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REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

Plastic Busters CAP

MONITORING APPROACHES FOR MICROLITTER ON THE COASTAL & MARINE ENVIRONMENT

CRISTINA PANTI

UNIVERSITY OF SIENA, SIENA, ITALY

PANTI4@UNISI.IT

Mediterranean e-course on marine litter monitoring & mitigation

17 & 19 January 2023, 10.00 – 14.00 CET

MONITORING APPROACHES FOR MICROLITTER ON THE COASTAL & MARINE ENVIRONMENT

Monitoring MICROLITTER ON BEACH SEDIMENTS

Monitoring MICROLITTER ON SEA SURFACE

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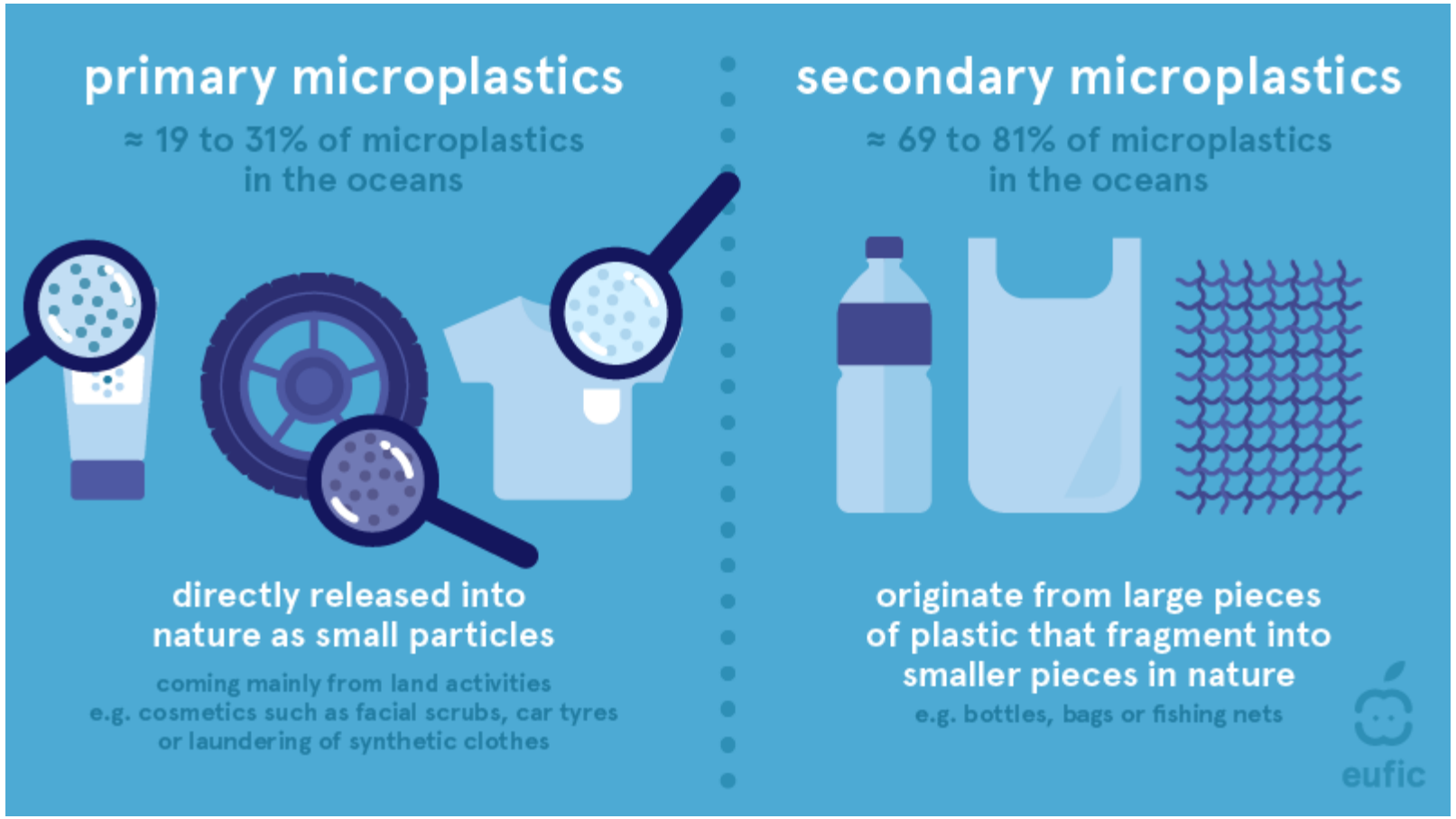
MICROLITTER DEFINITION



Microplastics (<5mm):
Large microplastics (1-5 mm)
Small (<1 mm)

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MONITORING MICROLITTER ON BEACH SEDIMENTS – SITE SELECTION

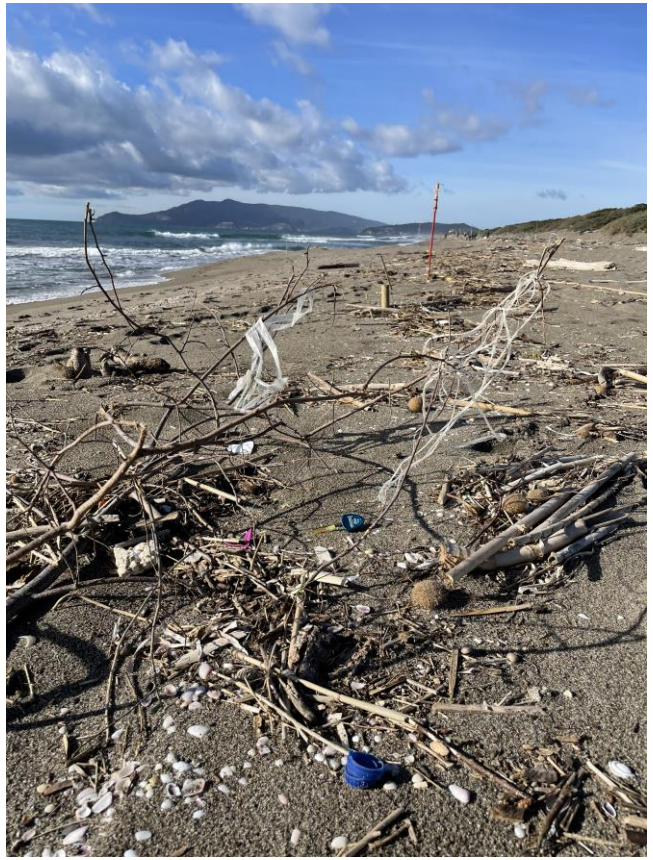
The survey sites for monitoring microlitter on beaches should be selected in accordance with the selection criteria of the survey sites for monitoring macrolitter; thus, the survey sites should fulfill the following characteristics:

- Have a minimum length of 100m;
- Be characterized by a low to moderate slope;
- Have clear access to the sea (not blocked by breakwaters or jetties);
- Be accessible to survey teams throughout the year;
- Ideally, not be subject to cleaning activities. In case they are subjected to litter collection activities, the timing of non-survey related beach cleaning must be known so that litter flux rates (the amount of litter accumulation per unit time) can be determined.

MONITORING MICROLITTER ON BEACH SEDIMENTS – SITE SELECTION

In addition, the location of the survey sites should be spatially stratified to reflect:

- different pressures and different levels of exposure to litter (e.g. close to river mouths, close to harbours/marinas, presence of touristic facilities nearby, etc.);
- different development and urbanisation levels, including a balanced mix of urban, semi-urban, and remote/natural beaches.



MONITORING MICROLITTER ON BEACH SEDIMENTS – FREQUENCY AND TIME OF SURVEY

At least four surveys should be carried out in winter, summer, spring and autumn.

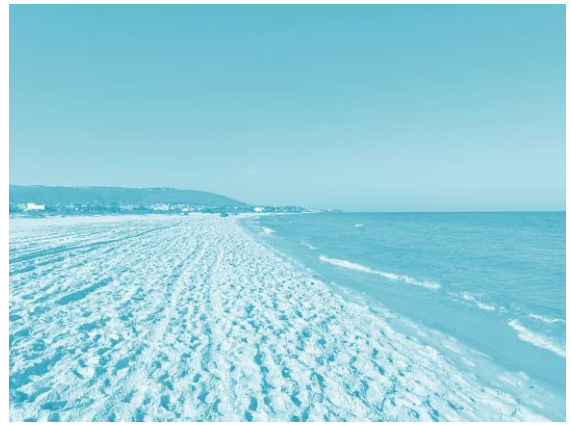
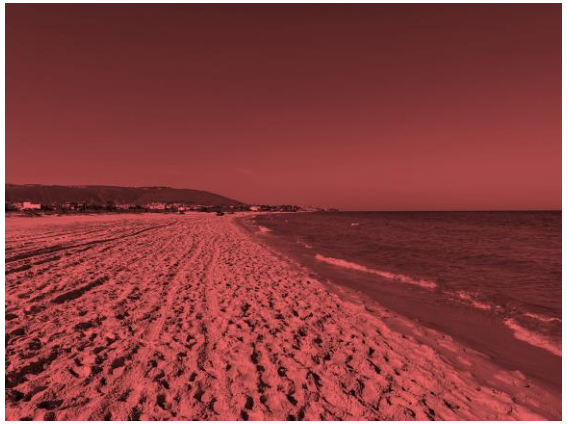
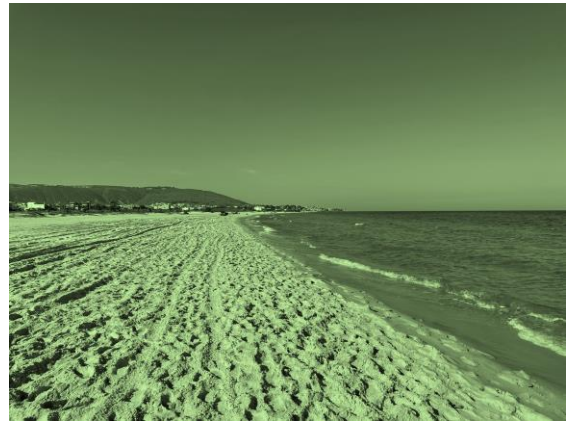
The optimum survey periods are:

Winter: January

Spring: April

Summer: July

Autumn: October

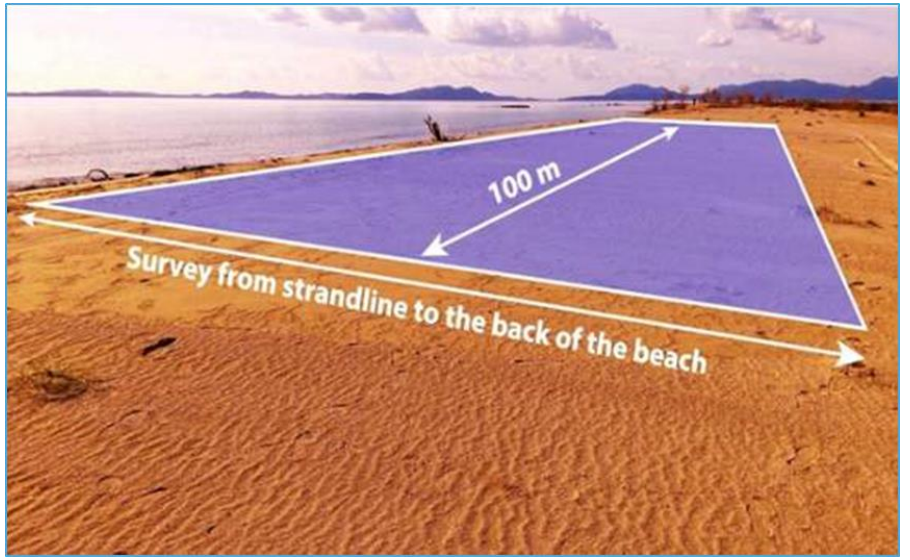





MONITORING MICROLITTER ON BEACH SEDIMENTS – SAMPLING UNIT

The sampling area should be defined by marking out a 100-metre transect in width, parallel to the strandline, using a measuring tape and taking note of the GPS coordinates on each side of the transect (A and B).

The transect will define the sampling area i.e. from the shoreline (low tide, AC1) to above the strandline (accumulation zone, AC2).

It should be highlighted that in many beaches the second tideline might not be always visible on the shore. Depending on the width of the beach, the sampling area can be extended to the back of the beach.



MONITORING MICROLITTER ON BEACH SEDIMENTS – SAMPLING UNIT

AC1

low tide accumulation area

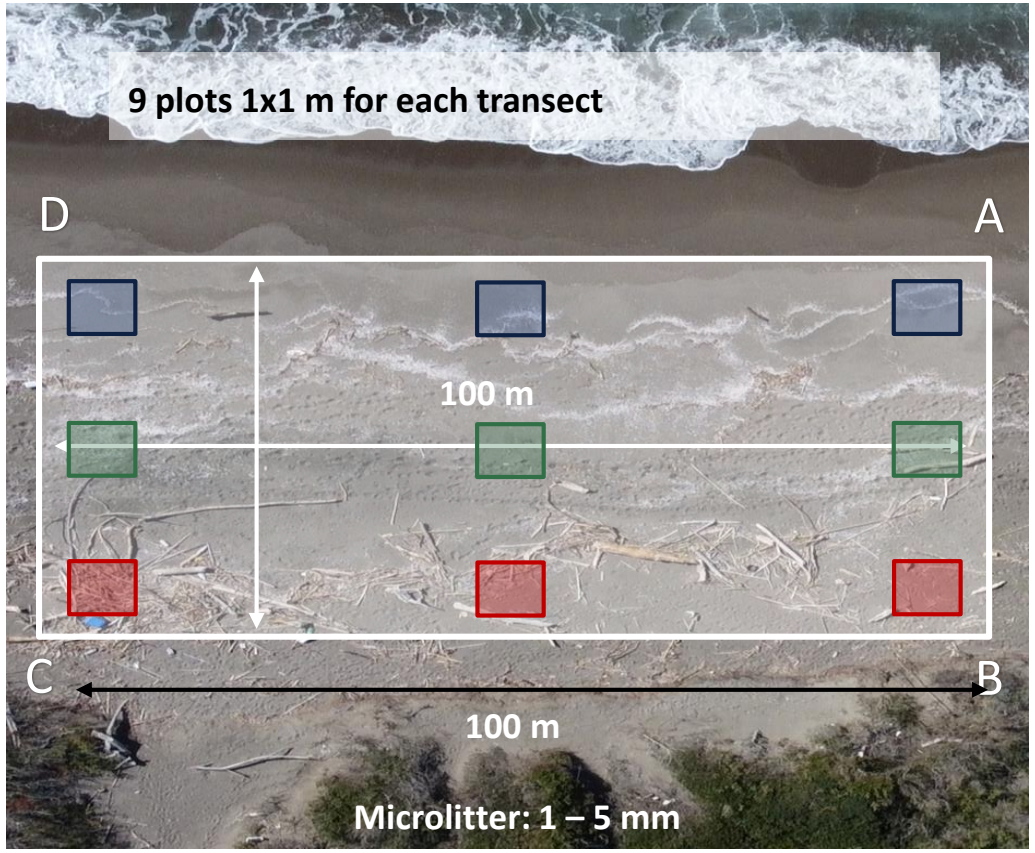
OAC

off accumulation area

AC2

high tide accumulation area

Frias et al, 2018



Top 5 cm of sand, weighted (kg) and sieved (1-5 mm)

GPS coordinates schold be recorded for each plot

MONITORING MICROLITTER ON BEACH SEDIMENTS – SAMPLING UNIT

A minimum of three samples along **three transects** vertical to the high tide line should be collected and the area between the two high tidelines should be surveyed.

The sampling unit (**30 x 30 cm or 50 x 50 cm or 1x1 m**) should be marked using a measuring tape or a quadrat and the GPS coordinates of each unit should be recorded.

The top 3-5 cm of sediment should be sampled using a metal shovel or similar.

MONITORING MICROLITTER ON BEACH SEDIMENTS – LITTER ANALYSIS AND CLASSIFICATION

Large microplastics (1-5 mm) can be separated by sieving the beach sediment samples *in situ* through two **metallic sieves with 1mm and 5mm mesh size**; this is an effective method of reducing the sample volume.

During sieving, the large or non-plastic items (e.g. shells, leaves, twigs, etc) should be removed. If the beach sediments are wet and difficult to go through the 1-mm sieve, the samples should be stored in glass jars or zip-lock bags and taken to the laboratory.

The sediment samples should then be dried in the oven and then subsequently sieved.

MONITORING MICROLITTER ON BEACH SEDIMENTS – SURVEY SHEETS

Country_____ **Location area** _____

Sampling site code _____ **Beach name**_____

Date: _____ / _____ / _____ (dd/mm/yyyy) **Sampling season:**_____

Start time: _____:_____ AM | PM **End time:** _____:_____ AM | PM

Beach Characteristics

Slope: _____(degrees) **Beach length:** _____ (m)

Beach substrate: ☐ Sand ☐ Gravel ☐ Boulder. ☐ Other_____

Dune Substrate: ☐ Sand ☐ Gravel ☐ Boulder. ☐ Other_____

Atmospheric conditions: ☐ Wind ☐ Rain ☐ Waves (strong, moderate, low): _____

Did any of the following atmospheric conditions affect OR prevent the sampling on this day?

☐ Storm | hurricane ☐ Ice | Frost ☐ Fog | Smog ☐ Dust- or sand-storm ☐ Waves exceptionally high

GPS coordinates:

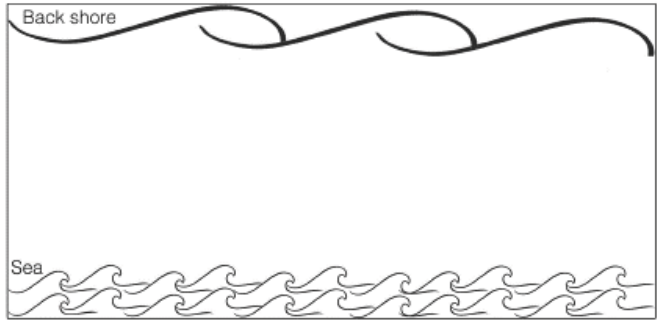
A _____ **B**_____

AC1 1. _____ 2. _____ 3. _____

AC2 1. _____ 2. _____ 3. _____

OAC 1. _____ 2. _____ 3. _____

SAMPLING



1. Draw the high tide lines representing the main accumulation areas (AC1 and AC2);

2. Mark starting point A and finish point B. These should have 100m of distance between them;

3. Draw the squares where sampling was conducted. (For example see Fig. 1).

Comments/Notes:_____

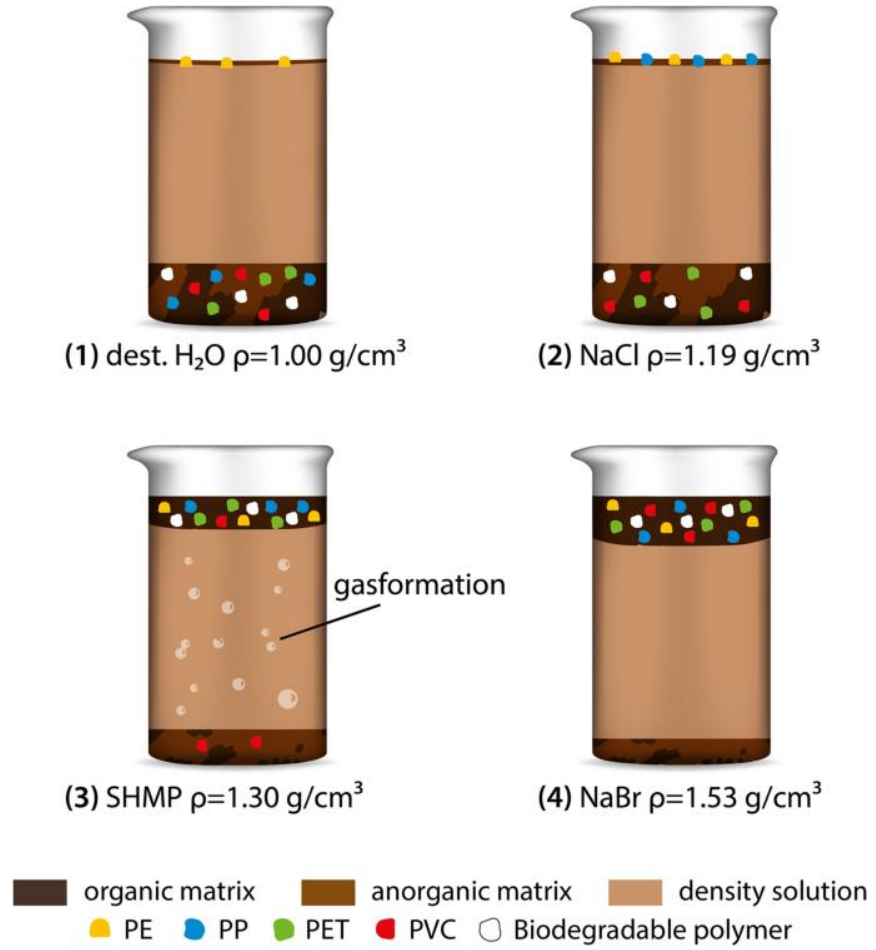
_____

MONITORING MICROLITTER ON BEACH SEDIMENTS – LITTER ANALYSIS AND CLASSIFICATION

Sieving is implemented for **large microplastics** (1-5mm), while **floatation** is used for **small microplastics** (<1mm) due to density differences between plastic and sediment particles.

The principle of **density floatation** is commonly employed to separate **less dense plastic polymers from denser sediment particles**, and a range of **high-density salt solutions** have been used to extract microplastics from coastal and marine sediments. The **floatation of the small microplastics should be carried out in the laboratory under specific conditions to avoid air-born contamination**.

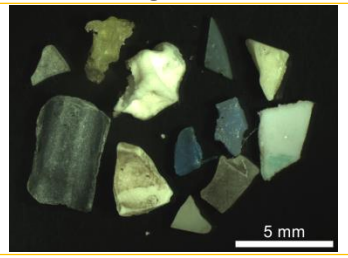
All steps of the microplastics analysis must be conducted using 100% cotton lab coats and precautions are to be taken to avoid cross-contamination (e.g. airborne fibres).



MONITORING MICROLITTER ON BEACH SEDIMENTS – LITTER ANALYSIS AND CLASSIFICATION

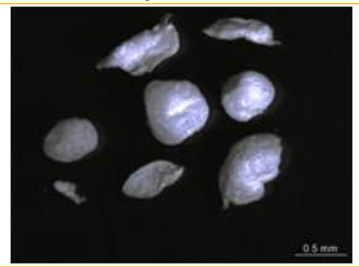
- The visual identification and classification of microlitter items can be carried out directly or through a microscope
- Microplastics sorted, counted and characterized by **type** on the basis of the following categories: pellet, fragment (granule, flake), fibre, film, filaments, microbeads, foam (expanded polystyrene-PS), in line with the MSFD TGML guidelines.
- The most common **colours** of microplastics identified are the following: black, blue, white, transparent, red, green, multicolour, other.
- For the identification of the **polymer type** it is recommended to use an ATR-FTIR spectrometer or Raman spectroscopy or Pyrolysis-Gas chromatography-mass spectroscopy (Py-GCMS).

Fragments

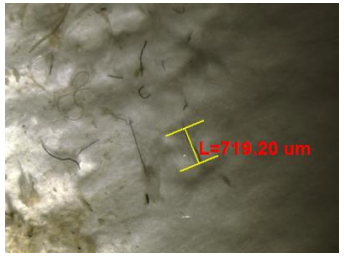


Films

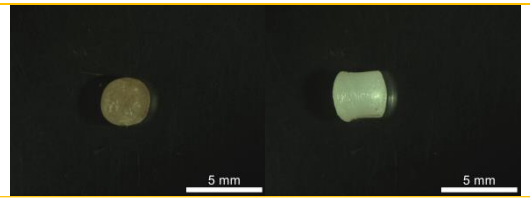
Styrofoam



Filaments



Pellets



MONITORING MICROLITTER ON BEACH SEDIMENTS – REPORTING UNIT

Reporting units are extremely important to allow comparison among studies. The proposed reporting units for microplastics retrieved from sediment samples are:

- **no. MPs per area (# particles m^{-2})**
- no. MPs per volume (# particles m^{-3})
- **no. MPs per mass** (# particles kg^{-1} dry sediment). In this case the weight of the sediment sample is needed or the density of the sediment
- **mass of MP per area (g MP m^{-2})**
- mass of MP per volume (g MP cm^{-3})

MONITORING MICROLITTER ON BEACH SEDIMENTS – MATERIAL AND EQUIPMENT

- High resolution camera
- Hand-held GPS unit, including extra batteries
- 100-metre tape measure (fiberglass preferred)
- Flag markers/stakes
- Metal shovel
- Metallic sieves (1mm and 5mm)
- Glass jars and paper bags
- Tweezers
- Recording sheets
- Pencils, pens, permanent markers
- Microscope
- ATR-FTIR spectrometer or Raman spectrometer









MONITORING MICROLITTER ON SEA SURFACE - SITE SELECTION

Given the high heterogeneity of litter distribution, the criteria for the survey sites selection could have crucial effect on results. The selection of the monitoring sites depends on the purpose and the methodology of monitoring, and can be made on the basis of certain characteristics of interest (i.e. MPAs of different scale such as large, medium or small) or through a random selection of survey sites (coastal or pelagic, high anthropogenic pressure areas, etc.)

MONITORING MICROLITTER ON SEA SURFACE – FREQUENCY AND TIME OF SURVEYS

At least two surveys, one in autumn and one in early spring should be carried out.

The proposed survey periods are: **Autumn** (mid-September to mid-October) and **Spring** (March-April)

MONITORING MICROLITTER ON SEA SURFACE – RECORDING SHEETS

Monitoring MICROLITTER on the Water Surface
Data Sheet

Location name	
Location ID	
Country	
Surveyor Name	
e-mail address	
Date of survey	

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 (metres) Gross weight of the vessel (tonnes)*

MANTA NET TRANSECT DETAILS			
Latitude/longitude start			*Recorded as nnn.nnnnn degrees at the start of the sample unit*
Latitude/longitude end			*Recorded as nnn.nnnnn degrees at the end of the sample unit*
Coordinates system			*Datum and coordinate system employed*
Vessel speed			*Average ship speed in knots*
Distance covered			*Total distance covered by the transect (m)*
Time start/end			*Time over which the survey took place*

ENVIRONMENTAL PARAMETERS - OBSERVATION DETAILS			
Wind speed			*Recorded in (Beaufort)*
Wind direction	☐ N ☐ E ☐ S ☐ W		*Tick more than one boxes e.g. for SE wind*
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.....			

SITE CHARACTERISTICS			
Nearest river name			*Name of nearest river*
Nearest river distance			*Distance to the nearest natural input (river or stream) (kilometers)*
Nearest river position	☐N ☐E ☐S ☐W		*Position of river mouth in relation to survey area*
Nearest major fishery			*Name of the nearest major fishery (named by type)*
Nearest major fishery distance			*Distance to the nearest major fishery (kilometers)*
Nearest major fishery position	☐N ☐E ☐S ☐W		*Position of the nearest major fishery in relation to survey area*
Nearest town			*Name of nearest town*
Nearest town distance			*Distance to the nearest town (kilometers)*
Nearest town position	☐N ☐E ☐S ☐W		*Position of the nearest town in relation to survey area*
Population size of this town			*No of inhabitants*
Additional features of the town	☐ Residential ☐ Tourist ☐ Residential & tourist	☐ Winter ☐ Spring ☐ Summer ☐ Autumn	*Indicate the main characteristic of the town, residential or touristic town; in case of the later indicate the high season peak*
Name of the nearest beach			*Name of the nearest beach*
Distance to nearest beach			*Distance to the closest coastline (kilometers)*
Position of the nearest coast	☐N ☐E ☐S ☐W		*Position of the closest coastline in relation to survey area*
Nearest shipping lane distance			*Distance to the nearest shipping lane (kilometers)*
Estimated traffic density			*Recorded in number of ships/year*
Vessel type			*Indicate the type of vessels that mainly use it e.g. merchant ships, etc.*
Position of the shipping lane	☐N ☐E ☐S ☐W		*Position of shipping lane in relation to survey area*
Name of the nearest harbor			*Name of nearest harbor*
Distance to nearest harbor			*Distance to the closest harbor (kilometers)*
Harbor position	☐N ☐E ☐S ☐W		*Position of the nearest harbor in relation to survey area*
Type of harbor			*Based on the types of vessels visiting the harbor*
Size of harbor			*Record the number of ships that reach the harbor per year*
Nearest discharge of waste water distance			*Distance to the closest waste water discharge point(kilometers)*
Position of nearest discharge point	☐N ☐E ☐S ☐W		*Position of nearest discharge points in relation to survey area*
Type of waste water discharge	☐Industrial ☐Municipal ☐Other		*Indicate type of waste water discharged*

MONITORING MICROLITTER ON SEA SURFACE – SAMPLING UNIT AND SIZE

Manta trawl equipped with a flowmeter

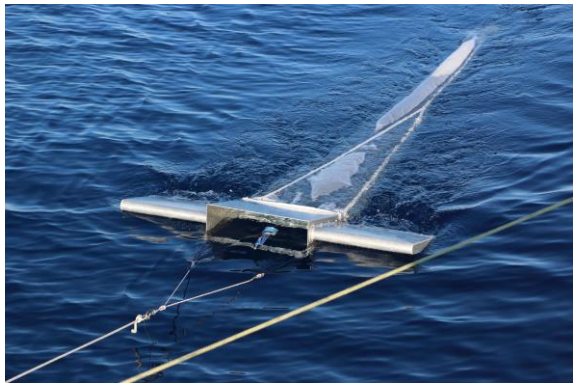
Mouth opening: **60 x 15 cm**

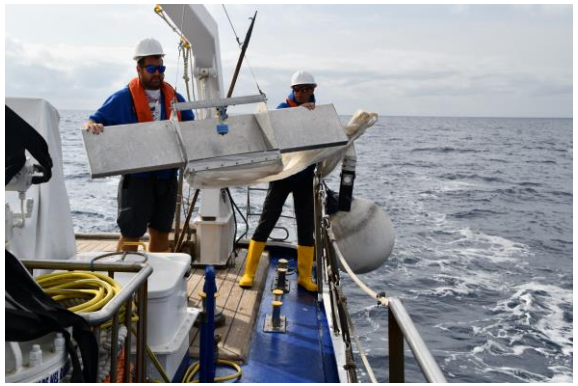
Mesh size: **330 µm**

Time: **30 minutes** (1.5 – 2.5 knots)

Sampling carried out using small vessels at low wind conditions (0-2 Beauforts) should be recorded by a portable anemometer or by ship's instruments.
Both start and end position should be recorded with GPS as well as the track.

MONITORING MICROLITTER ON SEA SURFACE – SAMPLING PROCEDURES



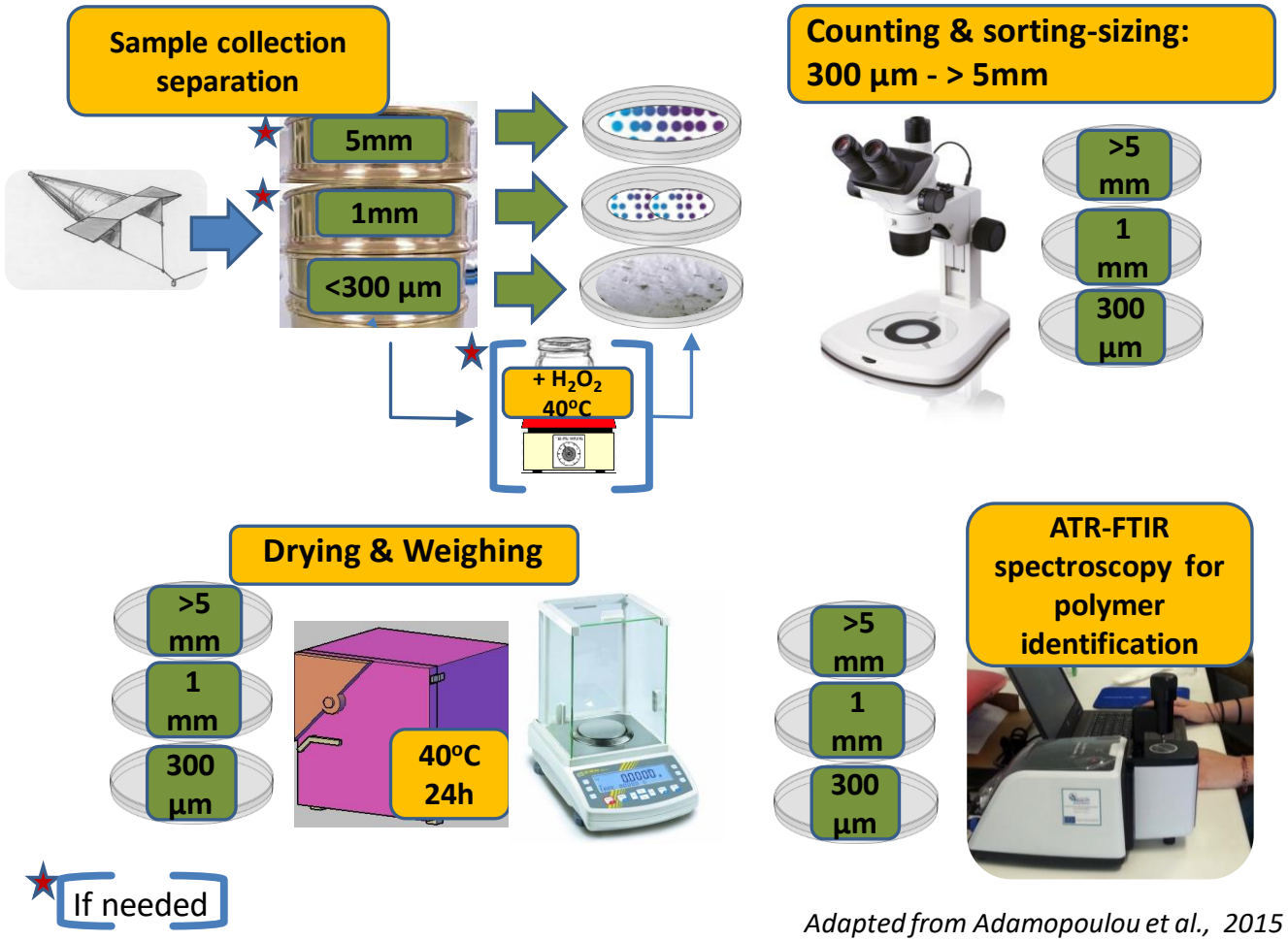


MONITORING MICROLITTER ON SEA SURFACE – SAMPLE PROCESSING AND SIZE CLASSIFICATION

The **sample** collected in the cod-end **should then be rinsed with seawater on a 300 µm metallic sieve** and transferred in glass jars with seawater.
Any natural debris items, such as leaves, twigs, seaweed etc., should be rinsed separately above the sieve and removed from the sample.

Microlitter is classified in three size classes:

- **Mesolitter (5 mm-25 mm)**
- **Large Microlitter LML (1mm-5mm)**
- **Small Microlitter SML (300µm – 1mm)**



Adapted from Adamopoulou et al., 2015

MONITORING MICROLITTER ON SEA SURFACE – SAMPLE PROCESSING AND SIZE CLASSIFICATION

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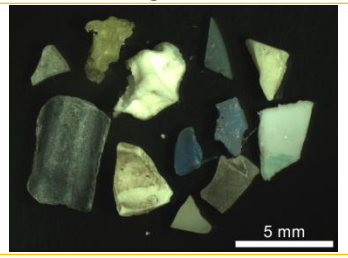
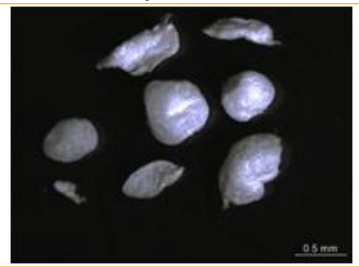
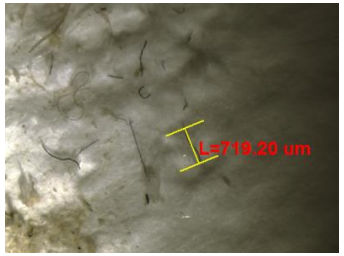


Films

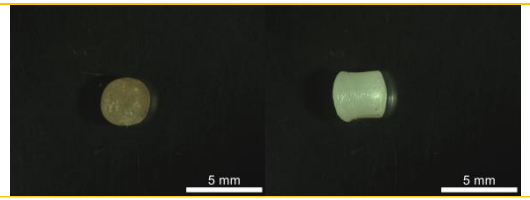
Styrofoam



Filaments



Pellets



MONITORING MICROLITTER ON SEA SURFACE – REPORTING UNITS

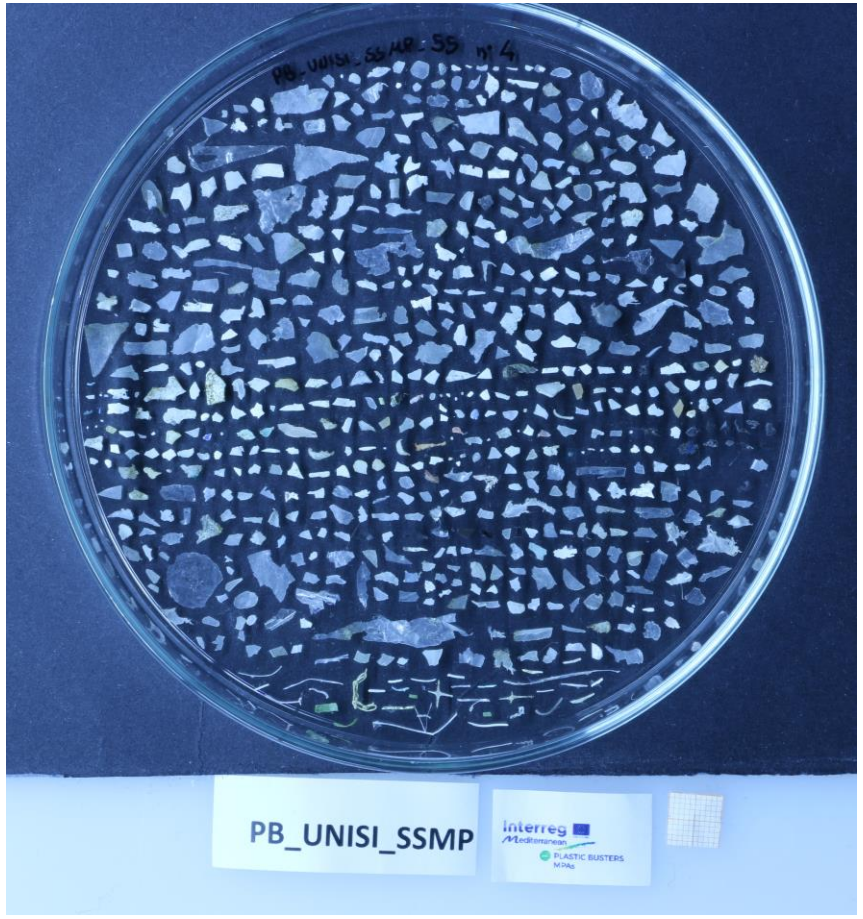
Microlitter counts (N) are reported as follows:

- **N per km^2 or N per m^2**, based on the start - end transect coordinates and the dimensions of the manta net mouth.

- **N per Km^3 or N per m^3**, based on flow meter indication and relevant formula.

Microlitter mass is reported as follows:

- **g per km^2 or g per m^2**
- **g per Km^3 or g per m^3**



MONITORING MICROLITTER ON SEA SURFACE – MATERIALS AND EQUIPMENT

SAMPLING EQUIPMENT

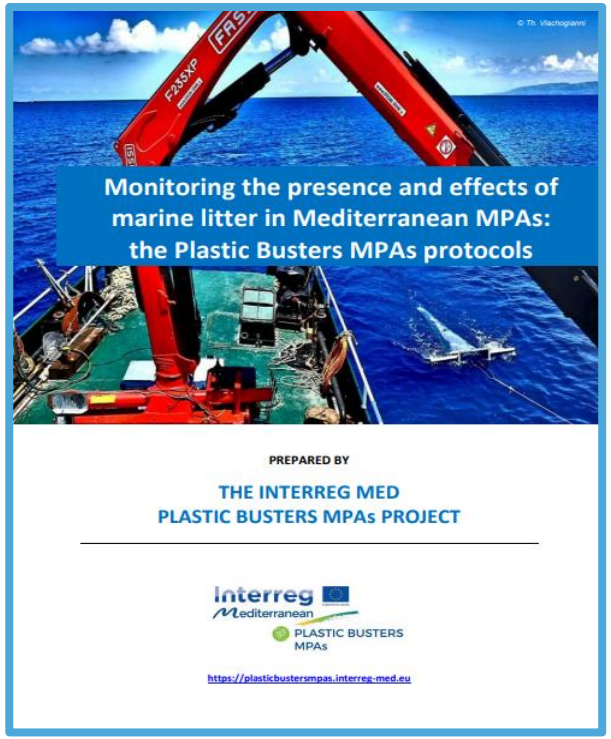
- **Manta net with wings and cod end** (mesh size: 330 µm)
- **Oceanographic flowmeter**
- Submersible water pump with a hose (for rinsing the net) or other equipment for net rinsing
- **GPS**
- **Glass jars** with caps or plastic bottles (500 ml) (one or more per each sample; when on the sea is a lot of sea grass, than you need 2 - 3 plastic bottles per sample)
- Sample container – cool box
- Screw driver
- **Sieve** (max 0.3 mm mesh size; preferable with smaller mesh size)
- Large bowl or washbasin (to prevent spillage of sample when emptying cod-end; 5 l <)
- Tap/fresh water source (tap/hose/squirt bottle)
- Squirt bottles2 x (one for water; one for alcohol)
- **Tweezers** (longer)
- **Metal spoon**
- (Ø 20 cm)
- Lat**Funnel**ex gloves without powder
- **70 % ethanol**
- **Waterproof marker**, vellum paper and pencil

MONITORING MICROLITTER ON SEA SURFACE – MATERIALS AND EQUIPMENT

LAB EQUIPMENT

- **Stereomicroscope** (min. 80x zoom; recommended also: transmission light with dark field, polarisation contrast and ring light)
- Object glasses (marked – number of a sample, date of analysis)
- Micro tweezer and tweezer
- Glass petri dishes
- Lab coat
- 70 % ethanol
- 3 Sieves with mesh sizes: 5mm; 1mm; 0.3 mm or smaller
- Squirt bottle 2x (one for distilled water; one for alcohol)
- Latex gloves without powder
- Filtered water or distilled water
- Analytical laboratory scale
- Multiwell plate provided by NIC for storing the microlitter particles

RESOURCES



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Plastic Busters CAP

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THANK YOU FOR YOUR ATTENTION!

“ For a litter FREE Mediterranean

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CSIC CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS
جمعية الرامس للتنمية المجتمع المحلي للمراعي والبيئة "Al-Rames Association for Local Community Development of Pastures and Environment"
INSTM
محمية شاطئ صور الطبيعية Tyre Coast Nature Reserve