IMP.act

Managing for Microplastics: A Baseline to Inform Policy Stakeholders

Intertidal sampling protocol

May 2019

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Project details

https://www.joaofrias.com/impact-project

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Citation

Frias, J. (2019). Intertidal sampling protocol. https://doi.org/10.13140/RG.2.2.32410.06082

#1 Collection

Intertidal sediment sampling

Beaches are dynamic systems with ever-changing conditions and sampling for microplastics should take into consideration that high tide lines can be highly variable over relatively short periods of time. In order to account for this, monitoring surveys should be held, whenever possibly, once per season (spring, summer, autumn and winter). To define the sampling area, mark out a 100m transect in width, parallel to the water edge (sea), using a measuring tape or similar and take note of the GPS coordinates on each side of the transect (Figure 1., A and B). This transect will define the sampling area i.e. from the shoreline (low tide, light grey, AC1) to the above the strand line (accumulation zone, dark grey, AC2). In Figure 1 the dark grey line represents the mean height of the spring tide line and the light grey line represents the low tide line. Please note that in many beaches this second tide line might not be always visible on the shore. If the second line does not exist, sample another area outside the accumulation zone.

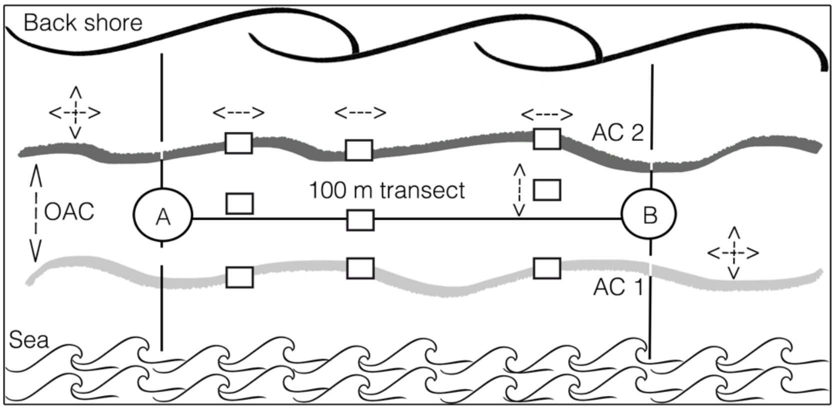


Figure 1 is a visual representative example of what could be draw in your datasheet.
The datasheet in the appendix provides an area for the surveyor to draw a representation of the beach on the day of the survey.

Figure 1 – Example of 100m transect (adapted from OSPAR, 2010 and NOAA, 2013)
(AC – accumulation area, OAC – outside accumulation area)

The sampling design is stratified random so collect a minimum of 3 samples (represented by square areas in Figure 1) along a transect in each high tide line (AC1 and AC2). Make sure you also survey the area between the two high tide lines (OAC).

Mark your sampling unit (30 x 30 cm) using the measuring tape or a quadrat and record the GPS coordinates of each unit. Collect the top 5 cm (total volume of approximately 4,500 cm3 = 4.5 L) of sediment using a small metal shovel and ideally store the sample in labelled glass jars, previously decontaminated. Alternatively, they can be stored in labelled grip- or zip-lock bags. The label should include site name, date, time (if needed), and the code of the sample (AC1a, AC1b, AC1c, OAC1a, OAC1b, etc..). This method will allow to estimate concentration of microplastics both horizontally and vertically, allowing collected data to be compared with a wide range of studies. Datasheets for this task can be found in the appendix (Form 1).

Laboratory processing

For citizen science purposes, make a sea salt (sodium chloride) saturated solution, as a density separation method. Seawater has an approximately salt concentration of 35 g L^{-1} and the recommended concentration for this laboratory method is to use a 100 g L^{-1} concentration. Introduce the sediment sample in a 1L glass beaker, add the saturated seawater solution and stir the solution for approximately 1 minute. Cover the solution with tinfoil to avoid airborne particles to go inside the solution. Wait approximately 20 mins to allow particles to deposit in the bottom. Some plastic polymers will have the tendency to float at the surface (see table A2 in the appendix).

Use a Buchner filtration system (figure 2) and appropriate filters (figure 3) to filter the solution. When dried, observe the filters under a microscope. Use the appropriate form below to register suspicious particles. Register if possible, type, shape, colour, number.

Figure 2 – Buchner filtration system with vacuum pump (credits: Merck Millipore)

Figure 3 – GF/C filters (credits: Fischer Scientific)

Marine litter survey

Once you have collected all the sediment samples from each quadrat and depending on your time availability or litter accumulation of the beach, you can conduct a marine litter survey to quantify and account of larger pieces of marine litter. One of the easiest measures that you can use in a citizen science project or if you are organising a voluntary beach clean-up is to consider collecting everything larger than a bottle cap (approximately 2.5 cm in diameter). In small groups of people (between 3 and 5), one person should be in charge of registering all items into the form. The easiest way to save time is for people to shout out what they are collecting into a large plastic bag. This way, all items will be quantified, and, in the end, you just need to weight the bags. For larger groups of people divide into smaller teams, have 1 person registering and 3 to 4 people collection. The person that is registering should do this tasks for the duration.

The most common marine litter categories can be seen in the specific form below in this document. For more details use the OSPAR report in the reference section, where these methods were adapted from.

Forms

Sampling site form

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: ☐ Strong 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:

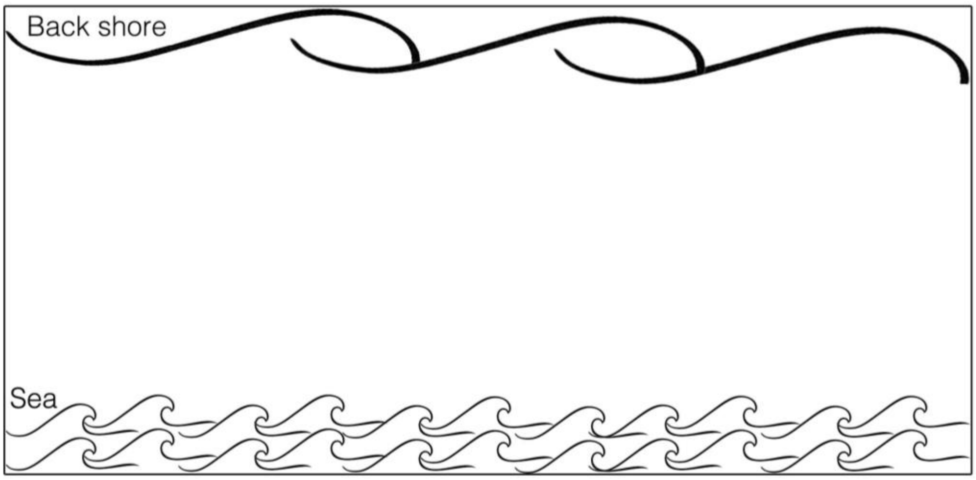
A ________________________________ **B**________________________________

AC1 1. ______________________ 2. ______________________ 3. ______________________

AC2 1. ______________________ 2. ______________________ 3. ______________________

OAC 1. ______________________ 2. ______________________ 3. ______________________

SAMPLING (according to scheme in page 3)



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:____

____

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____

Beach use: ☐ Urban ☐ Rural ☐ Other: ________________

Proximity to | Presence of ☐ Industry ☐ Tourist Attractions (e.g. surf schools) ☐ Rivers

☐ Sewage inputs ☐ Harbours/Ports ☐ Fishing facilities ☐ Marina ☐ Other: ________________

Factors that might influence the presence of marine anthropogenic litter:

☐ Beach Clean-up activity: Event locally organised by ☐ municipality ☐ civic movement/NGO.

How frequently is this beach cleaned? ☐ Annually ☐ Quarterly ☐ Bimonthly

☐ Monthly ☐ Weekly ☐ Daily

☐ Recent storms or extreme events. Which? ________________________________

☐ Festivals or other events. Which? ____

Impacts on marine fauna

Did you find dead animals? ☐ No ☐ Yes. How many: __________

Which species?

#1 ______________________________ #3 ______________________________

#2 ______________________________ #4 ______________________________

Were the dead animals entangled in marine litter? ☐ No ☐ Yes. How many: __________

Please provide more details on the entanglement:

#1 ______________________________ #3 ______________________________

#2 ______________________________ #4 ______________________________

Name of surveyor ____

Contact (e-mail): ______________________________@__________________________

Was marine litter collected in this activity? ☐ Yes ☐ No

Notes:____

____

____

____

____

____

____

____

Name of surveyor ____

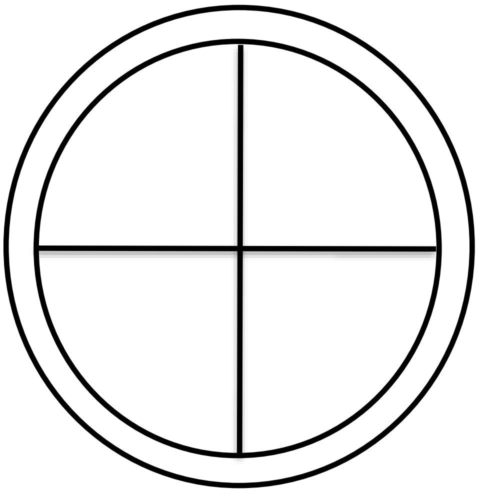
Contact (e-mail): ______________________________@__________________________

Date: ____/____/20___

Filter observation form

Sample code ____________________ Filter no. ______________

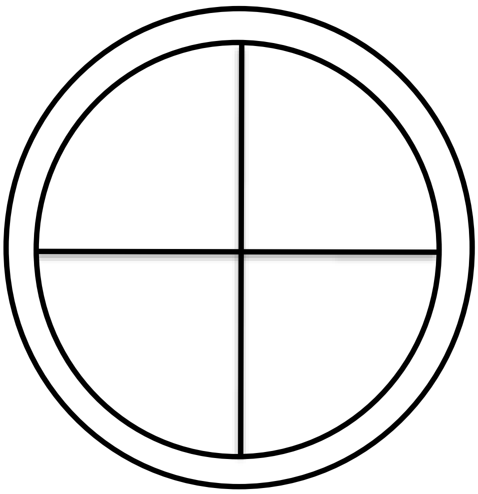
Date of collection: ____/____/20___ Magnification ________ x



Notes: ____

Sample code ____________________ Filter no. ______________

Date of collection: ____/____/20___ Magnification ________ x

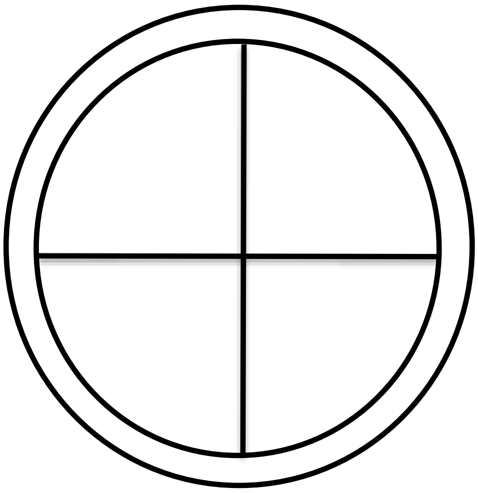


Notes: ____

Date: ____/____/20___

Sample code ____________________ Filter no. ______________

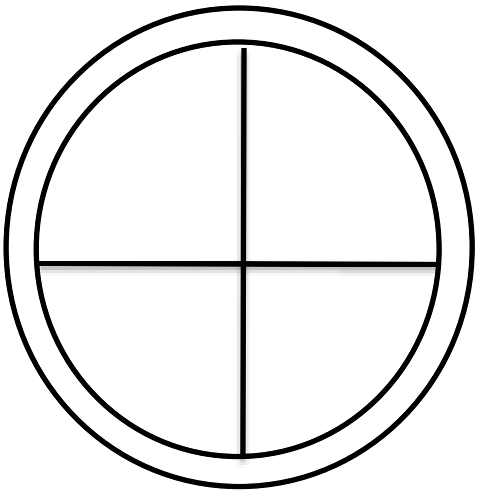
Date of collection: ____/____/20___ Magnification ________ x



Notes: ____

Sample code ____________________ Filter no. ______________

Date of collection: ____/____/20___ Magnification ________ x



Notes: ____

Marine litter collection form

Note: The easiest way to mark the number of items is III ~~IIII~~ = 8 | Use the back of this form if more space is needed

Items most likely to be found:

Cigarette filters: ______ = [ ]

Cigarette lighters: ______ = [ ]

Beverage bottles (plastic): ______ = [ ]

Beverage bottles (glass): ______ = [ ]

Beverage cans (metal): ______ = [ ]

Bottle caps (plastic): ______ = [ ]

Bottle caps (metal): ______ = [ ]

Bags (plastic): ______ = [ ]

Bags (paper): ______ = [ ]

Straws (plastic): ______ = [ ]

Cutlery (plastic): ______ = [ ]

Plates and cups (plastic): ______ = [ ]

Plates and cups (paper): ______ = [ ]

Bottle caps Bottle caps (metal): ______ = [ ]

Fishing buoys, pots and traps: ______ = [ ]

Fishing nets and pieces: ______ = [ ]

Fishing line and rope: ______ = [ ]

Balloons: ______ = [ ]

Condoms: ______ = [ ]

Hygiene pads: ______ = [ ]

Tampons/tampon applicators: ______ = [ ]

Medical tablets: ______ = [ ]

Hygienic wipes: ______ = [ ]

Syringes: ______ = [ ]

Tabaco wraps: ______ = [ ]

Food wraps: ______ = [ ]

Construction materials (including processed wood): ______ = [ ]

Items of local concern:

1. ______ = [ ]
2. ______ = [ ]
3. ______ = [ ]
4. ______ = [ ]
5. ______ = [ ]

Metrics

Did you register the weight? [ ] No [ ] Yes.

If so, how much: ______ ? [ ] kg [ ] lb

Distance cleaned ______ ? [ ] km [ ] miles

How many people participated? ______

Material Checklist

- ☐ Sampling box
- ☐ Measuring tape
- ☐ Pencils
- ☐ Datasheets
- ☐ Labels
- ☐ Waterproof clipboards
- ☐ Photo camera / mobile phone
- ☐ GPS / mobile phone
- ☐ Metal shovel
- ☐ Zip-lock bags
- ☐ Permanent markers
- ☐ Personal safety equipment (Wellies and wet gear)
- ☐ Big plastic bags (25, 50 or 100L depending on the amount of beached litter)
- ☐ Gloves (gardening gloves are the recommended due to the thickness)
- ☐ Weighing scale
- ☐ Transect sticks (3)
- ☐ Container for sharp objects
- ☐ metal quadrats (3)

#2 Appendix (references for sediments and microplastics)

Table A1 - Densities of common polymers (adapted from Enders et al., 2015)
Density limit using: ■ Sodium chloride and ■ Sodium tungstate dihydrate and all above 1.40 g cm^{-3}

Abbreviation	Polymer	CAS no.	Density (g cm^{-3})
PS	Polystyrene	9003-53-6	0.01 – 1.06
PP	Polypropylene	9003-07-0	0.85 – 0.92
LDPE	Low-density polyethylene	9002-88-4	0.89 – 0.93
EVA	Ethylene Vinyl Acetate	24937-78-8	0.94 – 0.95
HPDE	High-density polyethylene	9002-88-4	0.94 – 0.98
PA	Polyamide	63428-84-2	1.12 – 1.15
PA 6,6	Nylon 6,6	32131-17-2	1.13 – 1.15
PMMA	Poly methyl methacrylate	9011-14-7	1.16 – 1.20
PC	Polycarbonate	25037-45-0	1.20 – 1.22
PU	Polyurethane	9009-54-5	1.20 – 1.26
PET	Polyethylene terephthalate	25038-59-9	1.38 – 1.41
PVC	Polyvinyl chloride	9002-86-2	1.38 – 1.41
PTFE	Polytetrafluoroethylene	9002-84-0	2.10 – 2.30

Polymers until the marked lines are retained by the solutions. Please note that this is a theoretical model and some polymers with higher densities could potentially be found in sediments even using a solution with density lower to 1.40 g cm^{-3}.

Table A2 – Buoyancy of common polymers (adapted from Crawford and Quinn, 2017)

Abbreviation	Polymer	Density (g cm^{-3})	Buoyancy
PS	Polystyrene	0.01 – 1.06	Positive (↑)
PP	Polypropylene	0.85 – 0.92	Positive (↑)
LDPE	Low-density polyethylene	0.89 – 0.93	Positive (↑)
HPDE	High-density polyethylene	0.94 – 0.98	Positive (↑)
Seawater		**1.025**	
PA	Polyamide	1.12 – 1.15	Negative (↓)
PA 6,6	Nylon 6,6	1.13 – 1.15	Negative (↓)
PMMA	Poly methyl methacrylate	1.16 – 1.20	Negative (↓)
PC	Polycarbonate	1.20 – 1.22	Negative (↓)
PU	Polyurethane	1.20 – 1.26	Negative (↓)
PET	Polyethylene terephthalate	1.38 – 1.41	Negative (↓)
PVC	Polyvinyl chloride	1.38 – 1.41	Negative (↓)
PTFE	Polytetrafluoroethylene	2.10 – 2.30	Negative (↓)

Polymer density might vary with additives added during production, and therefore this table is a theoretical model.

Tables available at https://www.researchgate.net/publication/326552185

#3 References

1. OSPAR (2010). Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area. ISBN: 90 3631 973 9. Available @ https://www.ospar.org/documents?v=7260

2. Frias *et al.,* (2018). Standardised protocol for monitoring microplastics in sediments. JPI-Oceans, published in ResearchGate. Available @ https://doi.org/10.13140/RG.2.2.36256.89601/1

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Irish Whale and Dolphin Group

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This project contributes to the following
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4 QUALITY EDUCATION

14 LIFE BELOW WATER

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