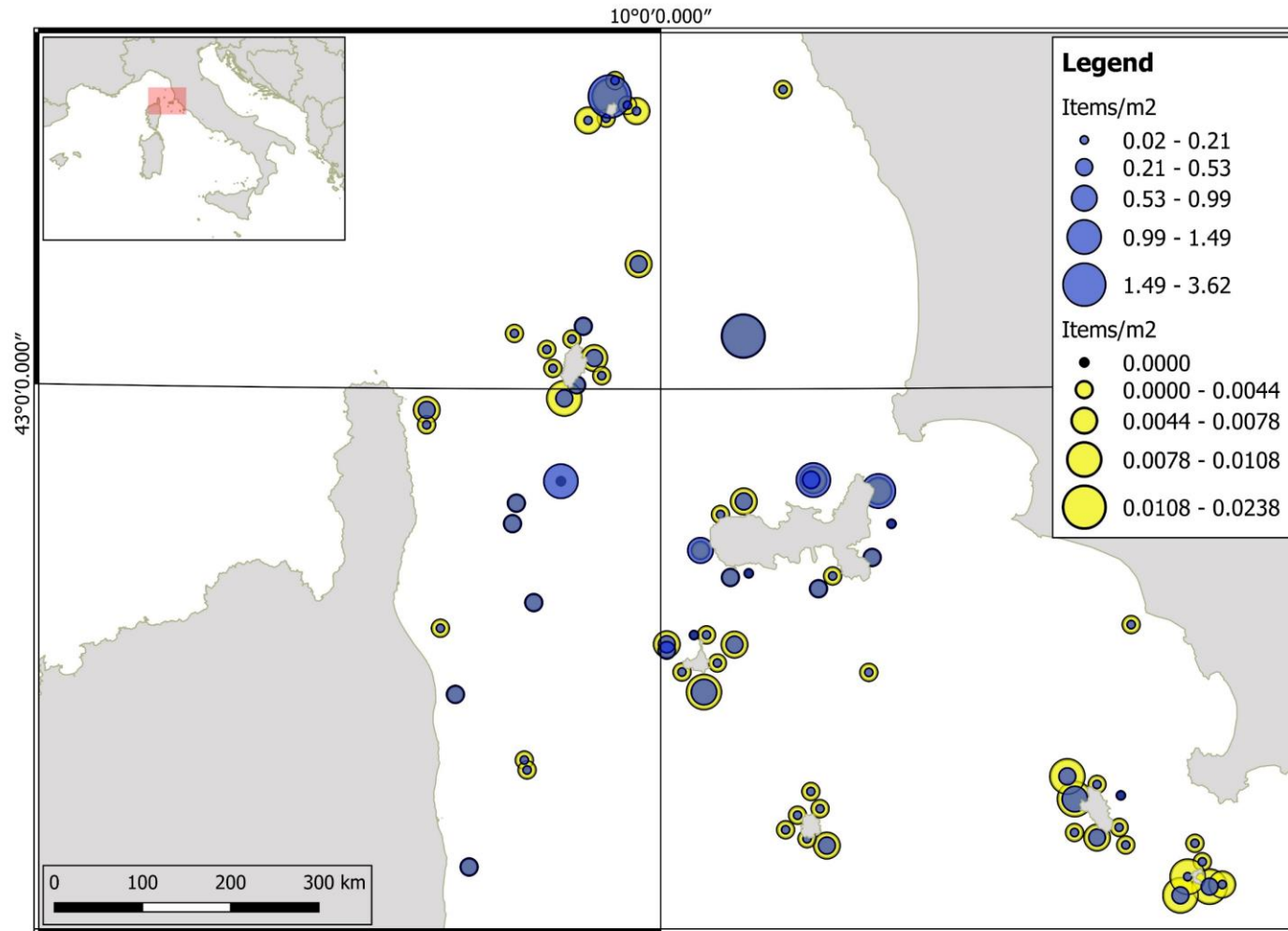
# PNAT campaign: Sea surface Macro-Litter

Plastic represents **99%** of the items **observed**



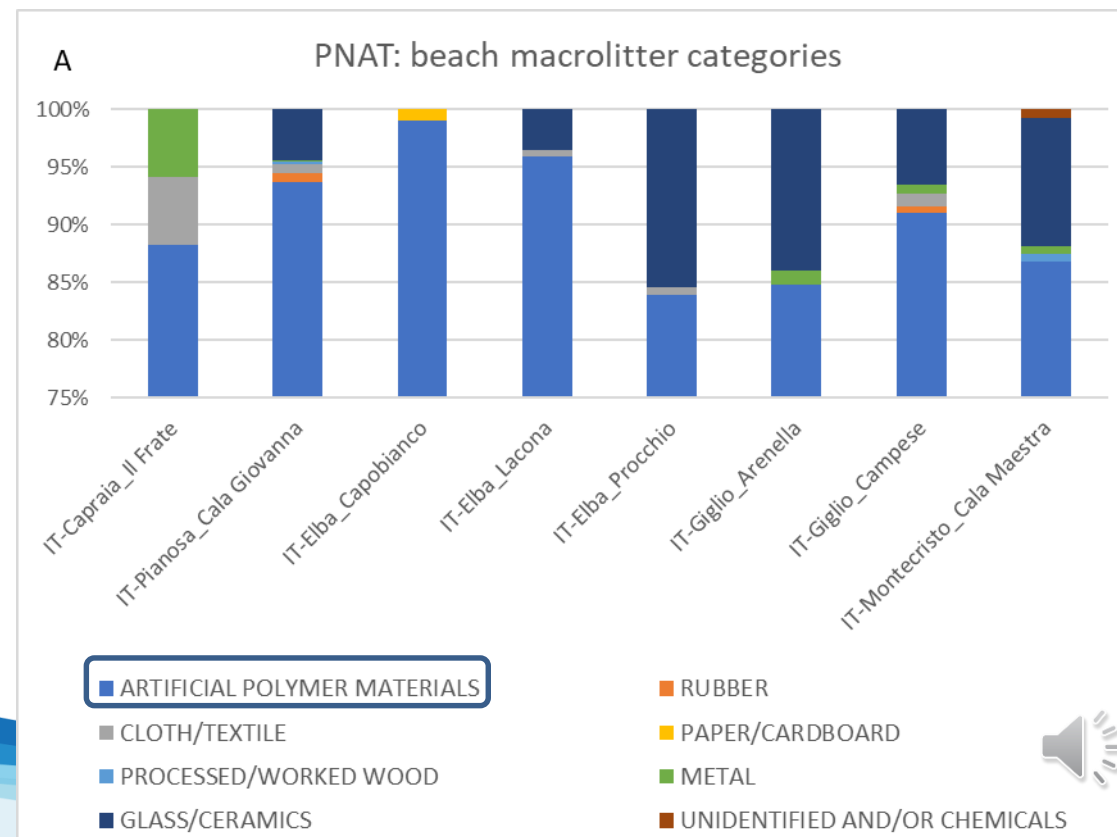
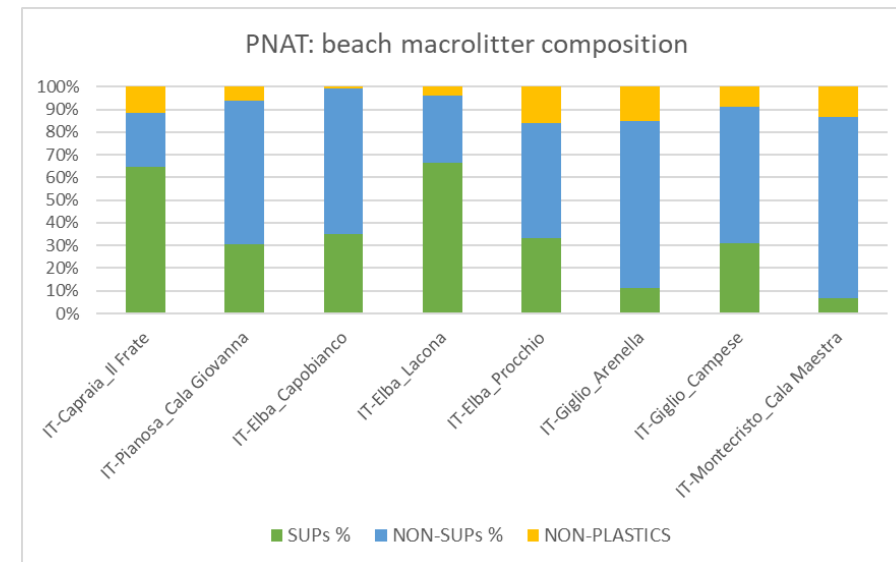


# PNAT campaign: Sea surface Macro-Litter vs Micro-Litter



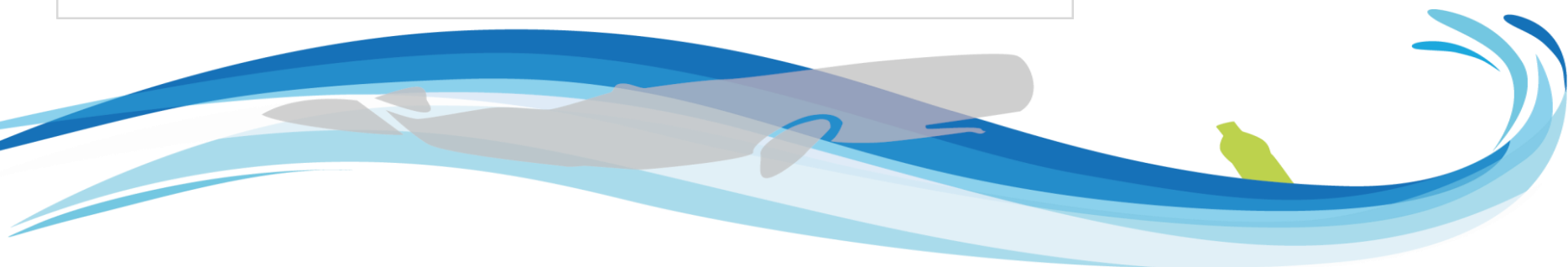
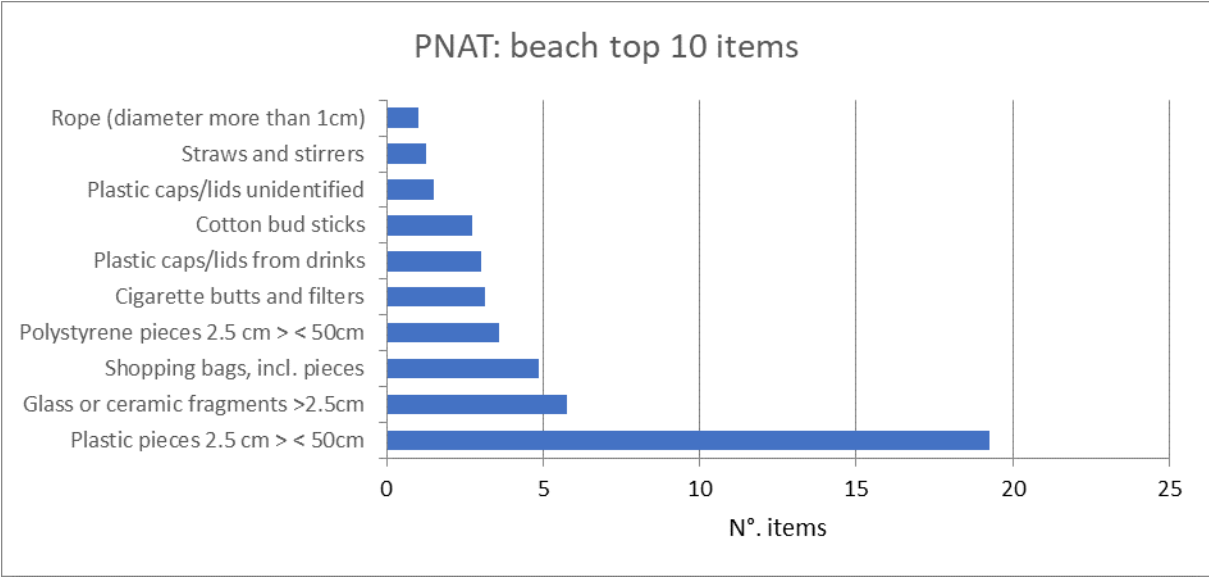
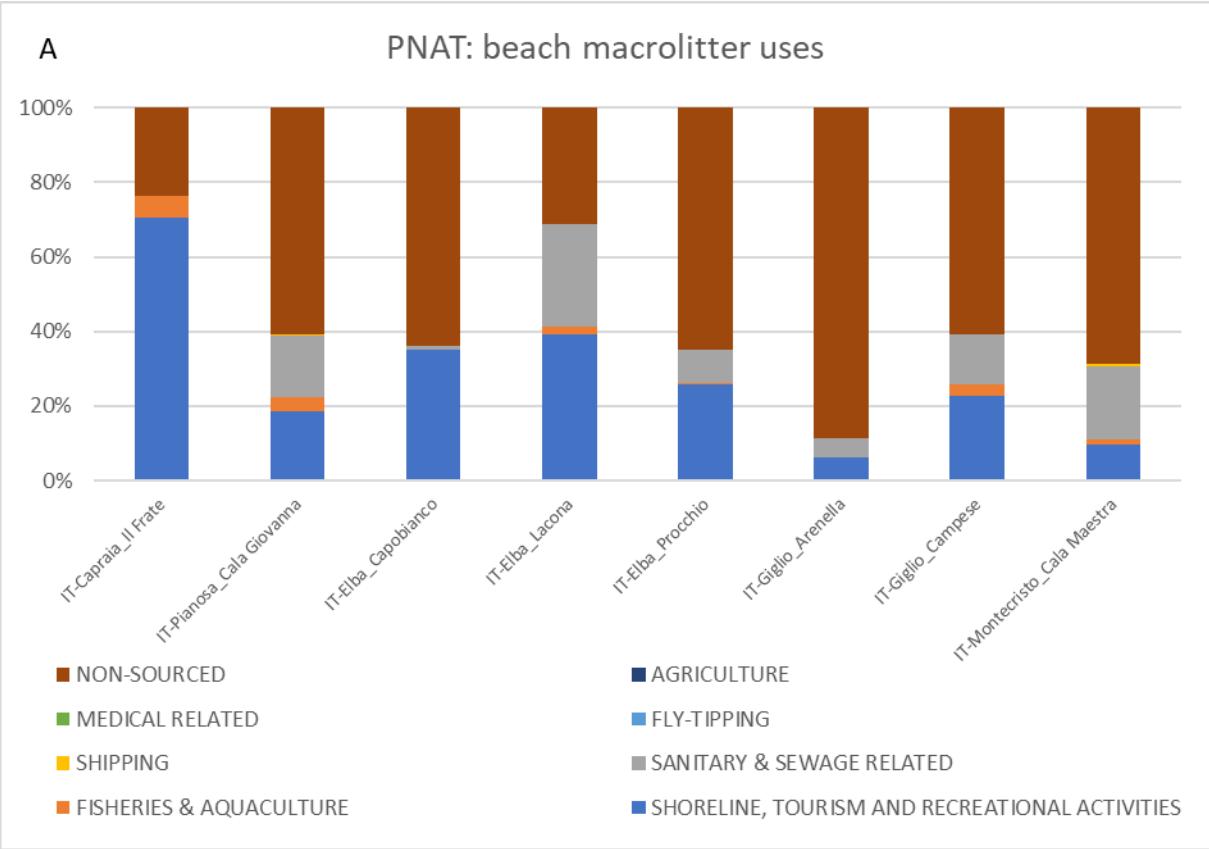
# Beach litter monitoring - Macrolitter

| Beach name and project ID       | Median number of items/100 m | Median number of items/m <sup>2</sup> . |
|---------------------------------|------------------------------|---|
| IT-Capraia_<br>Il Frate         | 23                           | 0.03                                    |
| IT-Pianosa_<br>Cala Giovanna    | 263                          | 0.22                                    |
| IT-Elba_<br>Capobianco          | 53                           | 0.04                                    |
| IT-Elba_<br>Lacona              | 49                           | 0.02                                    |
| IT-Elba_<br>Procchio            | 39                           | 0.03                                    |
| IT-Giglio_<br>Arenella          | 40                           | 0.06                                    |
| IT-Giglio_<br>Campese           | 92                           | 0.04                                    |
| IT-Montecristo_<br>Cala Maestra | 144                          | 0.05                                    |

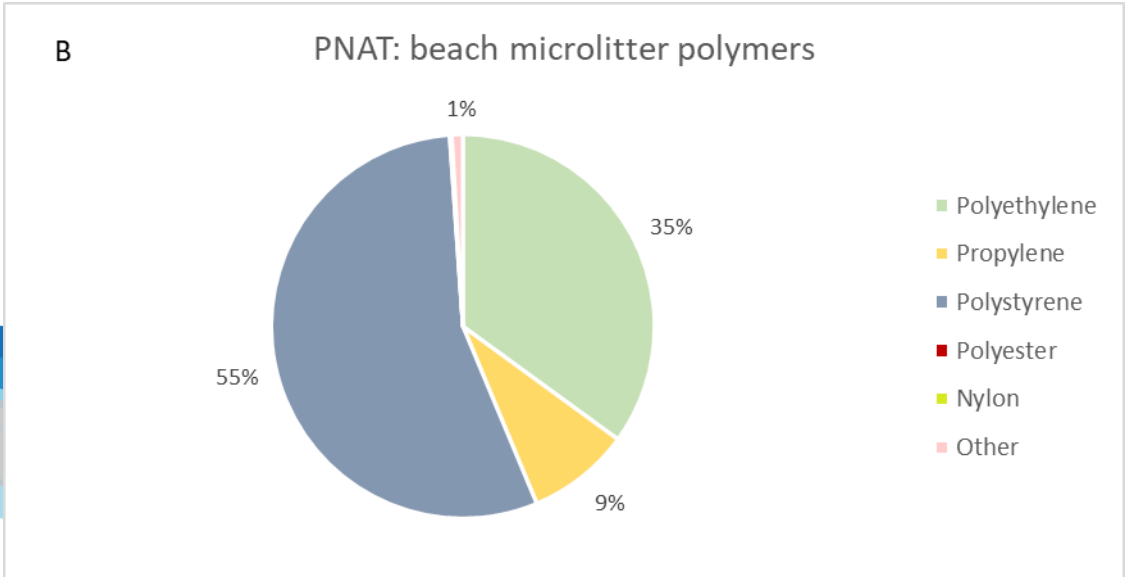
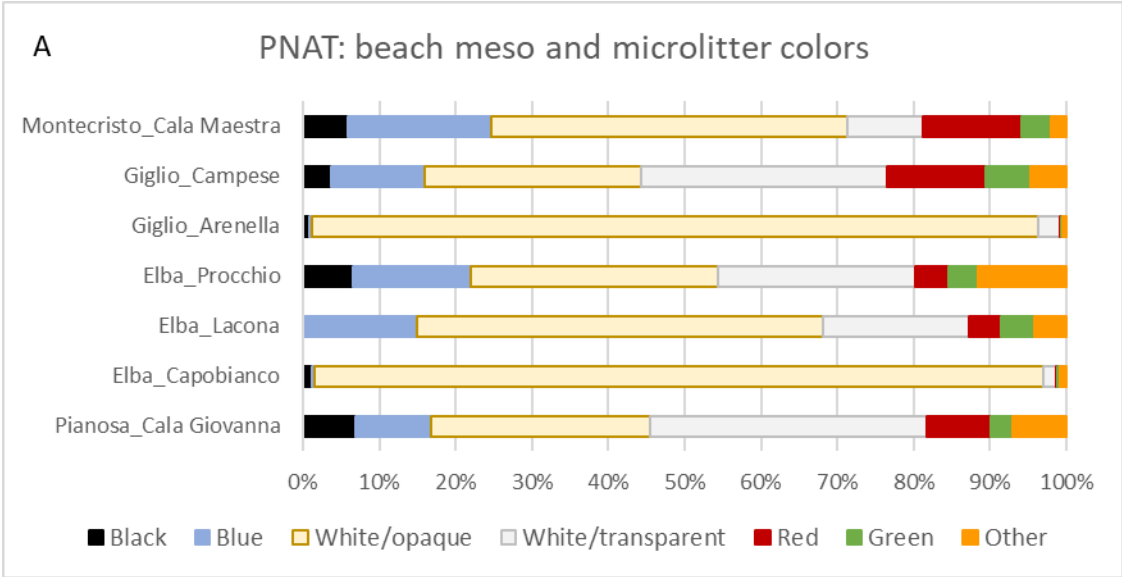
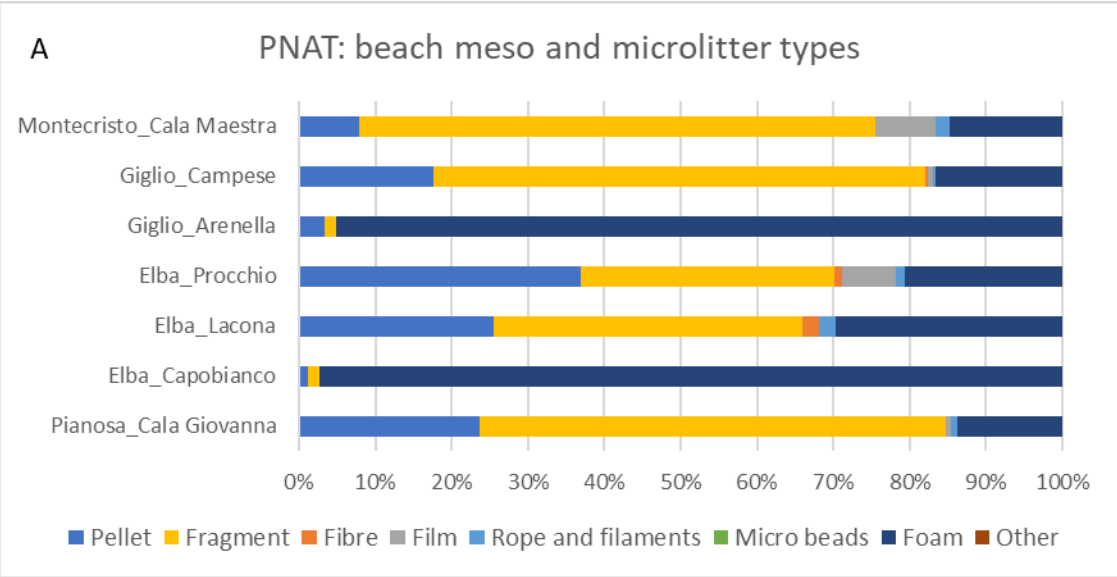




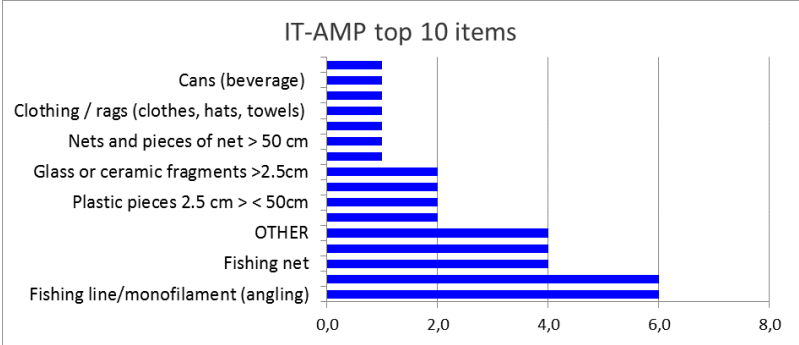
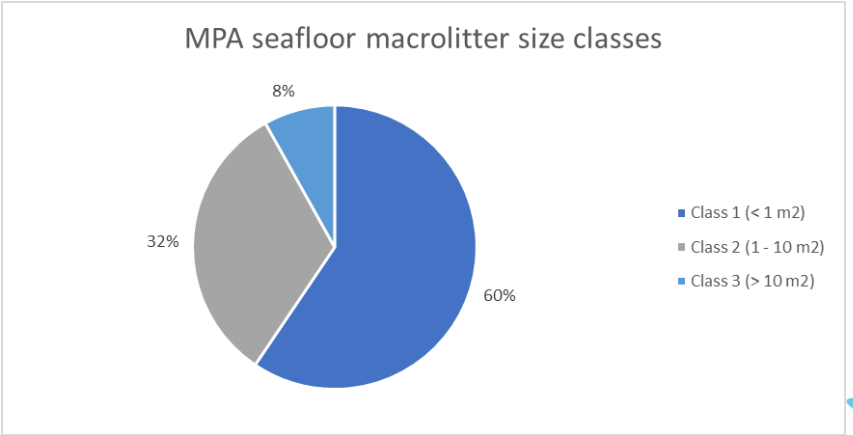
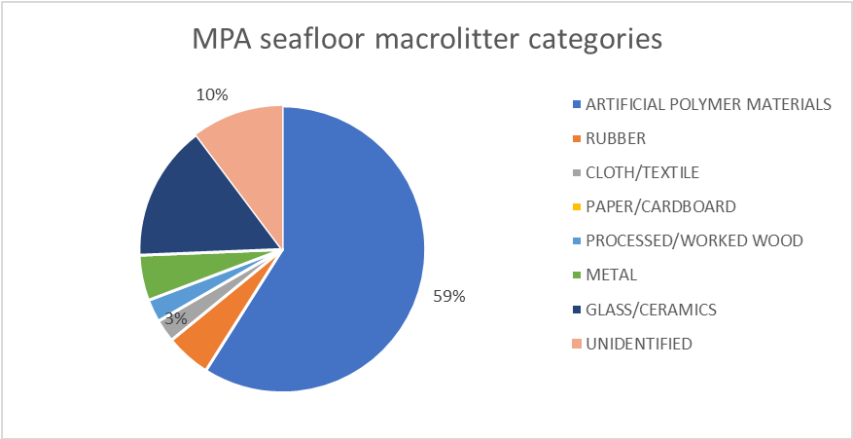
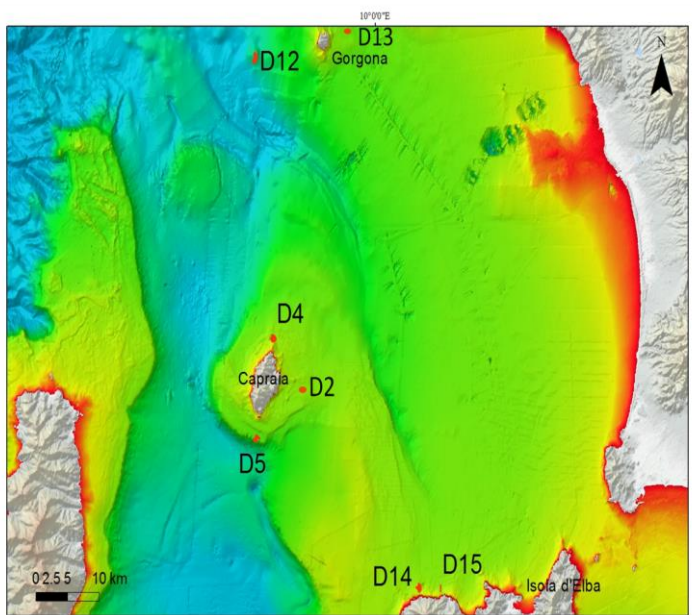
# Beach litter monitoring - Macrolitter



# Beach litter monitoring - Microlitter



# Seafloor litter monitoring in four islands with ROV



Stazione  
Zoologica  
Anton Dohrn  
Napoli

Interreg  
Mediterranean

PLASTIC BUSTERS  
MPAs

Project co-financed by the European  
Regional Development Fund





## Correlation with other data in the PNAT

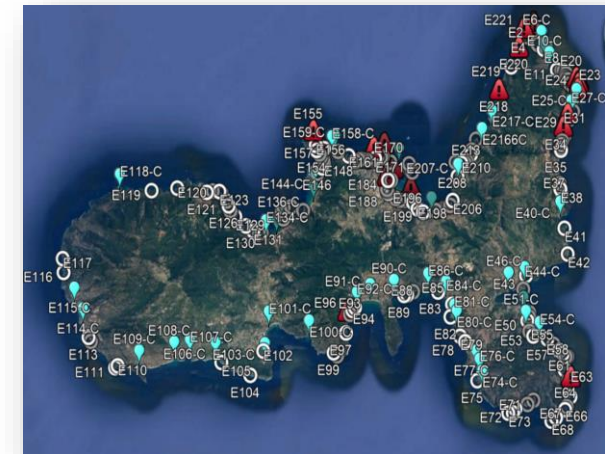
## Beach litter monitoring



## Seafloor litter monitoring in four islands with scuba divers

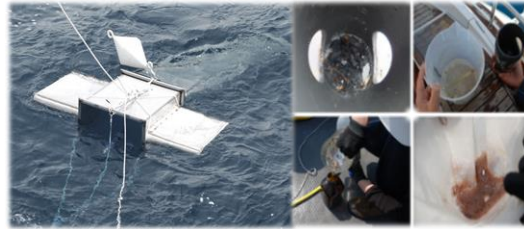


## Extensive Stranding of Litter



# Experimental design: *Multiple sampling*

Superficial **Microplastics** sampling



Floating Macro Litter sighting



Cetaceans Skin Biopsy sampling



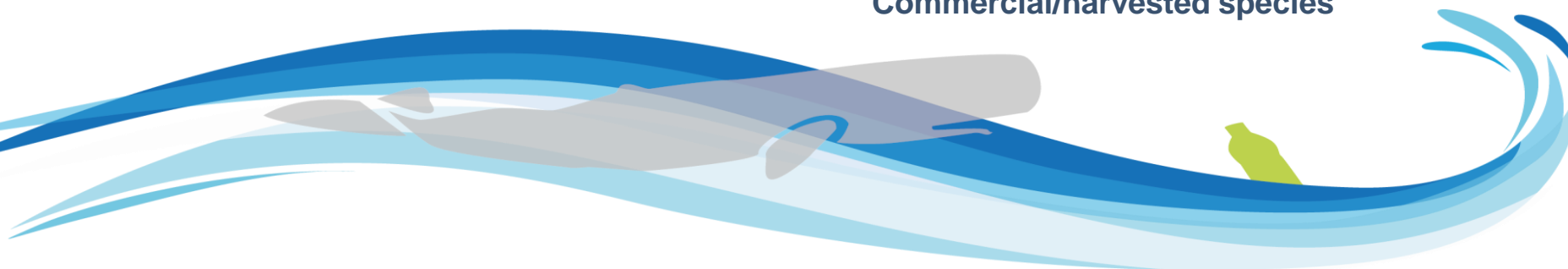
Neustonic Bioindicator species  
sampling



**Biota sighting**  
Cetaceans, Turtles, Birds  
and other species



Commercial/harvested species

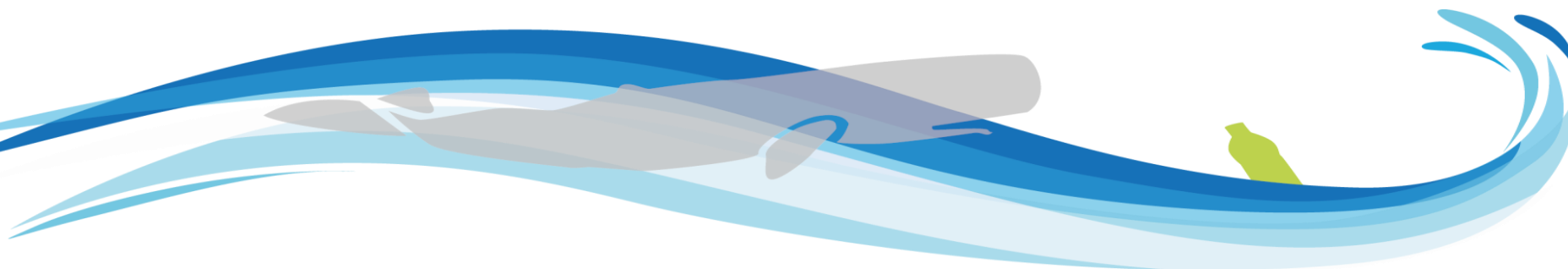


# Experimental design:

## *Simultaneous monitoring of Biota*



- **Simultaneous monitoring** of the **presence of biota** and floating marine litter
- **3 observers** positioned to **elevated platforms** to scan for cetaceans plus **1 more person** in charge for the data-acquisition on the tablet/sheets



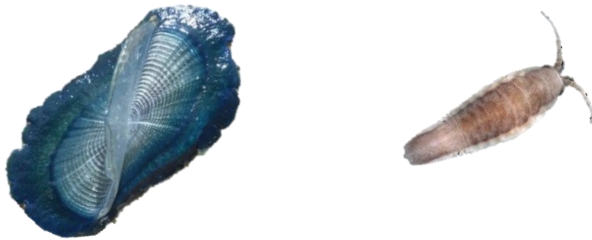


# Sampling of Commercial/Harvest species

Organisms has been sampled taking into account the different **trophic levels** and **niches** that they occupy in order to obtain a complete overview of the threats caused by microplastics on the whole marine food web

## Neustonic Bioindicators

Isopods, Jellyfish and Lanternfish



Sampled using a plankton net

## Commercial fish species

Bogue



Red striped mullet



White seabream



European pilchard



European anchovy

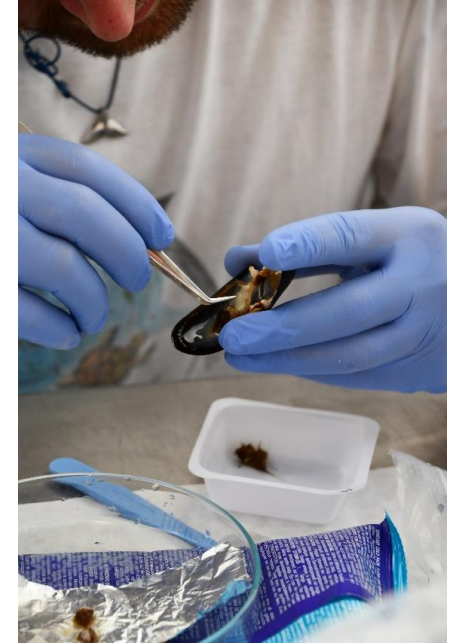


Sampled using bottom trawl and trammel net in collaboration with local fisheries



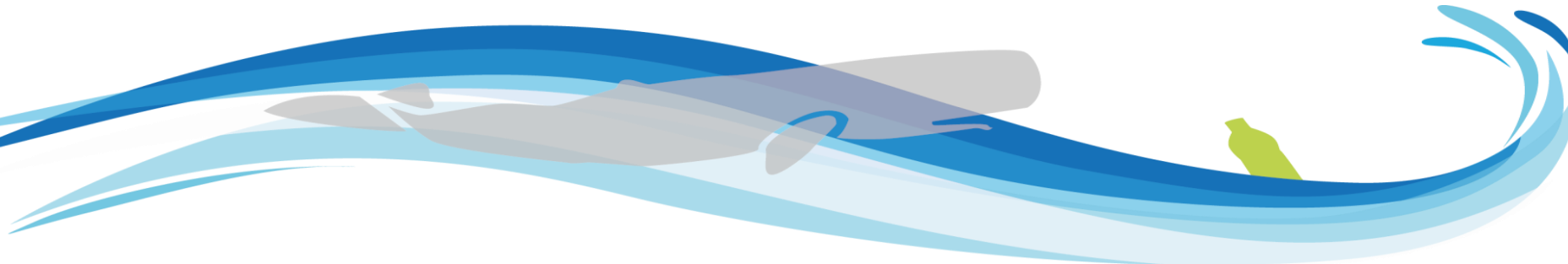
# Sampling of mussels inside the MPA

*Mytilus galloprovincialis*



The samples were collected under the buoys inside the MPAs (Capraia, Montecristo)

- *Analysis of MP ingestion*
- *Analysis of biomarkers*



# Sampling Endangered species, fish and invetebrates



Fin whale N° = 7



Isopods



N° = 19 pools

Mediterranean Mussel



N° = 120

Striped dolphin N° = 4



Red Striped Mullet European anchovy



N° = 50  
Alive and dead  
samples



N° = 50

Bogue

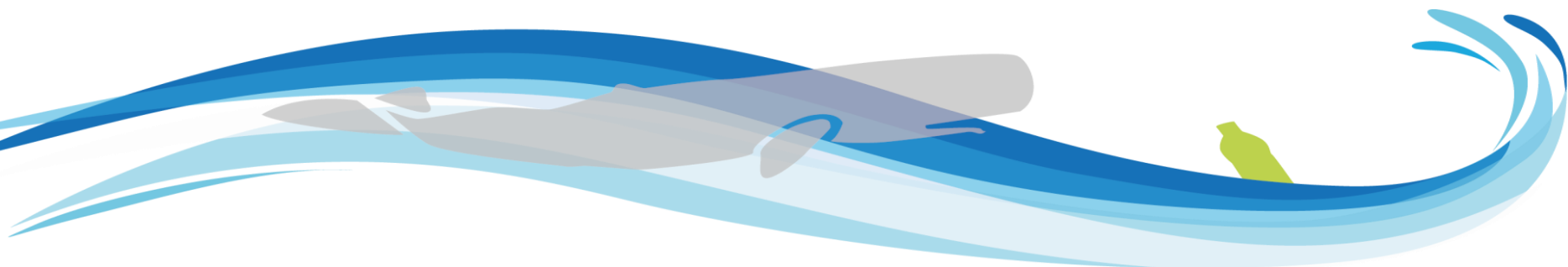


N° = 80

European pilchard



N° = 50





# Laboratory analysis: *Microplastics ingestion*

*Mytilus galloprovincialis*

Capraia occurrence: **71%**

Giglio occurrence: **0%**

Montecristo occurrence: **54%**



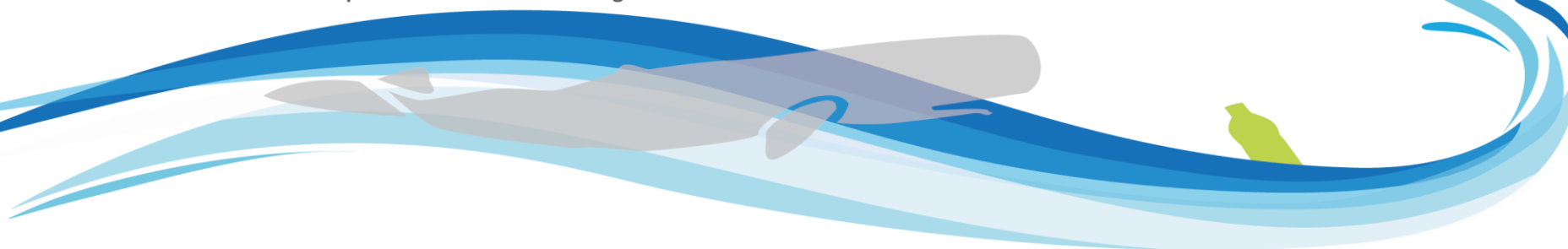
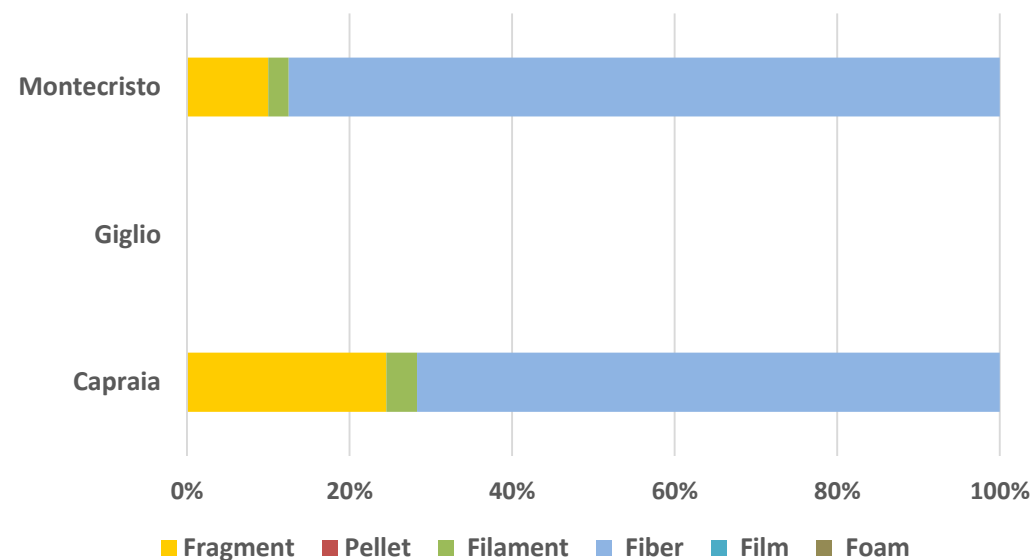
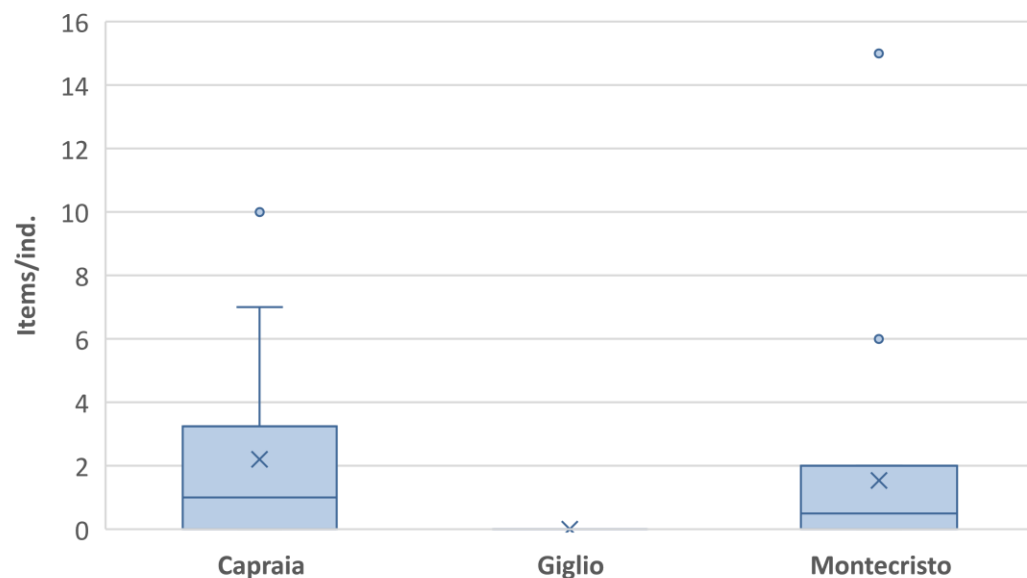
N° = 54

**96 microplastics isolated**

**58% < 1 mm in length**

**79% fibers**

**18% fragments**



# Biomarkers analysis

Species: *Mullus surmuletus*

## ➤ Enzymatic and cellular biomarkers

Glutathione S-transferase (GST)

Lipid peroxidation (LPO)

Acetylcholinesterase (AChE)

Micronucleus test

## ➤ Gene expression

Fatty acid elongase 6 (*elovl6*)

Methylsterol monooxygenase (*msmo1*)

Caspase 3 (*casp3*)

Interferon induced transmembrane protein 1 (*Ifitm1*)

TNF receptor associated factor 3 (*traf3*)

Interleukin 1 alpha (*il1α*)

### Function

} Lipid metabolism

} Apoptosis

} Inflammation

} Immune response

Species: *Mytilus galloprovincialis*

## ➤ Enzymatic and cellular biomarkers

Glutathione S-transferase (GST)

Lipid peroxidation (LPO)

Acetylcholinesterase (AChE)

Micronucleus test







Project co-financed by the European Regional Development Fund







# Thank you!

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