D1.1-RE: Short report on the strengths and weaknesses of different beach sampling methods

Project acronym:	**BONUS MICROPOLL**
Project full title:	**Multilevel assessment of microplastics and associated pollutants in the Baltic Sea**
Deliverable number:	**Call2015-122_D1.1-RE**
Nature / type of deliverable:	**RE - report**
Dissemination level :	**PU - Public**
Delivery month :	**14**
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Last modified:	**2018-09-24**

BONUS BLUE BALTIC project MICROPOLL has received funding from BONUS (Art 185), funded jointly by the EU and the BMBF Germany, Projektträger Jülich (PT J)

Objectives of WP1 - Marine MP sampling & processing

Our hypotheses are that highly-populated areas (via estuaries etc.) and Baltic Sea lanes are the most relevant sources for MP, and that beaches and coastal sediments are the major sinks of MP. On the other hand, besides beaches, vertical flux of MP towards the sediments is supposed to be one of the essential sinks in the Baltic Sea. To test this, the aim of this WP is to identify MP distribution:
- vertically, in the water column and associated sedimentation rates.
- spatially, in water, biota, sediment and beaches of relevant estuaries, shorelines and the open seas in the Baltic Sea.

Results

There are two different methods used, the Sand Rake method and the Flood accumulation zone method. Subsequent we show the results of both methods and summarize at the end all results in a conclusion.

Sand Rake method

The Rake-method (Haseler et al., 2017) covers the whole width of the beach between the waterline and the vegetation, cliff etc. The Rake method is able to measure the pollution at specific locations at the beach, which allows statements about spatial gradients of pollution not only for different beaches but also for different areas per beach. As the whole width of the beach is investigated the method is able to deliver information about short-term and long-term pathways of litter. Due to the used mesh size of 2 mm especially larger micro-litter (2 – 5 mm) and meso-litter (5 – 25 mm) are targeted. The lower susceptibility of large micro-litter and meso-litter against beach cleanings (common around sandy Baltic beaches) makes the method useful to gain knowledge besides established monitoring methods, like the 100 m monitoring by OSPAR (2010).

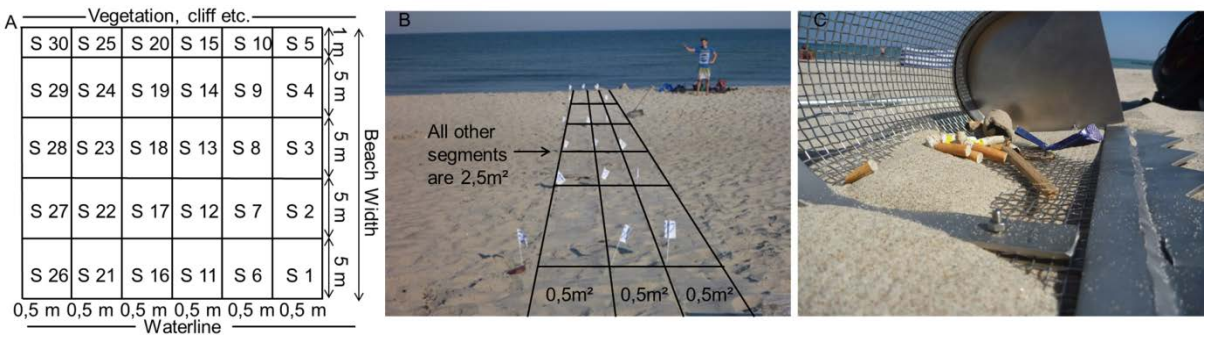

Figure 1: The Rake-method at the beach. Raking starts with stripe 1 at segment 1 (S1) at the waterline leading towards to the vegetation line, cliffs etc. (S5). Followed by stripe 2 (S6-S10) and so on. b Operation width ofthe rake is 0.5m and the length per regular segment is 5m except of those segments at the vegetation line, cliff etc. which are possibly shorter, here 1

m. Regular segments have an area of 2.5 m2 and the segments at the vegetation line have an area of 0.5 m2 each. c Different mesh sizes (MS) are available, here the 5 mm MS with remaining sediment and litter inside, moreover visibly the inner frames fixed with nut and bolt which enable to change the mesh wire used (C)

Table 1: Strength and weaknesses of the Sand Rake method

specific side characteristics	Advantages	Disadvantages
small beach (<100m width)	more stripes are to sieve; covers the whole area between the waterline and the vegetation line more times; gives good results about the distribution of litter along the width of the beach within the sampling area	can give a falsely high or low total of litter at the beach, as certain sections left or right of the sieved stripes may be more or less polluted than the beach between
wide beach (>100m width)	covers the whole area between the waterline and the vegetation line once; gives good results about the distribution of litter along the width of the beach within the sampling area	if at large area beaches only a small area (one stripe) is raked, this can give a falsely high or low total of litter at the beach, as certain sections left or right of the sieved stripes may be more or less polluted than the beach between
boulders, stones on the whole beach or on large areas / frozen beach sediment	none	method is inapplicable
stones, gravel, organic material etc. at different sections of the beach	litter items still found	can stock inside the rake; complicate the viewing of litter; penetration depth diminish; more time intensive; litter inside the rake can be overseen
wet sediment / accumulation zone/intertidal zone	none	penetration depth diminish; complicate the viewing of litter; wet sand stocks longer inside the rake; organic material stocks in the rake; more time intensive; litter inside the rake can be overseen
manual beach cleaning	method is useful and possible to use; litter items can still be found	macro- and some meso-litter items on the surface are presumably picked up at the beach cleaning
error possibility	standardized technical tool; easy to follow method; usable for volunteers	
mesh size (MS)	the use of different MS adapted to the beach and outer circumstances (sediment type, moisture etc.) is possible	larger MS (>2mm) lead to a loss of micro-litter items
litter below the surface	investigate not only the surface; reaches a depth down to 5 cm at fine sediment beaches when sediment within this layer is dry; possible to detect litter hot spots	raking depth can't be measured exactly
unequal distribution of litter along the beach	none	extrapolation of results is difficult

Flood accumulation zone method

Litter surveyed at beaches is often a mixture of accumulated sea-litter and litter left by beach users and may therefore not be an accurate indicator of litter washed ashore. To overcome these weaknesses, the Flood accumulation zone method was developed to estimate the amount and trends of fresh accumulated litter on our shores as demanded in the Marine Strategy Framework directive (MSFD). As the accumulation zone of the beach is surveyed directly after high-waters or stormy events, littering impact of beach users is expected to be minimal. The Flood accumulation zone method investigates an area of 10 m² targeting larger micro-litter (2 – 5 mm) and meso-litter (5 – 25 mm).

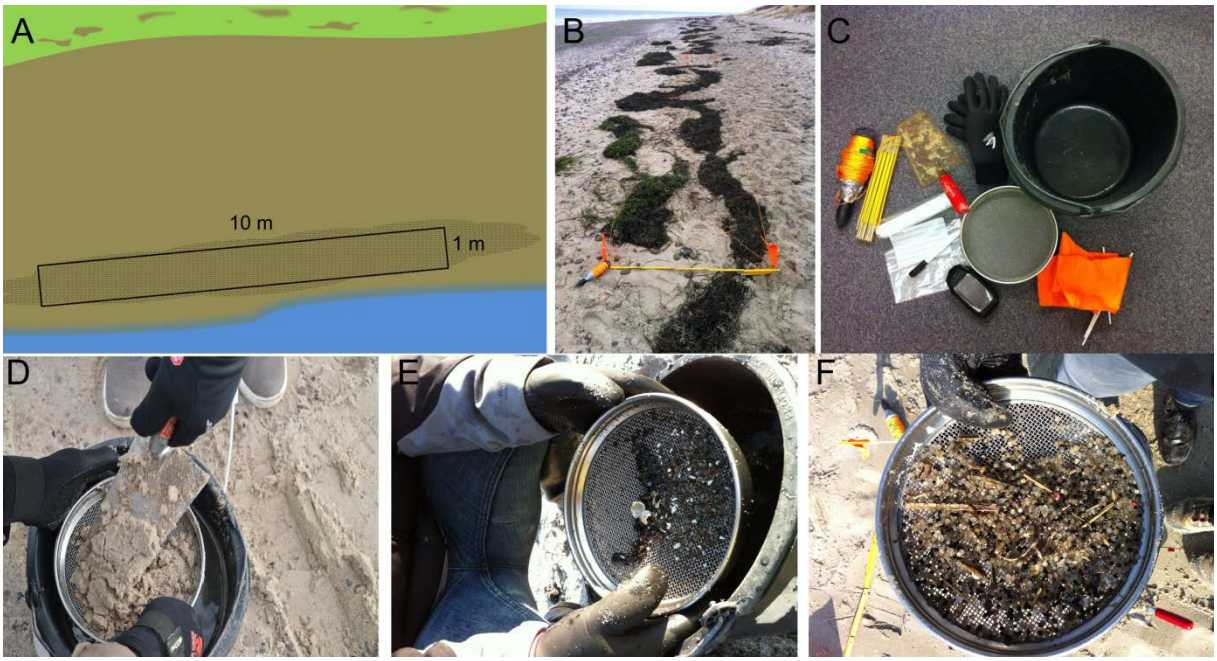

Figure 2 A) Location of the 10 m² transect of the Accumulation zone method at the beach. B) The amount of seagrass in the accumulation zone. C) Needed material for the method is: a rope and a folding meter to measure the size of the transect, flags to mark the transect and a GPS device to determine the location. A trowel is needed to put the sediment on the 2 mm sieve and a bucket to shake the sieve in. Bags are needed to collect the litter and a pen to label the bag with the necessary data, like date, time etc. D) the sediment is given on the sieve with the trowel. E) Afterwards the sieve is shaken in the bucket to flush out all the sediment. F) Remaining material that has to be observed for potential litter items.

Table 2 Strength and weaknesses of the Flood accumulation zone method

specific side characteristics	Advantages	Disadvantages
small amount of beach wrack at the beach	easier sieving process due to smaller amounts of seagrass etc.; easier view of litter items in the sieve	the accumulation zone may not cover the whole area (10 m^2) therefore areas not influenced by the stormy event or high-water event of interest are covered too
large amount of beach wrack at the beach	general higher amounts of litter that can be observed	sieving process may be hampered / not be possible; seagrass get stuck in the sieve
boulders, stones in the accumulation zone	none	sieving process is hampered
frozen beach sediment	litter items still found	sieving process may be hampered or impossible, litter items stick to the seagrass and may be overseen, increase of working time
wet sediment / accumulation zone/intertidal zone	litter items still found	no negative impacts
manual beach cleaning	method is useful and possible to use; micro and meso-litter is still found	beach survey has to be done before the cleaning, otherwise a lost of bigger litter items is possible due to cleaning process
error possibility	standardized technical tool; easy to follow method; usable for volunteers	
mesh size (MS)	the use of different MS adapted to the beach and outer circumstances (sediment type, moisture etc.) is possible	larger MS (>2mm) lead to a loss of micro-litter items
litter below the surface	investigate not only the surface; reaches a depth of 1 cm	litter below a depth of 1 cm is not investigated
unequal distribution of litter along the accumulation zone	none	extrapolation of results is difficult

Conclusion

The cost effective equipment and the easy to follow outdoor and indoor working steps make both methods useful for a volunteer based long-term monitoring on a low budget, implementable at all sandy beaches. Large micro and meso-litter is easy to detect, it is easy to count and easy to identify; compared to smaller micro-litter (< 2 mm). All litter items found are counted, measured, photographed, identified (according to the list of litter (MSFD TSG ML, 2013)) and categorized (source identification) by an adapted percentage allocation method by Tudor and Williams (2004). This is normally done within less than 3 h and can be done by volunteers after a short introduction of 20 min.

References

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