



Monitoring the presence and effects of marine litter in Mediterranean MPAs: the Plastic Busters MPAs protocols

PREPARED BY

THE INTERREG MED PLASTIC BUSTERS MPAs PROJECT

Interreg 
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MPAs

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Document Information

This document (Deliverable 5.2.1) is a compilation of all the protocols that should be applied in order to elaborate a comprehensive diagnosis of the presence and effects of marine litter in Mediterranean MPAs.

Approvals

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1. Introduction

1.1 Marine litter a lurking threat in Mediterranean MPAs

The Mediterranean Sea is one of the areas most affected by marine litter worldwide. Marine litter - any persistent, manufactured or processed solid material- is found lying on the shores, as well as floating anywhere from the surface to the bottom of the sea. Even in pristine environments of the Mediterranean, such as coastal and marine protected areas (MPAs), marine litter is building up, threatening habitats and species. Impacts vary from entanglement and ingestion, to bio-accumulation and bio-magnification of toxic substances released from litter items, facilitation of introduction of invasive species, damages to benthic habitats, etc. MPA managers stand at the forefront of this issue, and admittedly they lack the tools, knowledge, and often the resources to effectively tackle it. As a result, the achievement of the conservation goals set is hampered.

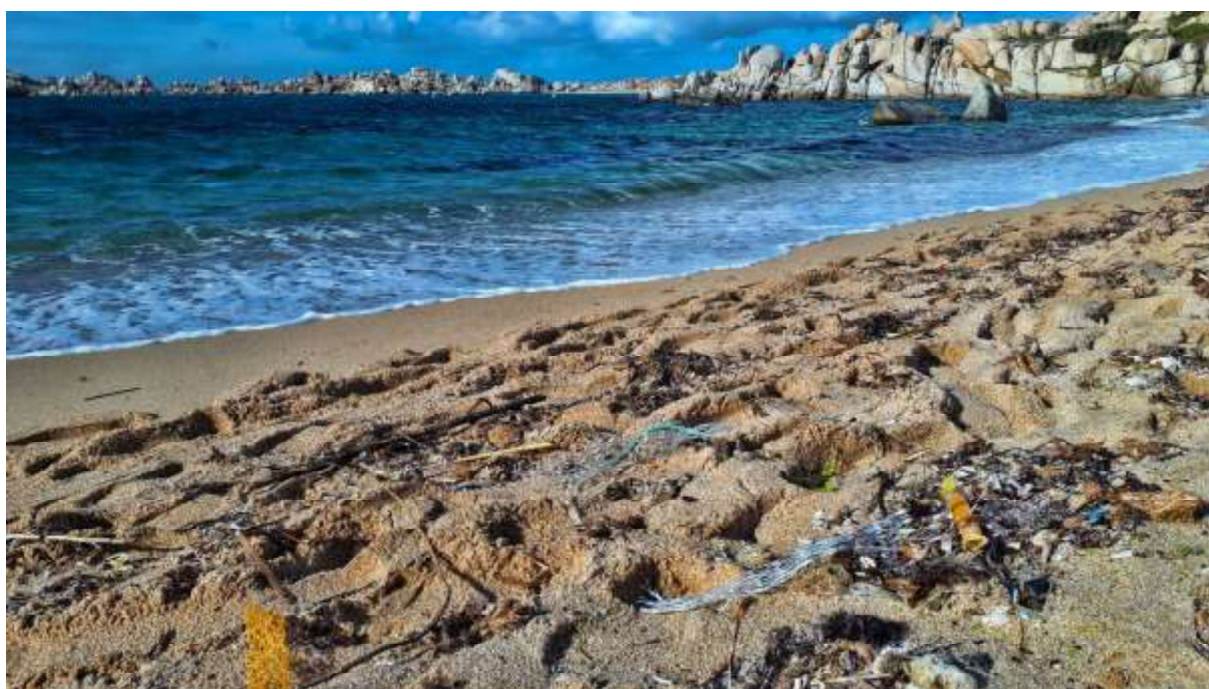


Figure 1-1. Marine litter a lurking threat in Mediterranean MPAs (Photo © Th. Vlachogianni).

1.2 The Plastic Busters MPAs project in a nutshell

The 4-year-long Interreg Med Plastic Busters MPAs project aimed at contributing to biodiversity protection and preservation of natural ecosystems in pelagic and coastal marine protected areas (MPAs), by defining and implementing a harmonized approach against marine litter. The project entailed actions that addressed the entire management cycle of marine litter, from monitoring and assessment to prevention and mitigation, as well as actions to strengthen networking between and among pelagic and coastal MPAs.

Plastic Busters MPAs consolidated Mediterranean efforts against marine litter by:

- Assessing the impacts of marine litter on biodiversity in MPAs and identifying marine litter ‘hotspot’ areas;
- Defining and testing tailor-made marine litter surveillance, prevention and mitigation measures in MPAs;
- Developing a common framework of marine litter actions for Interreg Mediterranean regions towards the conservation of biodiversity in Mediterranean MPAs.

The Plastic Busters MPAs project deployed the multidisciplinary strategy and common framework of action developed within the Plastic Busters initiative led by the University of Siena and the Sustainable Development Solutions Network Mediterranean (SDSN Med). This initiative frames the priority actions needed to tackle marine litter in the Mediterranean basin and was labelled under the Union for the Mediterranean (UfM) in 2016, gathering the political support of 43 Euro-Mediterranean countries.



Figure 1-2. *The Plastic Busters MPAs project in a nutshell.*

1.3 Definitions and policy context

Within this document, marine litter is defined as any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine and coastal environment. Marine litter can be classified in size classes as follows: macrolitter refers to items larger than 25 mm in the longest dimension, mesolitter to items between 5 mm to 25 mm, and microlitter to items ranging from 1 µm to 5 mm. This latter size class is sometime further broken down into large microlitter ranging from 1 mm to 5 mm and microplastic, from 1 µm to 1 mm in size.

The main legislative frameworks related to marine litter monitoring are the EU Marine Strategy Framework Directive – MSFD (2008/56/EC, 2010/477/EC, 2017/848/EC) and the Barcelona Convention Ecosystem Approach (COP19 IMAP Decision IG.22/7, UNEP/MED WG.450/3, June 2018) (see Box 1.1 and Box 1.2).

Box 1.1. *The Marine Litter Descriptor, criteria, and respective Indicators within the framework of the EU MSFD.*

Marine Litter within the EU MSFD

Descriptor 10: *Properties and quantities of marine litter do not cause harm to the coastal and marine environment*

Criteria D10C1 - Primary: The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed are at levels that do not cause harm to the coastal and marine environment.

- ▶ amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)
- ▶ amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)

Criteria D10C2 - Primary: The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in seabed sediment are at levels that do not cause harm to the coastal and marine environment.

- ▶ amount, distribution and, where possible, composition of microparticles (in particular microplastics) (10.1.3)

Criteria D10C3 - Secondary: The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned.

- ▶ amount and composition of litter ingested by marine animals (10.2.1)

Criteria D10C4 - Secondary: The number of individuals of each species, which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects.

Box 1.2. *The Marine Litter Operational Objectives and respective Indicators within the framework of the Barcelona Convention Ecosystem Approach and the Integrated Monitoring and Assessment Programme (IMAP).*

Marine Litter and the Barcelona Convention Ecosystem Approach

Ecological Objective 10 (EO10): Marine and coastal litter do not adversely affect the coastal and marine environment.

IMAP Common Indicator 22:

Trends in the amount of litter washed ashore and/or deposited on coastlines (including analysis of its composition, spatial distribution and, where possible, source).

IMAP Common Indicator 23:

Trends in the amount of litter in the water column including micro plastics and on the seafloor.

IMAP Candidate Indicator 24:

Trends in the amount of litter ingested by, or entangling marine organisms, focusing on selected mammals, marine birds, and marine turtles.

1.4 About this document

The overarching aim of this document is to provide an operational protocol for implementing the Plastic Busters MPAs harmonized marine litter monitoring approach and assess the presence and effects of marine litter in pelagic and coastal Mediterranean MPAs with special emphasis on marine species, including endangered ones (cetaceans, sea turtles, birds, endangered sharks, etc.). In this respect, this document is a compilation of all the protocols that should be applied in order to elaborate a comprehensive diagnosis of the marine litter problem in Mediterranean MPAs.

This document takes stock of all recent advances made by the EU MSFD Technical Group on Marine Litter and the Barcelona Convention CORMON Group. Furthermore, this document capitalizes on the outcomes of relevant projects such as the IPA-Adriatic DeFishGear project, the EU-funded INDICIT project and the Interreg Med marine litter related projects, namely the MEDSEALITTER, AMARE and ACT4LITTER.



Photo © Th. Vlachogianni



2. Methodology for monitoring MACROLITTER on beaches

This document describes the methodological approach for monitoring macrolitter on beaches. It has been compiled based on the related methodology developed within the IPA-Adriatic DeFishGear project and the 2022 MSFD TGML Updated Guidance on Monitoring of Marine Litter in European Seas, while taking into account the results from the Plastic Busters MPAs testing phase.

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2.1. Site selection

The survey sites should fulfil 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.

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.

It should be highlighted that all necessary precautions should be taken to ensure that surveys will not pose any threat to endangered or protected species such as sea turtles, shorebirds, marine mammals or sensitive beach vegetation/habitats.

2.2. Frequency and timing of surveys

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

2.3. Sampling unit

A sampling unit is defined as a fixed section of a beach covering the whole area from the strandline to the back of the beach. The sampling unit should be a 100-metre stretch of beach along the strandline and reaching to the back of the beach. The back of the beach needs to be explicitly identified using coastal features such as the presence of vegetation, dunes, cliff base, road, fence or other anthropogenic structures such as seawalls (either piled boulders or concrete structures).

Sampling units should represent the general characteristics of the survey site and the general state of litter in the survey site. The sampling units should not be placed on the edges of a beach or on parts of the beach that have a higher potential to accumulate litter. In addition, the sampling unit should not be placed in potential litter hotspots such as areas near the entrance of the beach or near coastal parking lots or directly in front of hotels. Based on these considerations a set of potential sampling units should be identified and a random selection of sampling units should then be made from this set (e.g., dividing the coast into 100 m sections and randomly choosing a number of these sections as sampling units).

In case of heavily littered beaches, 100-metre stretches may be too difficult to survey and therefore two 50-metre stretches should be surveyed instead.

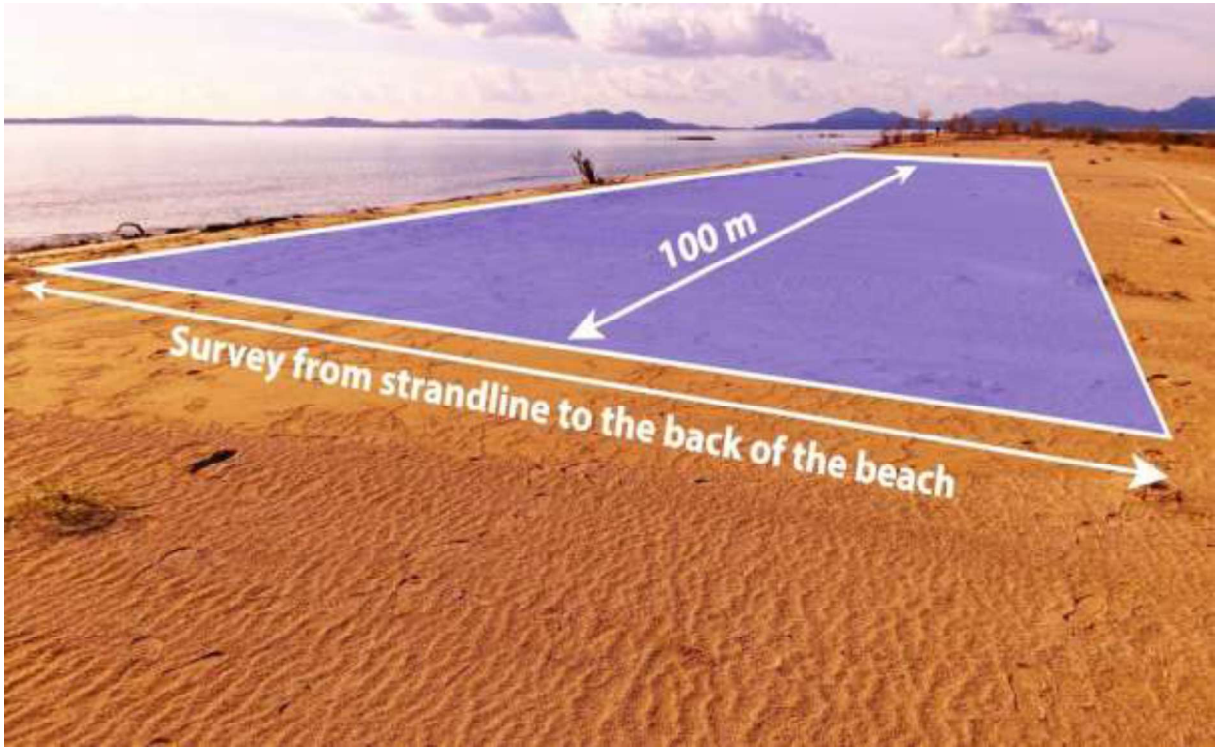


Figure 2-1. The sampling unit.

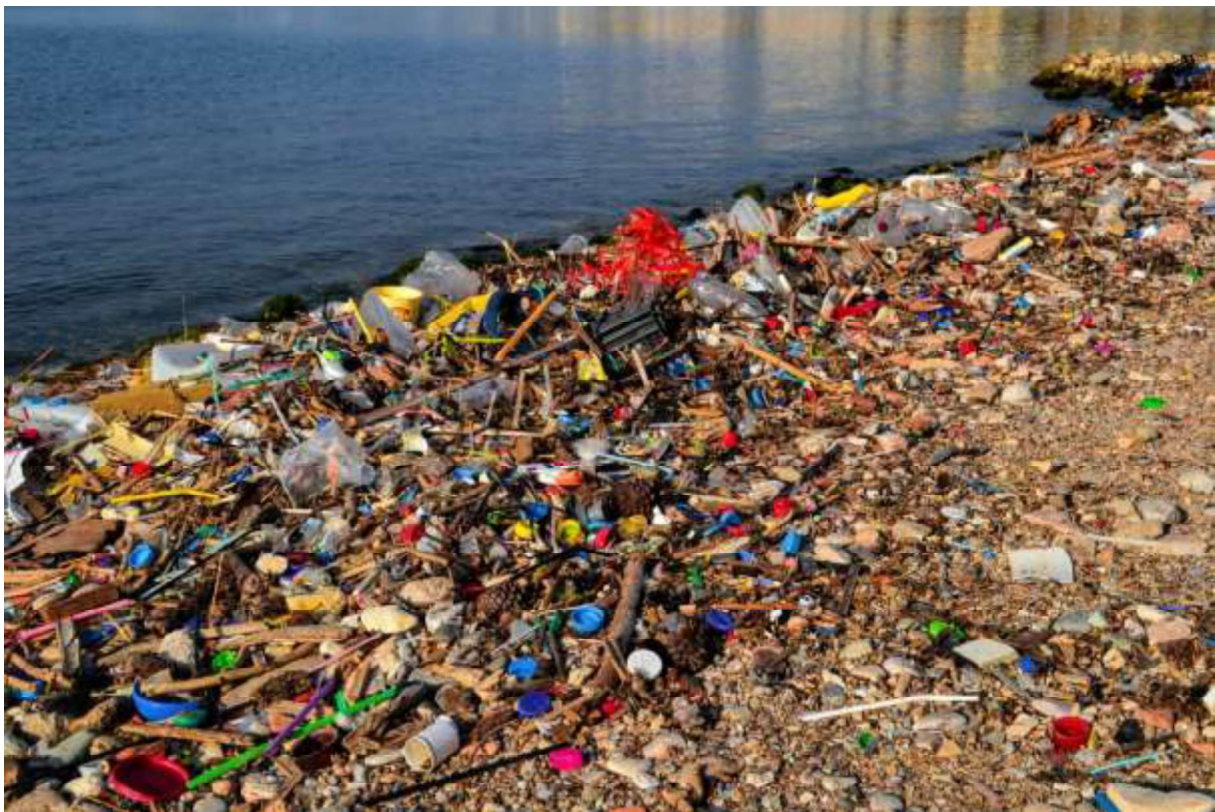


Figure 2-2. A heavily littered beach (Photo © Th. Vlachogianni).

2.4. Litter size classes to be surveyed

There are no upper size-limits for litter items to be recorded on beaches. But in order to ensure the inclusion of caps, lids, cigarette butts and other similar items in the quantification of beach litter, items as small as 2.5 cm in the longest dimension have to be recorded. In case such items are found in extremely high numbers, a 1-metre (rather than a 100-metre) beach transect should be used instead, saving effort and time.

2.5. Litter items classification and quantification

Items found on the sampling unit must be classified by type, according to the 'Joint List of Marine Litter Items Categories' prepared by the MSFD Technical Group on Marine Litter (MSFD TG ML) in close collaboration with EU Member States and the Regional Sea Conventions (Fleet et al., 2021). The manual for applying the Joint List classification system provides detailed information on how to classify litter items and a complementary photo guide helps the surveyors identify and categorise the litter items ([Online Photo Catalogue of the Joint List of Litter Categories](#)).

Litter items can be classified and recorded either on-site or in a working place (e.g. a lab) after the sampling has been completed (e.g., in case of bad weather conditions and/or heavily littered beaches); however, the latter should be avoided for weathered or fragile items, which easily disintegrate and can lead to overestimation of these litter items.

The unit to be used to assess the litter density is 'number of items' and should be expressed as counts of litter items per one 100-metre stretch.



Figure 2-3. Marine litter items classification (Photo © Th. Vlachogianni).

2.6. Litter items removal and disposal

During the survey, all litter items should be removed from the sampling unit. Larger items that cannot be removed (safely) by the surveyors should be marked, for example with paint spray (which meets environmentally friendly standards) so that they are not counted again at the next survey. The litter items collected should be disposed of properly. Regional or national regulations and arrangements should be followed. If these do not exist, local municipalities should be informed.

2.7. Materials and equipment

The following items are necessary to carry out beach surveys:

- ▶ High-resolution camera
- ▶ Hand-held GPS unit with extra batteries
- ▶ 100-metre tape measure (fiberglass preferred)
- ▶ Flag markers/stakes
- ▶ Rubbish bags
- ▶ Protective gloves
- ▶ Rigid container and sealable lid to collect sharp items such as needles, etc.
- ▶ Clipboard for each surveyor
- ▶ Recording sheets (printed on waterproof paper)
- ▶ Pencils and pens
- ▶ First aid kit (to include sunscreen, bug spray, drinking water)

2.8. Additional considerations

The amount and type of litter found on beaches can be influenced by different circumstances. To ensure that data will be analyzed and interpreted properly these circumstances must be recorded. Indicative examples of such circumstances include: events that may lead to unusual types and/or amounts of litter (e.g. shipping container losses, overflows of sewage treatment systems, etc.); difficult weather conditions (e.g. heavy winds or rain, etc.); replenishment/nourishment of the beach; etc.

References

Andresmaa, E., Angiolillo, M., Anastasopoulou, A., Bakker Paiva, M., Booth, A., Bunhalko, N., Cadiou, B., Clarò F., Consoli, P., Darmon, G., Deudero, S., Eriksson, J., Fischer, E., Fleet, D., Fortibuoni, T., Fossi, M.C., Galgani, F., G rigny, O., Giorgetti, A., Guse, N., Hanke, G., Ioakeimidis, C., Kammann, U., K hn, S., Lacroix, C., Lips, I., Loza, A.L., Matiddi, M., Molina Jack, E., Ronchi, F., Papadoyannakis, M., Pragnel-Raasch, H., Rindorf, A., Ruiz, M., Ruiz-Orej n, L.F., Set l , O., Schultze, M., Silvestri, C., Soederberg, L., Storr-Paulsen, M., Strand, J., van Franeker, van Loon, W., J., Vighi, M., Vinci, M., Vlachogianni, T., Weiel, S., Werner, S., 2022. Updated Guidance on Monitoring of Marine Litter in European Seas. A guidance document within the Common Implementation Strategy for the Marine Strategy Framework Directive. MSFD Technical Group on Marine Litter.

Fleet, D., Vlachogianni, Th., Hanke, G., 2021. A Joint List of Litter Categories for Marine Macrolitter Monitoring. EUR 30348 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21445-8, JRC121708. <https://doi.org/10.2760/127473>

Fossi, M.C., Vlachogianni, T., Anastasopoulou, A., Alomar, C., Bains, M., Caliani, I., Campani, T., Casini, S., Consoli, P., Cillari T., D'Alessandro, M., Deudero, S., Galgani, Galli M., F., Kaberi H., Panti, C., Ped , C., E. Romeo, T., Scotti, G., Tsangaris, C., Zeri, C., 2019. Toolkit for monitoring marine litter and its impacts on biodiversity in Mediterranean MPAs. Interreg Med Plastic Busters MPAs project (D.3.3.2).

IPA-Adriatic DeFishGear, 2014. Methodology for Monitoring Marine Litter on Beaches (macro-debris >2.5 cm).

Survey Site/Beach Identity Sheet

Name and area of survey site/beach:

Beach ID:

Country:

1. Beach width at mean low spring tide (m):
2. Beach width at mean high spring tide (m):
3. Total length of the beach (m):
4. Back of beach (e.g. cliffs, dunes, etc.):
5. GPS coordinates of the four corners of the sampling unit:
 A:
 B:
 C:
 D: :
6. Coordinate system used:
7. Date coordinates were measured://(d/m/y).....
8. Prevailing sea currents off the beach: N E S W
9. Prevailing winds: N E S W

When you look from the beach to the sea, what direction is the beach facing: N E S W

Type of beach material (% coverage):(e.g. sand 60%, pebbles 40%)

Beach topography: (e.g. slope 20%)

Are there any objects in the sea (e.g. a pier) that influence the currents:

Prevalent beach usage (local people, swimming and sunbathing, fishing, surfing, sailing, etc.):		
1.	seasonal or whole year round:
2.	seasonal or whole year round:
3.	seasonal or whole year round:

.....
Size of harbor (number of ships):
.....

What is the distance from the beach to the nearest river mouth (km):
.....

What is the name of the river:
.....

Position of river mouth in relation to survey area: N E S W

Is the beach located near a discharge or discharges of waste water:
.....

What is the distance from the beach to the discharge points (km):
.....

Position of discharge points in relation to survey area: N E S W

How often is the beach cleaned:

Daily Weekly Monthly Other

All year round:

Seasonal, please specify in months:

Daily Weekly Monthly Other

What method is used:

Manual Mechanical

Who is responsible for the cleaning:
.....
.....
.....

Additional comments and observations about this beach:
.....
.....
.....

Please include:

1. A map of the beach

2. A map of the beach and the local surroundings. When relevant please mark on this map the following:

- | | | |
|-----------------------------------------|----------------------------------------------|-----------------------------------------------------------------|
| <input type="checkbox"/> Nearest town | <input type="checkbox"/> Food/drink outlets | <input type="checkbox"/> Nearest shipping lane |
| <input type="checkbox"/> Nearest harbor | <input type="checkbox"/> Nearest river mouth | <input type="checkbox"/> Discharge or discharges of waste water |

3. A regional map



Date sheet is filled in:/...../..... (d/m/y)

Name:

E-mail:



Survey Sheet (100m)

Name and area of beach:

.....

Beach ID:

.....

Country:

.....

Total number of surveyors:

.....

Date of survey:/...../..... (d/m/y)

Name of surveyor 1:

.....

e-mail address:

.....

Name of surveyor 2:

.....

e-mail address:

.....

Start time of the survey:

End time of the survey:

Additional Information

When was the beach last cleaned:

...../...../..... (d/m/y)

Did you divert from the predetermined 100 meters:

No Yes, please specify.....

.....

Did any of the following weather conditions affect the data of the survey? If so, please tick appropriate box:

Wind Rain Snow Ice Fog

Sand storm Exceptionally high tide

Did you find stranded or dead animals:

Yes No

If so, how many:

Please describe the animal, or note the species name if known:

Alive Dead

Sex of animal (if known):

Age of animal (if known):

Is the animal entangled in litter:

Yes No

If so, please describe nature of the entanglement and type of litter:

.....

Were there any circumstances that influenced the survey? (For example tracks on the beach (cleaning or other), recent replenishment/nourishment of the beach or other, difficulties in identifying items due to the presence of large amounts of wood washed ashore, etc.).

Please specify:.....

.....

Were there any events that led to unusual types and/or amounts of litter on the beach? (For example beach party or other)

Please specify:

Joint List of Marine Macrolitter Items

* To be recorded also if smaller than 2.5 cm

J-CODE	SUP/FG	NAME	ITEMS COUNT
ARTIFICIAL POLYMER MATERIALS			
J220		plastic sheeting from greenhouses	
J221		plastic irrigation pipes	
J222		other plastic items from agriculture	
J90		plastic flower pots	
J223		trays for seedlings of foamed plastic	
J46	FG	plastic oyster trays	
J45	FG	plastic mussels/oyster mesh bags, net sack, socks	
J47	FG	plastic sheeting from mussel culture (Tahitians)	
J102		plastic flip-flops	
J136		footwear made of plastic - not flip flops	
J40		plastic gloves (household/dishwashing, gardening)	
J41		plastic gloves (industrial/professional applications)	
J252		single-use plastic gloves	
J69		plastic hard hats/helmets	
J256		foamed plastic insulation including spray foam	
J89		plastic construction waste (not foamed insulation)	
J8	SUP	plastic drink bottles >0.5 l	
J7	SUP	plastic drink bottles ≤ 0.5 l	
J224	SUP	plastic food containers made of foamed polystyrene	
J21*	SUP	plastic caps/lids drinks	
J225	SUP	plastic food containers made of hard non-foamed plastic	
J1	SUP	plastic 4/6-pack yokes & six-pack rings	
J226	SUP	cups and cup lids of foamed polystyrene	
J227	SUP	cups and lids of hard plastic	
J228	SUP	plastic cutlery	
J229	SUP	plastic plates and trays	
J230	SUP	plastic stirrers	
J231	SUP	plastic straws	
J30	SUP	plastic crisps packets/sweets wrappers	
J31	SUP	plastic lolly & ice-cream sticks	
J85	FG	plastic commercial salt packaging	
J58	FG	fish boxes - foamed polystyrene	
J57	FG	fish boxes - hard plastic	
J92	FG	plastic bait containers/packaging	
J60*	FG	plastic fishing light sticks / fishing glow sticks incl. packaging	
J62	FG	plastic floats for fishing nets	
J59	FG	plastic fishing line	
J54	FG	plastic nets and pieces of net > 50cm	
J53	FG	plastic nets and pieces of net 2.5 cm ≥ ≤ 50 cm	
J232	FG	plastic string and filaments exclusively from dolly ropes	
J233	FG	other plastic string and filaments exclusively from fishery	
J234	FG	plastic tangled nets and rope without dolly rope or mixed with dolly rope	

J-CODE	SUP/FG	NAME	ITEMS COUNT
J235	FG	plastic tangled dolly rope	
J61	FG	other plastic fisheries related items not covered by other categories	
J42	FG	plastic crab/lobster traps (pots) and tops	
J44	FG	plastic octopus pots	
J70		plastic shotgun cartridges	
J11		plastic beach use related body care and cosmetic bottles and containers	
J12		plastic non-beach use related body care and cosmetic bottles and containers	
J95	SUP	plastic cotton bud sticks	
J29		plastic combs/hair brushes/sunglasses	
J98		plastic diapers/nappies	
J236		other plastic personal hygiene and care items	
J96	SUP	plastic sanitary towels/panty liners/backing strips	
J144	SUP	plastic tampons and tampon applicators	
J97		plastic toilet fresheners	
J237	SUP	plastic wet wipes	
J253		plastic single-use face-mask	
J211		other plastic medical items (swabs, bandaging, adhesive plasters etc.)	
J100*		plastic medical/ pharmaceuticals containers/tubes/ packaging	
J99		plastic syringes/needles	
J9		plastic bottles and containers of cleaning products	
J15		plastic engine oil bottles & containers >50cm	
J14		plastic engine oil bottles & containers 2.5 cm \geq \leq 50 cm	
J17		plastic injection gun containers/cartridges	
J16		plastic jerry cans	
J22*		plastic caps/lids chemicals, detergents (non-food)	
J23*		plastic caps/lids unidentified	
J24*		plastic rings from bottle caps/lids	
J13		other plastic bottles & containers (drums)	
J3	SUP	plastic shopping/carrier/grocery bags	
J101		plastic dog/pet faeces bag	
J5	SUP	the part that remains from tear-off plastic bags	
J36		other plastic heavy-duty sacks	
J238		plastic mesh bags for vegetable, fruit and other products	
J4	SUP	small plastic bags	
J91*		plastic biomass holder from sewage treatment plants and aquaculture	
J18		plastic crates, boxes, baskets	
J65		plastic buckets	
J93		plastic cable ties	
J84		plastic CDs & DVDs	
J67		plastic sheets, industrial packaging, sheeting	
J64		plastic fenders	
J68		fibre glass items	
J63		plastic floats/buoys other source than fishing or not	

J-CODE	SUP/FG	NAME	ITEMS COUNT
		known	
J239		other foamed plastic items and fragments not made of foamed polystyrene	
J257*		foamed plastic packaging	
J83		fragments of foamed polystyrene > 50cm	
J82		fragments of foamed polystyrene 2.5 cm ≥ ≤ 50 cm	
J80		fragments of non-foamed plastic > 50cm	
J79		fragments of non-foamed plastic 2.5cm ≥ ≤ 50cm	
J240		other identifiable foamed plastic items	
J241		other identifiable non-foamed plastic items	
J166		plastic paint brushes	
J28		plastic pens and pen lids	
J49		plastic rope (diameter more than 1cm)	
J242		plastic string and cord (diameter less than 1cm) not from dolly ropes or unidentified	
J66		plastic strapping bands	
J43		plastic tags (fishing, shipping, farming and industry)	
J87		plastic masking/duct/packing tape	
J88		telephone	
J72		plastic traffic cones	
J86		plastic fin trees (from fins for scuba diving)	
J243		plastic remains of fireworks	
J32*		plastic toys and party poppers	
J27*	SUP	tobacco products with filters (cigarette butts with filters)	
J26		plastic cigarette lighters	
J25		plastic tobacco pouches / plastic cigarette packet packaging	
J19		plastic vehicle parts	
RUBBER			
J127		rubber boots	
J133		rubber condoms (incl. packaging)	
J131*		rubber band (small, for kitchen/household/post use)	
J248		rubber sheet	
J134		other rubber pieces	
J249		rubber belts	
J125*	SUP	rubber balloons	
J126		rubber balls	
J250		rubber inner-tubes	
J251		rubber tyres	
CLOTH/TEXTILE			
J137		clothing	
J138		shoes & sandals made of leather and/or textile	
J141		cloth textile carpet & furnishing	
J140		hessian sacks/packaging	
J143		sails, canvas	
J145		other textiles	
J139		cloth textile backpacks & textile bags	

PAPER/CARDBOARD			
J150		paper cartons/Tetrapak milk	
J151		paper cartons/Tetrapak (non-milk)	
J244		paper cups	
J245		paper food trays, food wrappers, drink containers	
J246		paper cotton bud sticks	
J247		other paper containers	
J147		paper bags	
J148		cardboard boxes	
J156		paper fragments	
J154		paper newspapers & magazines	
J158		other paper items	
J155		paper tubes and other pieces of fireworks	
J152		paper cigarette packets	
PROCESSED/WORKED WOOD			
J159		wooden corks	
J165		wooden ice-cream sticks, chip forks, chopsticks, toothpicks	
J164		wooden fish boxes	
J163		wooden crab/lobster pots	
J162		wooden crates, boxes, baskets for packaging	
J172		other processed wooden items > 50cm	
J171		other processed wooden items 2.5 cm ≥ ≤ 50 cm	
J160		wooden pallets	
J167		wooden fireworks & matches	
METAL			
J194		metal cables	
J175		metal drinks cans	
J176		metal food cans	
J181		metal tableware (e.g. plates, cups & cutlery)	
J184		metal lobster/crab pots	
J182*		metal fisheries related weights/sinkers, and lures	
J180		metal appliances (refrigerators, washers, etc.)	
J187		metal drums & barrels	
J174		metal aerosol/spray cans	
J188		other metal cans	
J190		metal paint tins	
J178*		metal bottle caps, lids & pull tabs from cans	
J195*		metal household batteries	
J177		metal foil wrappers, aluminium foil	
J199		other metal pieces > 50cm	
J198		other metal pieces 2.5cm ≥ ≤ 50cm	
J186		metal industrial scrap	
J191		wire, wire mesh, barbed wire	
J179		metal disposable BBQs	
J193		metal vehicle parts / batteries	
J130		wheels with metal hub	

GLASS/CERAMICS			
J204		glass ceramic construction materials (bricks, tiles, cement)	
J203		glass and ceramic tableware (plates/cups/glasses)	
J207		ceramic or glass octopus pots	
J200		glass bottles	
J201		glass jars	
J208		pieces of glass/ceramic (glass or ceramic fragments \geq 2.5 cm)	
J205		glass fluorescent light tube	
J202		glass light bulbs	
J219		other ceramic items	
J210		other glass items	
CHEMICALS			
J216		unidentified generally dark-coloured oil-like chemicals	
J217		unidentified generally light-coloured paraffin-like chemicals	
J218		unidentified chemicals	
FOOD WASTE			
J215		organic food waste	



3. Methodology for monitoring MICROLITTER in beach sediments

This document describes the methodological approach for monitoring microlitter on beaches. It has been compiled based on the related methodologies developed within the IPA-Adriatic DeFishGear project and the JPI-Oceans BASEMAN project, while taking into account the results from the Plastic Busters MPAs testing phase.

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3.1. Survey 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.

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.



Figure 3-1. Microlitter on beach sediment (Photo © Th. Vlachogianni).

3.2. Frequency and timing of surveys

At least four surveys should be carried out in winter, summer, spring and autumn, at the same time with the beach macrolitter surveys. The optimum survey periods are:

- ▶ Winter: January
- ▶ Spring: April
- ▶ Summer: July
- ▶ Autumn: October

3.3. 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 (Fig. 3.2, 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.

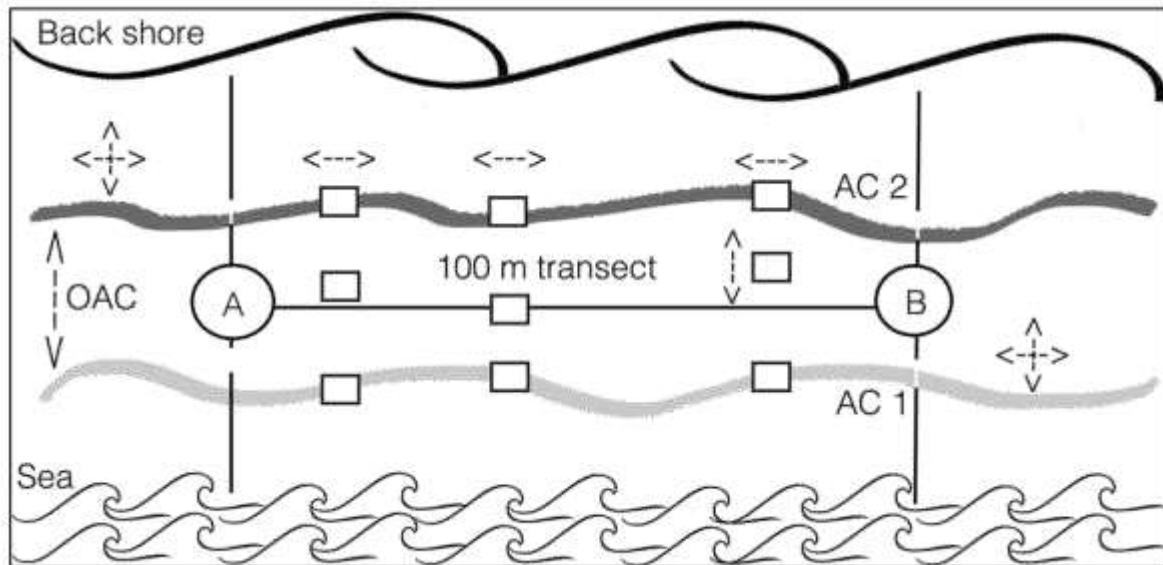


Figure 3-2. Example of 100-metre transect (Frias et al., 2018) (AC: accumulation area, OAC: outside the accumulation area).

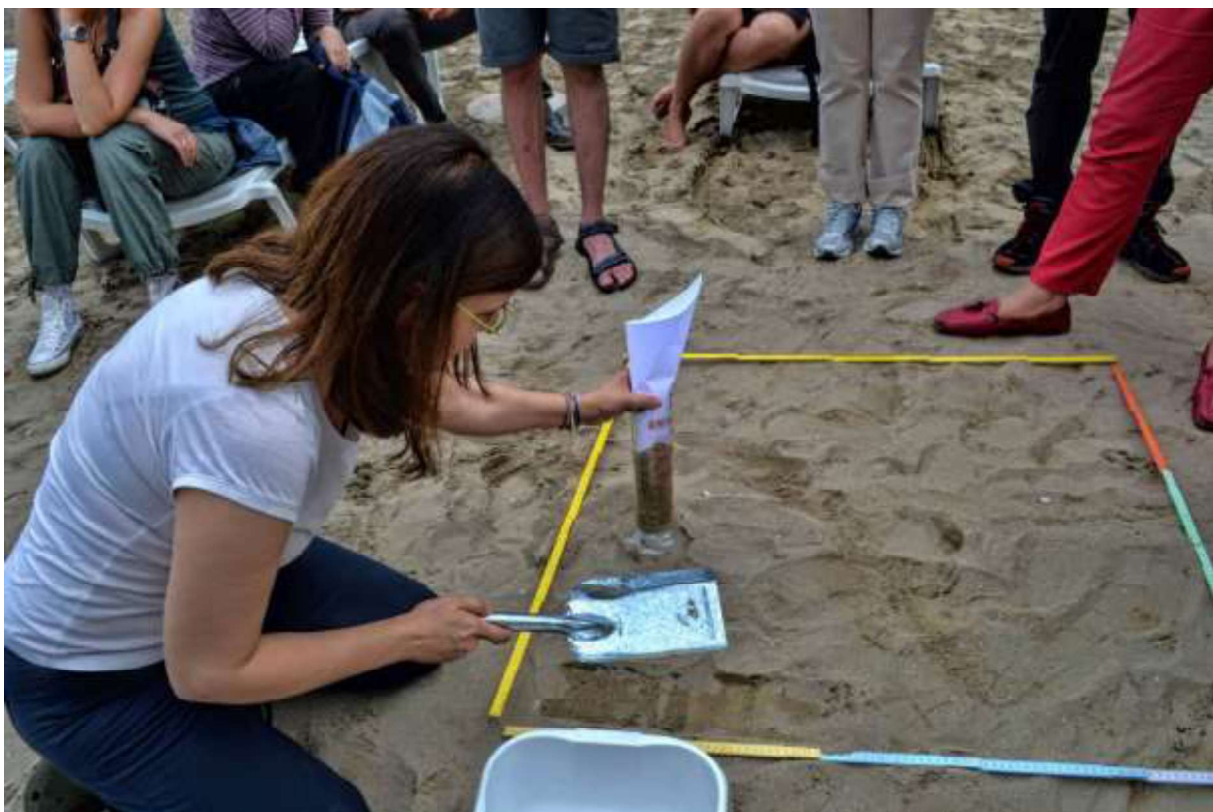


Figure 3-3. Microplastics sampling on beaches (Photo © Th. Vlachogianni).

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.

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.

3.4. Microlitter size classes to be surveyed

Typically litter items that are larger than 5mm and smaller than 2.5cm are sampled in microlitter surveys on beaches, however, the mesolitter items (items larger than 5mm and smaller than 2.5cm) that have been retained on the 5mm sieve can be surveyed too.

3.5. Litter analysis and classification

Concerning the separation of microplastics from the beach sediment, 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 is a rather demanding procedure, which should be carried out in the laboratory under specific conditions to avoid air-borne 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).



Figure 3-4. Microplastics identification (Photo © Th. Vlachogianni).

The visual identification and classification of microlitter items can be carried out directly or through a microscope. Microplastics are characterized by **type** on the basis of the following categories: pellet, fragment (granule, flake), fibre, film, filaments, microbeads, foam (expanded polystyrene-PS). 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.

3.6. Reporting units

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)

3.7. Materials 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 and pens
- ▶ First aid kit (to include sunscreen, bug spray, drinking water)
- ▶ Microscope
- ▶ ATR-FTIR spectrometer or Raman spectrometer

References

- Fossi, M.C., Vlachogianni, T., Anastasopoulou, A., Alomar, C., Baini, M., Caliani, I., Campani, T., Casini, S., Consoli, P., Cillari T., D'Alessandro, M., Deudero, S., Galgani, Galli M., F., Kaberi H., Panti, C., Pedà, C., E. Romeo, T., Scotti, G., Tsangaris, C., Zeri, C., 2019. Toolkit for monitoring marine litter and its impacts on biodiversity in Mediterranean MPAs. Interreg Med Plastic Busters MPAs project (D.3.3.2)
- Frias et al., 2018. Standardized protocol for monitoring microplastics in sediments. JPI-Oceans BASEMAN project.
- GESAMP, 2019. Guidelines on the monitoring and assessment of plastic litter and microplastics in the ocean (Kershaw P.J., Turra A. and Galgani F. editors), (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 99, 130p.
- IPA-Adriatic DeFishGear, 2014. Methodology for Monitoring Marine Microlitter on Beaches.

3.8. Survey sheets

An example of a datasheet is given below (from Frias et al, 2018). Alternatively, the survey datasheet used for the macrolitter surveys can be used, where the coordinates of each square should be also reported.

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:

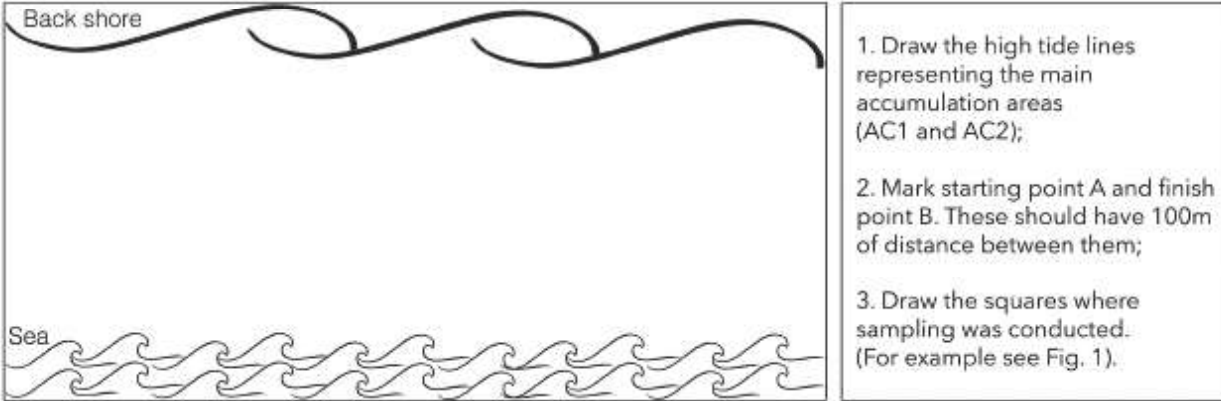
A _____ B _____

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: _____

A photograph of a rocky beach with a large amount of driftwood and marine litter. The litter includes plastic bottles, a blue cap, and other debris scattered among the rocks and logs. The background shows a steep, rocky cliff face.

4. Methodology for identifying MARINE LITTER HOTSPOTS on beaches

This document describes the methodological approach for monitoring identifying marine litter hotspots on beaches. It has been compiled based on the related methodology piloted within the Interreg Med AMARE project and it has been tested and adapted within the framework of the Plastic Busters MPAs project to address the recent advances in the field.

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4.1. Introduction

The present document presents a proposed approach to identify marine litter hotspots in Mediterranean MPAs using a simple protocol, which may also provide valuable insights for carrying out more comprehensive monitoring surveys using the protocols described in chapters 2 and 3. In addition, this methodological approach can provide the evidence needed for guiding targeted cleanup operations. It should be stressed that this approach does not provide a detailed assessment of amounts, types, composition and sources of marine litter, but it rather provides initial information on sites of interest.

The fate of most items is unknown and accumulations may occur at some locations as determined by several factors including hydrodynamic currents and circulation patterns, coastline structure, weather conditions, associated beach morphodynamics, residual swell, marine litter sources, both land-based and sea based. The amounts of litter observed thus reflect the long-term balance between inputs (land-based and sea-based sources and stranding processes) and removal (through export, burial, degradation and clean-ups). Apart from episodic storms events that may affect the number of items rather than the location of stranded items, most of the factors affecting the location of litter remain fairly constant with accumulation areas being the consequence of the integration of long term processes.

4.2. Methodological approach

Data are obtained from small boats (5-6 m) operating at low speed (1-12 knots) and moving at a distance of 20-100 m from the shore. The position of accumulation areas is recorded using GPS for low accumulation zones (2-10 litter items/site, usually a 5-30 m stretch distance onshore) and high accumulation zones (> than 10 litter items/site). The mapping of the hot spots of stranded litter is done through google maps, for simple analysis, or through a GIS (*.shp) files mapping system, calculating the number of high accumulation areas (> 10 items / site) load on 2 km or 3 km stretches of coastline. Maps are finally interpreted to support both the identification of potential monitoring sites, association with modelling predictions or identification of priority areas for removal actions.



Figure 4-1. (A) Visual observations and mapping of low (2-10 litter items/site, white circles) or high (> 10 litter items/site, red triangles) litter accumulation zones around the Elbe Island (Blue circles); (B) Mapping of high (> 10 litter items/site, red triangles) litter accumulation zones around the Elbe to locate priority areas for monitoring or cleaning.

References

Fossi, M.C, Vlachogianni, T., Anastasopoulou, A., Alomar, C., Bani, M., Caliani, I., Campani, T., Casini, S., Consoli, P., Cillari T., D'Alessandro, M., Deudero, S., Galgani, Galli M., F., Kaberi H., Panti, C., Pedà, C., E. Romeo, T., Scotti, G., Tsangaris, C., Zeri, C., 2019. Toolkit for monitoring marine litter and its impacts on biodiversity in Mediterranean MPAs. Interreg Med Plastic Busters MPAs project (D.3.3.2).

GESAMP (2019). Guidelines or the monitoring and assessment of plastic litter and microplastics in the ocean (Kershaw P.J., Turra A. and Galgani F. editors)). Rep. Stud. GESAMP No. 99, 130p.