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Focus

The influence of the intensity of use, rainfall and location in the amount of marine debris in four beaches in Niterói, Brazil: Sossego, Camboinhas, Charitas and Flechas

Melanie Lopes da Silva^{a,*}, Alessandro Souza Sales^b, Suzane Martins^b,
Rebeca de Oliveira Castro^a, Fábio Vieira de Araújo^b

^a Universidade Federal Fluminense, Brazil

^b Universidade do Estado do Rio de Janeiro, Faculdade de Formação de Professores, Brazil

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ABSTRACT

The presence of marine debris in coastal and oceanic regions is a worldwide and growing problem and own to different factors. In order to check the influence of some of these factors in the amount of debris in these areas, we quantified and identified marine debris found on sand of four beaches in the city of Niterói, RJ during dry and rainy seasons; two in oceanic region and two in Guanabara Bay, and observed the intensity of use of them by people. Our results showed that intensity of use and intensity of rain had influence in the presence and amount of solid waste collected. Environmental education campaigns and improvements in basic sanitation are extremely necessary to prevent the pollution of aquatic environments and get improvements on waste management in the cities of Niterói, RJ.

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1. Introduction

The presence of marine debris in coastal and oceanic regions is a global issue of increasing concern and is caused by various factors (Ferreira et al., 2011). The lack of urban planning leads to the accumulation of solid waste in inappropriate locations, which finally gets deposited on the beaches. Rains also influence the presence of waste on beaches as they lead to the accumulation of a large amount of sewage, garbage, and other debris on the beaches by overflow or effluent discharges through storm sewers, streams, and drainage channels. After the waste enters the marine environment, factors such as currents, tides, and waves direct their dispersion in the seas and bays (Ferreira et al., 2013; Silva and Quinones, 2012; CETESB, 2011).

Solid waste can reach the sea from the rivers and ships and through littering by visitors on the beaches. Littering by visitors is recognized as one of the main sources of marine pollution as proven by studies using markers to identify the consumption of various items such as disposable cups, napkins, straws, and cigarette butts by bathers on the beaches (Baptista Neto and Fonseca, 2011; Ferreira et al., 2011; Neves et al., 2011).

Various factors such as location of the beaches, the intensity of use of the environment, and the intensity of rainfall affect the presence of solid waste in the sand of the beaches, and their characterization is therefore essential for the appropriate management and handling of waste in the coastal regions. To determine which of the above mentioned factors

have greater influence on the amounts of residues collected on the beaches, we chose beaches that differed in terms of these factors for comparison purpose in this study.

2. Methodology

Four beaches were selected: Sossego and Camboinhas beaches located in the oceanic region of Niterói, RJ, and Charitas and Flechas beaches located in Guanabara Bay. These beaches differed in terms of their location, the intensity of use by bathers, and the presence/absence of commercial activities (Fig. 1).

Solid waste was collected for 20 min from a 600 m² area [20 m (W) × 30 m (L)], starting from the waterline to the top of the beach, which was bordered by vegetation, during low tide on April 30 and October 29 (rainy season) and June 11 and August 13 (dry season) in 2013. According to “Alerta Rio” (Sistema Alerta Rio, 2014), a Rio de Janeiro state website that provides information on the rainfall index in the different regions of the state, the precipitation in Guanabara Bay was 61.6 mm in April, 25.2 mm in October, 5 mm in June, and 2 mm in August. The collected solid waste was stored in plastic bags until quantification according to the methodology developed by Cheshire et al. (2009) and adapted for this work.

The intensity of use of the beaches was estimated using the methodology developed by Silva et al. (2009) where the frequency of the bathers was noted every 10 min during a 1-h period in an area of 20 m² on a Sunday. The mean value was expressed in bathers/m², and it was categorized as follows: very high (0–4 m² of sand per bather),

* Corresponding author.

E-mail address: melaniels_1@hotmail.com (M.L. Silva).

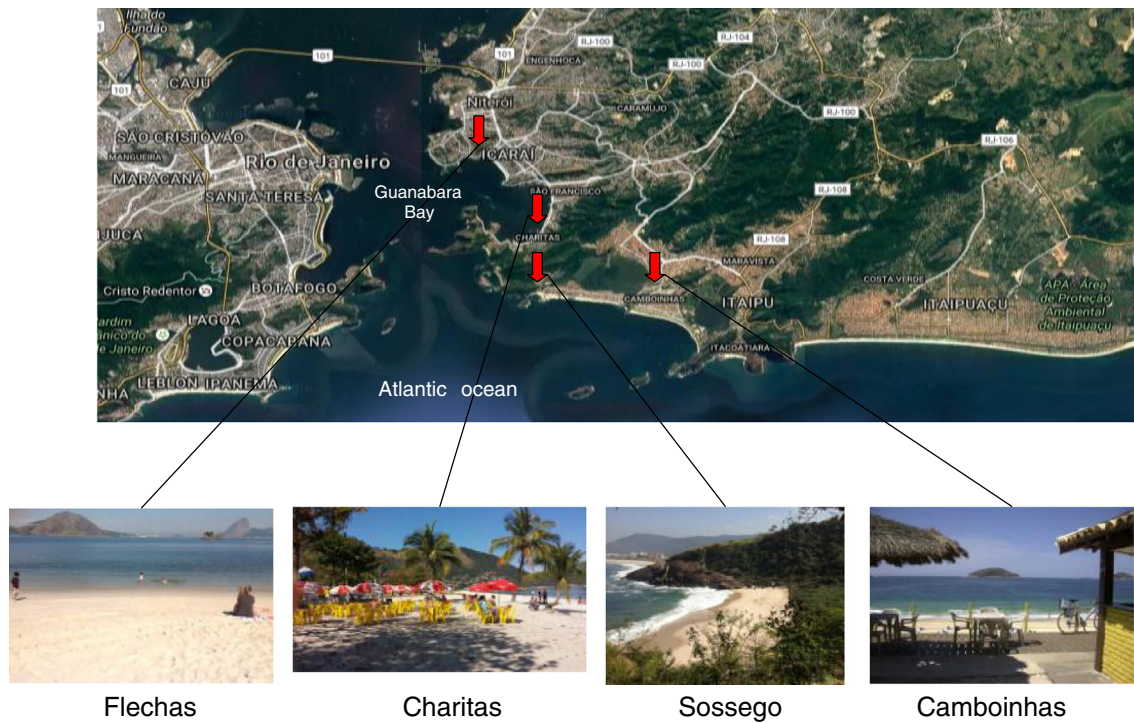


Fig. 1. Map showing the locations of the beaches; photos of the beaches studied.

high (4–10 m²), medium (11–20 m²), low (21–50 m²), and very low (up to 50 m²).

3. Results

On Sossego beach, 1390 units of marine litter, equivalent to 18.6 kg, were collected. The most commonly found material was plastic, with 966 units. On Camboinhas beach, 497 units of litter, corresponding to 5.6 kg, were collected. Plastic was the predominant material with 403 units. On Flechas beach, 437 units of litter, equivalent to 2.9 kg of waste, were collected, of which 273 units were of plastic. Finally, on Charitas beach, 465 units of litter, corresponding to 2.35 kg, were

collected, and the most commonly found material was plastic, with 331 units. Cigarette butts were the second-most common items found on all beaches, except on Sossego beach that had glass as the second-most common item (Fig. 2).

3.1. Relationship between the amount of marine debris and rainfall

In all beaches except Flechas beach, the largest amount of debris in units and weight was collected during the rainy season (Table 1). On Sossego and Camboinhas beaches, the residues were more abundant along the tide line and near the vegetation. On Charitas beach in both seasons, the residues were more abundant near the part of the beach

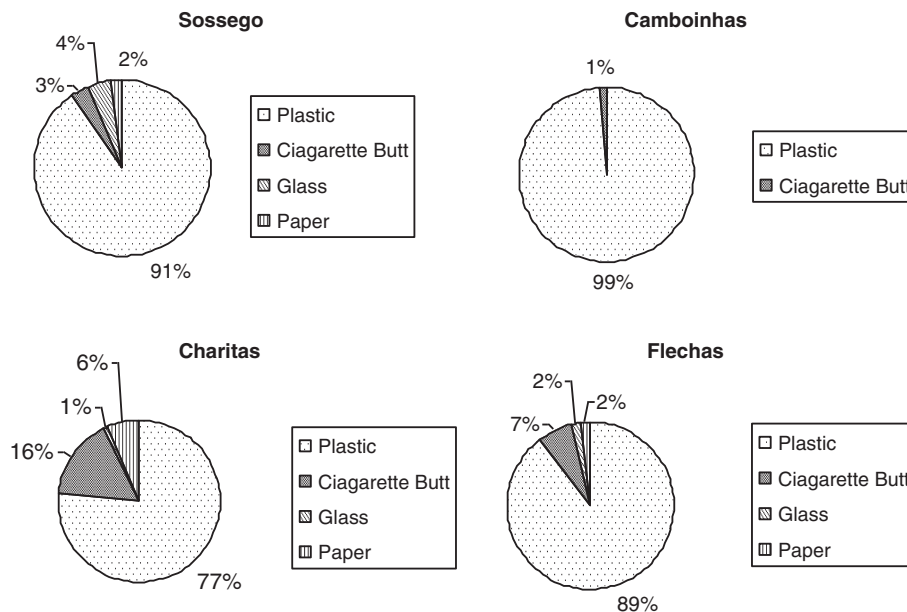


Fig. 2. Types of the most abundant marine debris in the four beaches.

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