

MICROPLASTICS ON THE STRANDLINE: SNAPSHOT OF A BRAZILIAN BEACH

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ABSTRACT

Plastic pellets and plastic fragments contaminating beaches, especially the strandline, have been reported in the peer-reviewed literature all around the world. However this size fraction is rarely considered when beach or water column sampling is made over large geographical scales. The microplastics on the strandline of an urban, plastic polluted beach, was qualitatively assessed in a single survey. An average of 2.8 pellets or fragments / cm² of strandline area were registered at the most dissipative stretch of the beach. The main sources of fragments (96.7%) is supposed to be the breaking down of the plastic pollution of the beach itself and, in the case of pellets (3.3%), the marine environment and nearby port facilities, since the beach is presently out of the influence of any petrochemical plant. The threat this size category of plastic pollutant offers to the environment and society is briefly discussed and its consequences highlighted.

Keywords: nibs, size classes, marine debris.

INTRODUCTION

The occurrence of microplastics in different coastal and marine environments has been well known for a long time (GREGORY, 1983; MOORE et al., 2001; THOMPSON et al., 2004; REDDY et al., 2006). It includes plastic pellets (nibs) and fragments of all types from larger plastic items which have undergone thermal and photochemical (sun), chemical (salt and burial in organic matter rich sand), or physical (wind, waves and sand abrasion) degradation. The pollution from this size fraction of plastics has also been registered for the Brazilian shores, both on the sand and in the stomach contents of large marine animals (IVAR DO SUL AND COSTA, 2007). Due to the difficulty to efficiently sample such small items (usually <5cm) in large scale (hundreds of m² transects) surveys this fraction is normally not considered in the majority of marine debris surveys (IVAR DO SUL and COSTA, 2007), in spite of the fact that its size allows ingestion by a far larger number and diversity of animals (THOMPSON et al., 2004; ERIKSON and BURTON, 2003). Unfortunately, the consequences of this sort of pollution are poorly known and understood.

Considering that plastics pollution of coastal and marine environments is ubiquitous (COE and ROGERS, 2000), it is possible to suggest that microplastics are also widely spread and prevalent in every coastal and marine environment. Some habitats, as convergence zones and the strandline of dissipative beaches, will probably have a more significant accumulation of this size fraction of plastic pollution due to its natural characteristics. So, marine biota in these environments will be at a greater risk than average of plastic ingestion. This is a worrying perspective, since these habitats are plankton and other organic matter gathering places, and therefore feeding grounds of many species.

The objective of the present work was to take a snapshot of the microplastics fraction from an urban beach on the Northeast of Brazil, in order to make a qualitative assessment of the level of pollution caused by this size fraction on an environment well known in terms of its larger plastic items contamination (SILVA et al., 2008).

MATERIALS AND METHODS

The strandline of an urban beach (Boa Viagem beach, Recife – Northeast Brazil) was sampled for its microplastics contaminants by scraping the two first centimetres of sand from nine 988 cm² quadrats placed randomly along one hundred meters. The samples were then taken to the laboratory where they were oven-dried at 100°C overnight. The dry samples were sieved and the material retained was examined and separated under stereomicroscope. The material retained by

each sieve was later washed in filtered seawater to further separate the floatable plastic pellets and fragments from the remaining sand, anthropogenic and biological debris. The plastics in each of the two fractions were separated by type (plastic pellets/nibs and fragments), weighted and counted. The material was further separated into size classes: ~ 2cm, ~ 0.8cm, ~ 0.3cm and <1mm. The colours/conditions of the nibs were registered. Notes were also taken on the nature of the anthropogenic and biological debris that occurred together with the plastics on the strandline.

RESULTS AND DISCUSSION

The non-plastic materials which occurred on the strandline were natural (algae, leaves, animals, etc.) and man-made (matches, peanut shells, etc.). An average of 9.7 ± 2 (N=9) occurred in each 988cm^2 . After being divided into broad categories, fine woody branches and peanut shells were the most and equally frequent items, followed by coal pieces (second), shell fragments, minerals/rocks, iron/rust, coral fragments and bones or fish bones (third). The least frequent categories were barnacle shells, paper, crab shells, quail's eggshell fragments, seeds, matches, sargassum, insects and unidentified fragments respectively.

All nine samples presented plastic contamination from plastic pellets/nibs and fragments in different amounts (Tab. 1). In total, 2751 plastic items were found, which represents 2.8 pellets/nibs or fragments / cm^2 of strandline area. The total number of pellets/nibs was 90 in 8892cm^2 , varying from 4 to 20 (10 ± 5.5) in each 988cm^2 quadrat. Pellets/Nibs accounted for 3.3% of the plastic items sampled. Plastic pellets/nibs were mainly white or pearly, blueish/greenish and brownish. Some were cylindrical, others oval shaped and others still were "squashed". The total number of plastic fragments was 2661 and varied from 2 to 231 (76 ± 63.4) considering all samples and size categories. The weight of plastic fragments varied from 1.42. to 5.8g ($3.7 \pm 1.3\text{g}$). Plastic fragments were mainly white and pearly, but many other colours also occurred (red, green, blue, yellow, pink). Fragments had all sorts of shapes, but the majority were edgy fragments of hard plastic and cigarette filters.

Table 1: Weight (g) and counts of each fraction and plastic pellets, or nibs found on the strandline at Boa Viagem Beach – Recife, Brazil.

Sample (988cm ²)	weight (g)		counts				
	others + plast.	plast. only	nibs* only	~ 2cm	~ 0.8cm	~ 0.3cm	< 1mm
1	13.94	5.40	16	17	76	173	36
2	4.75	1.42	7		32	86	76
3	5.42	2.02	5	3	54	105	109
4	3.57	3.38	4	2	18	79	72
5	10.06	5.79	6	19	56	223	158
6	14.36	3.75	14	14	55	106	77
7	11.11	3.87	8	13	29	111	59
8	15.18	5.80	20	18	123	231	227
9	5.90	2.31	10	11	33	80	80
Total (8892cm²)	84.29	33.73	90	97	476	1194	894
%			3.3	3.5	17.3	43.4	32.5
mean±stdev.	9.4±4.6	3.7±1.6	10.0±5.5	12.1±6.5	52.9±31.8	132.7±60.5	99.3±58.8

* nibs belong to the ~ 0.3cm size category.

The size classes analysis showed the prevalence of the ~ 0.3cm size category, which also includes the nibs (Fig. 1). This is a frequently reported size in ingestion works (ERIKSON and BURTON, 2003) and must therefore be regarded as a threat to marine life and maybe even unsupervised children, since the shape and colours might resemble those of certain mint-flavoured type of sweets.

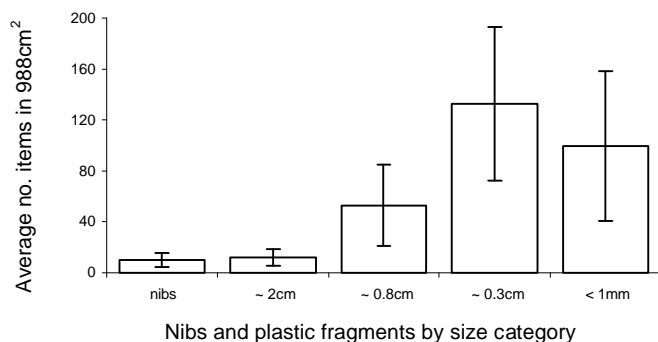


Figure 1: Average number of plastic items (pellets/nibs and fragments) in each 988cm² sampling quadrat randomly thrown on 100m of strandine along Boa Viagem Beach, Recife- Northeast Brazil.

This size fraction of plastic pollution of coastal and marine environments is difficult to detect, unless specific sampling is being carried out. However, its diagnosis is important, since the sources of pellets/nibs are usually port facilities (container terminals), petrochemical plants and other specific trading activities. The presence of pellets/nibs away from such sources will imply in long-range marine transport. In the case of plastic fragments from larger items, it is important to have their pollution well characterized since it is one of those cases where pollution from a apparently harmless source (e.g. beach users) becomes increasingly perverse due to the development of the problem after it has already reached the marine environment and is beyond our control. So, it is the case to ask what other sort of impact will be detected after we already know that a plastic item thrown in the ocean can transport alien organisms, hurt people or entangle marine animals, break down in small pieces and associate itself with persistent organic pollutants (POPs) and, finally be ingested by almost every filter feeder or small predator in the water column and benthos?

CONCLUSIONS

The present results show that at any place and time a beach is sampled for this specific contaminant, this size category of plastic will almost certainly be found, reinforcing the idea of the ubiquitousness of this sort of pollution. There is no cleaning services alternative for this size category of plastic pollution. The only option is to prevent spillage of plastic pellets/nibs at their source and, always try to abate and combat the presence and permanence of larger, breakable plastic items in the environment. The main sources of fragments in this case are supposed to be the breaking down of the larger plastic items polluting the beach itself and, in the case of pellets/nibs, the marine environment and nearby port facilities, since the beach is presently out of the influence of any petrochemical plant.

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