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Artigo de Pesquisa

ENVIRONMENTAL PERCEPTION OF BEACHGOERS OF ITAIPU, NITERÓI, RJ, ABOUT THE ANTHROPOGENIC LITTER AFTER AWARENESS ACTIVITIES

PERCEPÇÃO AMBIENTAL DOS FREQUENTADORES DA PRAIA DE ITAIPU, NITERÓI, RJ, SOBRE RESÍDUOS SÓLIDOS APÓS ATIVIDADES DE SENSIBILIZAÇÃO AMBIENTAL

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Abstract

Anthropogenic litter is a problem in marine and coastal environments such as sandy beaches. The large amount of litter discarded on beaches is due to the actions of humans. In this sense, the aim of this study is to introduce environmental awareness actions among beachgoers in relation to the presence of litter in the sand to minimize the effects of this problem. This study evaluated the environmental perception of beachgoers at Itaipu beach, Niterói, RJ, Brazil, in relation to anthropogenic litter through awareness-raising activities. To assess this awareness activity, a questionnaire was applied to assess the perception and collection of litter in the study area in a different way to assess the behavior change. Although litter was found on both days, the results showed a significant difference in the itens of litter collected per person (itens.person^{-1}) in the study area between the two days, showing the importance of carrying out environmental awareness activities regarding anthropogenic litter.

Keywords: actions of humans, behavior change, marine and coastal environment, plastic fragments, sandy beaches.

Resumo

Os resíduos sólidos são um problema no ambiente marinho e costeiro, principalmente nas praias arenosas. A grande quantidade de lixo descartada nas praias se deve às ações do homem. Nesse sentido, o objetivo deste estudo é introduzir ações de sensibilização ambiental entre os banhistas em relação à presença de lixo na areia para minimizar os efeitos desse problema. Este estudo avaliou a percepção ambiental dos banhistas da praia de Itaipu, Niterói, RJ, Brasil, em relação aos resíduos sólidos por meio de atividades de sensibilização. Para avaliar esta atividade de sensibilização, foi aplicado um questionário de forma distinta para avaliar a percepção e a mudança de comportamento dos indivíduos. Apesar dos resíduos terem sido encontrado nos dois dias, os resultados demonstraram uma diferença significativa nos itens de lixo coletado em relação ao número de pessoas (itens.pessoa^{-1}) na área de estudo entre os dois dias, mostrando deste modo a importância da realização de atividades de sensibilização ambiental.

Palavras-chave: ambiente marinho e costeiro, ações do homem, fragmentos plásticos, mudança de comportamento, ambiente marinho e costeiro, praias arenosas.

1. Introduction

Anthropogenic litter is defined as synthetic or processed material produced and used by human beings and discarded disposed or abandoned in the marine environment or beaches (Macedo *et al.,* 2019; Rangel-Buitrago et al., 2020; Asensio-Montesinos *et al.,* 2021, Ribeiro *et al.,* 2021). The presence of litter in coastal environments, such as beaches, is a current and highly relevant problem, which kills the marine community, for instance, birds, turtles, and mammals, and weakens the economy by reducing tourism (Chesire *et al.,* 2009; Wright *et al.,* 2013, Smith and Edgar, 2014; Gall and Thompson, 2015; Yagmour *et al.,* 2018; Vélez-Rubio *et al.,* 2018).

Part of the litter found on the beaches, such as plastic (cups, packaging, straws), metals (beer cans), among others, is generated and left by the beachgoers (Santana Neto *et al.,* 2011, Silva *et al.,* 2015; Araujo *et al.,* 2018; Timbó *et al.,* 2019). This behavior is considered repulsive by most regulars of the beaches as showed by Timbó *et al.* (2019), but even so, there are still several beachgoers contributing to the pollution of these environments (Santana Neto *et al.,* 2011; Dias-Filho *et al.,* 2011; Silva *et al.,* 2015; Bom *et al.,* 2020).

To change this behavior, Dias Filho *et al.* (2011) suggests that initially, it is necessary to know the users' perception of the environment that they frequent. According to Fernandes *et al.* (2004), it is through the study of environmental perception that the interrelationship between man and the environment, their expectations, desires, satisfactions and dissatisfactions, judgments, and behavior are understood. Nonetheless, the works in environmental perception must seek not only to understand what the individual perceives but also to promote awareness, as well as the development of the system of perception and understanding of the environment (Faggionato, 2002; Silva *et al.,* 2021). Studies with environmental education are important, as many people can seek solutions through skills and abilities to change attitudes (Roos and Becker, 2012).

The present study contributes to science because it is through this that, we can sensitize people to changes in attitudes through environmental education and the example of citizenship. The present study presents the hypothesis is whether the previous awareness activity reduces the production of anthropogenic litter on Sunday at Itaipu beach. Thus, the present study aimed to assess perception, promote awareness, and observe the change in behavior of beachgoers on a beach frequented by a large number of people in the city of Niterói, RJ, Brazil.

2. Material and methods

2.1 Study Area

The beach selected for the study was Itaipu beach, located in the Oceanic Region of the city of Niterói, RJ, Brazil (Figure 1). This beach is approximately 700 meters long (Salvador and Silva 2002, Gomes *et al.,* 2021). Itaipu beach is influenced by Guanabara Bay, as well as the Itaipu – Piratininga estuarine system. This beach is part of the Itaipu Marine Extractive Reserve (RESEX Itaipu) (BRASIL, 2013) and is considered a buffer zone of the Serra da Tiririca State Park (BRASIL, 2008).

The beach was chosen because it is highly frequented and has been surveyed on the characterization of litter in its sands and in the environmental perception of its visitors (Silva *et al.,* 2015; Timbó *et al.,* 2019). This beach is intensely sought by families looking for its calm waters and many bars and restaurants for their leisure time. The fact that it is an end for several bus lines also favor high frequency of people on the region.

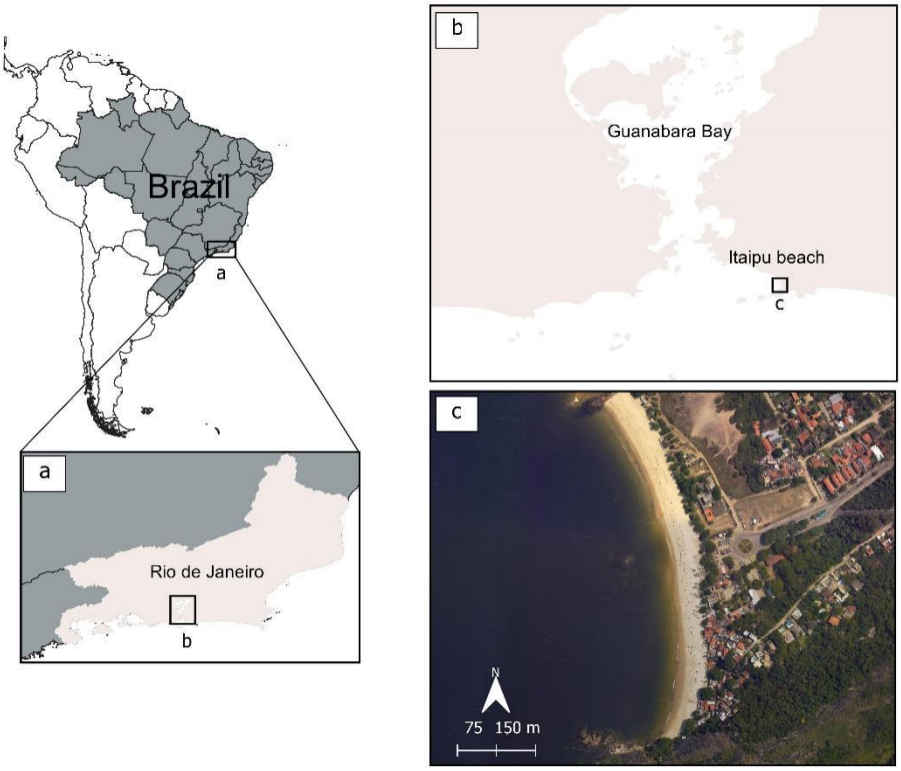

Figure 1: Visual representation of the study area in Rio de Janeiro (a). Collection site: (IT) Itaipu beach (b). Satellite image of the collection site in Itaipu beach (c).

2.2 Sampling and sample processes: Anthropogenic litter collection

The work was carried out on six weekends (Saturday and Sunday) in March, April, June, and November of 2014 and January and April of 2015 in an area of approximately 600m^2 (20 m wide x 30 m long of wet sand until the end of the beach) in the central part of the Itaipu beach in the backshore area, excluding the effect of the tides and winds. Anthropogenic litter collections were carried out on each weekend in two periods: in the morning, around 8:00 A.M., before the arrival of most regulars, and in the afternoon, around 5:30 P.M., after the departure of most regulars. The purpose of the morning collection was to clean the study area, of litter discharge. In the afternoon, litter was collected and stored in plastic bags and classified into different materials according to Cheshire *et al*. (2009).

2.3. Environmental perception

The environmental perception assessment and awareness activities were carried out with at least one member of each family that was occupying the study area, on the same days as litter's collections. The environmental perception was verified through the application of a questionnaire prepared by Timbó *et al.* (2019), which consisted of two parts: a first part aimed to verify the socio-economic profile of the interviewees and a second one focused on analyze their perception of the presence of litter on the beach.

The application of questionnaires, on Saturday, occurred while regulars were leaving the beach. On Sunday, the application of the questionnaire took place while the visitors were on the beach. All individuals who remained within the studied area for more than 30 min between 8:30 am and 5:30 pm during each day of activity were considered for the study.

2.4 Awareness activity

The environmental awareness activity took place shortly after the questionnaire was applied and consisted of the dissemination of information on the issue of litter in coastal and marine environments, which addressed the causes, consequences, and actions to mitigate the presence of these pollutants in these environments. On Saturday, the awareness activity occurred in the afternoon, before the regulars leave the beach.

In the present study, we chose to use the amount of anthropogenic litter found per person (itens.person^{-1}) on the beach as a measure to assess the awareness process. Anthropogenic litter was weighed using a portable digital scale with a winch coupled. The proportion of anthropogenic litter per person was calculated as a function of the weight divided by the total number of people (Kg litter.person^{-1}) in the study area in each collection. The proportion of anthropogenic litter items in relation to the number of people was calculated by dividing the number of items by the total number of people in the sampled area (itens.person^{-1}).

2.5 Statistical analysis

We used analysis of variance (ANOVA) to assess the differences in litter collected/person and items/person between Saturday and Sunday. Shapiro-Wilk's and Levene's tests were used to assess the assumptions of normality

and homogeneity of variance, respectively. Data on items/person were log-transformed in order to meet the ANOVA assumptions. All statistical analyses were performed using the R programming language (R Core Team, 2021).

3. Results and discussion

3.1. Quantitative and qualitative analysis of collected anthropogenic litter

At the end of the six collection weekends, 21.1 kg of litter, related to 1,597 items, was collected. The items collected were 835 plastic items (52.3%), mostly fragments; 344 cigarette butts (21.5%), 121 units of paper (7.6%); 102 items of modified wood (6.4%), 67 units of metal (4.2%), 54 fragments of styrofoam (3.4%) and 53 items of organic waste (3.3%). Other items were also collected, such as glass, rubber, fabric, construction material, and candles were found, but in fewer quantities (< 10 units each) (Figure 2).

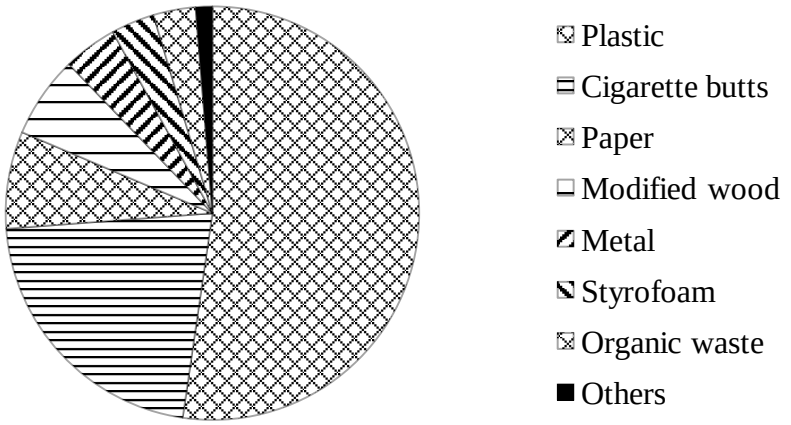

Figure 2: Percentage of different types of litter (%) found on Itaipu beach.

Most of the litter found during the collection campaigns was directly related to the activity carried out on site, such as the consumption of food, drinks, and cigarettes. This result corroborates what was found in a previous survey at Itaipu beach (Silva *et al.,* 2015).

The presence of plastic as the material most often found on the Itaipu beach is due to the usage of various disposable items in the beach bars of the area, as well as the packaging of food and other products that are sold and consumed to the beachgoers. Collections made on beaches located in the most diverse parts of the world report that the presence of plastic as litter is

most frequently found in these environments (Silva *et al.,* 2018). The great abundance of this type of litter is related to the wide use of this material, which is mainly due to its durability, low cost, and resistance (Derraik, 2002).

Cigarette butts were also abundantly found on beaches, being the most frequent item observed in several studies (Araujo and Costa, 2019). According to Araújo and Costa (2019), the presence of cigarette butts is a notorious, ubiquitous, and easily detectable fact, and they highlight the inexplicable number of butts that are inaccessible to conventional cleaning services.

Items such as modified wood, fragments of styrofoam and nylon, also found on the beach, if are not related to consumption activities, should be credited to the presence of intense fishing activity. Itaipu beach is known for its fishing colony and for the presence of anglers in the place who guarantee the subsistence of their families (da Silva *et al.,* 2017). These data corroborate with results from other studies carried out on the site, showing that most of litter found on Itaipu beach originates from the site itself (Silva *et al.,* 2015).

It was possible to observe a greater number of visitors on Sundays in relation to Saturdays, except for November of 2014 and April of 2015; as well as a greater number of visitors in the warmer months (March, November, and January) (Table 1).

Table 1: Number of beachgoers of study in site on the sampled dates.

Months of year	Saturday	Sunday	Total
March 2014	50	70	120
April 2014	26	30	56
June 2014	15	30	45
November 2014	45	30	75
January 2015	30	50	80
April 2015	20	15	35

Although one weekend of March 2014 has been the most frequented herein, the highest number of unities of litter were collected in January 2015 (Figure 3), probably due to a higher number of cigarette butts found, once plastic units match the other dates. However, we state once again that the

population that uses the beach as a recreational environment discarded most of the anthropogenic litter found. Interviewers repeatedly observed people disposing of different types of litter on the beach such as plastic fragments and food scraps. During the survey, we observed the disposal of plastic consumption items, fishing, and food scraps, among others (such as paper).

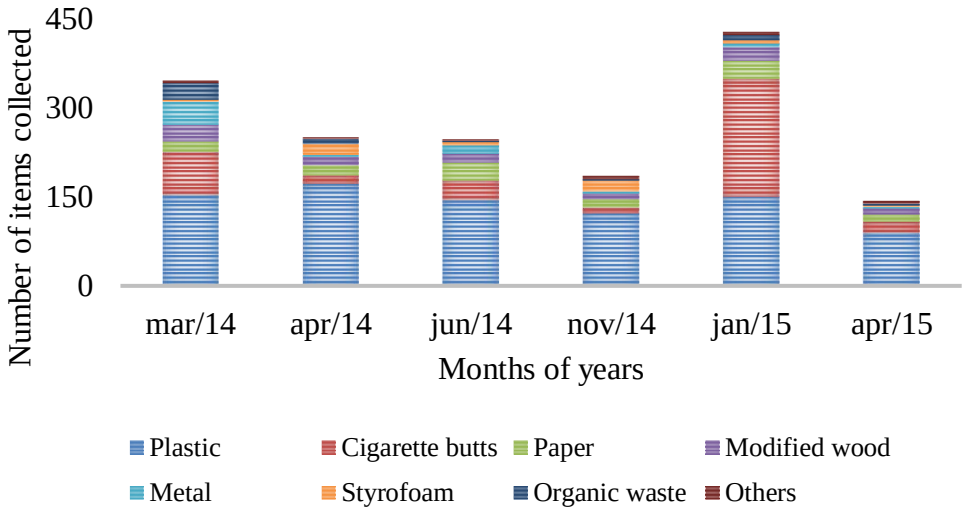

Figure 3: Quantities of the different litters collected in each weekend studied.

3.2. Socio-economic profile of beachgoers

The results of the applied questionnaires made it possible to assess the profile of the interviewees. A total of 173 questionnaires were applied. The profile of the interviewees in this study was mostly women, between 18 and 50 years old, with a monthly income of 2 to 5 minimum wages, who have completed high school and, despite not being mostly residents of the neighborhood, some visit the beach frequently and others rarely, especially on weekends, as they take the family to the beaches, as this environment is a type of low-cost recreation (Table 2).

The disagreement in socio-economic profile between the results obtained by Timbó *et al.* (2019) and our data can be attributed to the difference between in which the activity was performed. Timbó *et al.* (2019) carried out these activities once a month for a period of one year. While in the present work, the interviews were conducted over the weekend, where entire families can be present. Factors such as days of the week, periods of

the year, and time can influence the profile of beachgoers as established by Timbó *et al.* (2019).

3.3. Environmental perception of beachgoers

In relationship to cleanliness conditions, the vast majority (47%) of beachgoers replied that the beach was reasonably clean while 25% of respondents found the beach dirty and 9% very dirty. On the other hand, 17% found the beach clean, while 2% considered it very clean. The results allowed us to observe that most of the interviewees (66%) consider the beach reasonably clean to very clean, in disagreement with the results obtained by Timbó *et al.* (2019). From 53% of respondents who considered Itaipu as a dirty beach, 5% mentioned that the dirt present in the sand attracts dogs and pigeons, as also observed by Fernandes and Sansolo (2013), on Gonzaguinha beach in Santos.

The study of Ballance *et al.* (2000), carried out on the Cape Peninsula, in South Africa, demonstrated that the interviewees consider the level of cleanliness when choosing the beach to visit. Krelling *et al.* (2017) demonstrated that the level of cleanliness is quite subjective, but that with the presence of 15 items of litter/m^2, the vast majority (85%) consider the beach dirty. Although 34% consider Itaipu dirty to very dirty, this perception of the environment was not enough to keep them away from the place.

The vast majority of the respondents claim to have some feeling when they see litter on the beach: 49% have a feeling of disappointment and 40% have a feeling of revolt. Of the interviewers, 11% of the interviewees showed indifference regarding the presence of litter on the beach. The moment of leisure is when the individual relaxes from the stresses of everyday life. To enjoy this moment, it is natural to look for a place that has a beautiful scenic landscape, which explains the feeling of disappointment and revolt that most of the interviewees have when they find litter in these places (Fernandes and Sansolo, 2013). There is also a concern about the indifference shown by 11% of the interviewees, which can perhaps be explained by the fact that practically all beaches in the region have a litter in their sands (Farias *et al*., 2014; Silva *et al*., 2015; Silva *et al.,* 2016; Perez *et al.,* 2018) showing that the presence of litter is indifferent to the choice of the beach to be frequented by the beachgoers.

Among the types of litter most observed by respondents on the beach, 29% said plastic items, 19% food scraps, 18% aluminum materials, 17% glass items, 15% paper, and two percent items from other compounds, including cigarette butts. The interviewees' perception of the most observed litter becomes interesting for this study since it does not meet the data of the collected litter, with the exception for plastic, the material most collected and observed by respondents. The results of the answers show that users perceive, mainly the macro, formed by disposable cups, straws, bottles, aluminum cans, and other packaging, while the micro, composed of cigarette butts, small fragments of plastics, fragments of styrofoam, wood, and others, goes unnoticed at first. Fernandes and Sansolo (2013) in the municipality of Santos, on Gonzaguinha beach packaging, coconut (as the most perceived materials by beachgoers), food scraps, plastic cups, beverage cans, and bottles were noticed, suggesting that pollution is mainly due to beachgoers. This is probably because in their leisure time the regulars are contemplating the landscape, where the present macro does not stand out as much.

Regarding the destination they give to litter produced during their stay on the beach, the vast majority affirm that they give a correct destination, either by placing them in trashcans on the beach (67%) or taking them for disposal at home (23%). The remaining 10% stated that they were not concerned with correct disposal (7%) or not producing litter and the remaining or put in a bag or buried litter in the sand (3%). It was observed that the vast majority say to give a correct destination to their litter, which corroborates their aversion regarding the presence of litter on the beach, observed in a previous question. However, at the end of the day, the presence of litter left at the study site presented that the users claimed to give the correct proper destination, but they do not carry out this destination properly. Santos *et al.* (2005) try to explain this discrepancy, by saying that this is the embarrassment caused by this question to the interviewee, causing the number of answers with the correct destination of the litter to be overestimated.

As mentioned in several studies (Widmar and Reis, 2010; Santana Neto *et al.,* 2011; Fernandes and Sansolo, 2013), the lack of education among beachgoers on Itaipu seems to be the main reason for the presence of litter in the sand (66%). Another 24% of the respondents mentioned the lack of

trashcans as the main reason for the presence of litter in the sand at the time of collection. However, we highlight that Itaipu beach already has trashcans on its sands (personal observation). In the study by Mattos and Bondioli (2018), beachgoers mentioned the presence of trashcans to minimize the presence of these pollutants in the sand, but these same authors observed that even on beaches with the presence of trashcans, litter was still found in the sand. Of the interviewers, 10% of the respondents consider the lack of cleanliness by public agencies on the beach to be responsible for the presence of litter. According to Silva *et al.* (2015), Itaipu does not have a regular and efficient litter collection.

One way to reverse this lack of education is to make the beachgoers aware that keeping the beach clean is everyone's responsibility, as quoted by the majority, 81% of respondents, and not only by some as quoted by 1% of the respondents that credits the responsibility to traders, 2% that credit to authorities and 16% that credits to regulars the responsibility to keep the beaches clean. Timbó *et al.* (2019) cite environmental education activities with beach users as a way to minimize the presence of litter on the beaches. Environmental education aims to make the individual see himself as part of the environment, because only then will become more concerned with the environment (Jacobi, 2003; Silva *et al.,* 2021).

Environmental education activities become more important when we observe that 16% of the interviewees considered that the local economy is the most affected by the presence of litter on the beach. A little more than half of the respondents (52%) of the interviewees believe that the environment is the most affected by the presence of litter on the beach. Only 32% of the respondents cited the health of the beach users as the most affected by litter on the beach, leading us to think these interviewees see themselves as part of the environment, suffering the consequences of pollution in the environment where they are inserted. The studies of Fernandes and Sansolo (2013) and Timbó *et al.* (2019) were later answered mostly by men with higher education; the interviewees mentioned their health as the main impaired. In this case, a higher level of education shows an even greater perception of individuals in relation to the consequences of environmental pollution on humans.

In addition to health, the respondents managed to have a small perception that the fauna can be harmed by the presence of litter in the sand or in the marine environment. Some visitors to this beach reported the presence of litter in turtles, due to the environmental awareness actions of the Aruanã Project that show the waste ingested by these animals. This project studies the occurrence of sea turtles in the Guanabara Bay region and surrounding. Itaipu is an area of occurrence of sea turtles for feeding habits (Gomes *et al.,* 2021).

Although environmental education is one of the main tools to raise awareness among individuals and thus minimize the presence of anthropogenic litter on the beaches, only 19% of the respondents would collaborate with these activities. Most respondents, 73% said that disposing of litter correctly in trashcans would be their contribution. Five percent would participate in clean-up activities and three percent of the interviewees stated that the presence of litter on the beach was not a problem for them. Participating in environmental education and beach clean-up activities shows a greater concern in relation to environmental issues and a greater commitment to the collective. As noticed in the answers of some respondents, not everyone takes care of their litter, so if we only take care of ours, there will always be residues on the beaches until everyone is aware of the problem.

The process of environmental perception is of fundamental importance for the understanding of the relationship between man, society, and the environment (Fernandes and Sansolo, 2013), because the human being has different behaviors and lifestyles that influence different perceptions (Fernandes *et al.,* 2004). Through the study of environmental perception, it is possible to plan and carry out environmental education work, minimizing the generation of environmental impacts, starting from the reality of the target audience (Silva *et al.,* 2021).

Table 2: Socio-economic profile of beachgoers

Month	March 2014		April 2014		June 2014		November 2014		January 2015		April 2015	
Days of week	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday
Gender												
Female	9	16	9	10	8	9	10	6	6	16	5	6
Male	6	10	6	7	0	5	5	5	4	9	2	4
Age												
<18	0	0	1	0	1	0	1	0	0	0	0	1
18-30	3	4	4	5	2	3	9	3	1	5	1	1
31-40	4	9	3	6	0	4	2	5	0	6	3	4
41-50	3	7	5	4	4	3	1	2	5	8	2	2
>50	5	6	2	2	1	4	2	1	4	6	1	2
Wage												
1	4	7	3	5	0	3	4	3	2	8	3	2
2 - 5	9	9	7	9	5	8	8	6	3	10	4	8
5 - 10	1	4	1	2	2	2	1	0	2	4	0	0
>10	1	0	2	1	0	0	0	0	1	0	0	0
unfixed	0	6	2	0	1	1	2	2	2	3	0	0

Table 2 Cont.**:**.Socio-economic profile of beachgoers

Month	March 2014		April 2014		June 2014		November 2014		January 2015		April 2015	
Days of week	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday	Saturday	Sunday
						Education						
No schooling	0	0	0	0	0	0	0	0	0	0	0	0
Incomplete elementary	0	3	0	0	0	1	3	3	1	3	1	1
Complete elementary	2	7	1	2	1	1	1	1	0	1	0	1
Incomplete higher	2	1	4	0	0	0	2	1	0	3	1	2
Complete higher	5	11	4	7	3	5	6	5	4	13	3	4
Graduated	3	4	4	5	3	4	1	0	3	3	2	2
Postgraduate	0	0	0	0	0	0	1	0	0	0	0	0

Table 2 Cont.**:**.Socio-economic profile of beachgoers

Frequency of going to the beach												
least once a month	3	3	0	2	1	2	2	0	1	2	1	2
more than one weekend	2	2	3	4	3	6	1	1	1	3	0	0
Daily or frequently	5	12	2	7	2	2	2	2	8	13	2	4
Rarely	5	9	10	8	2	4	10	8	0	7	4	4
Origin												
neighbors	1	1	2	3	0	5	2	1	3	2	1	1
from the city	5	11	5	9	5	2	4	1	5	5	1	2
other city	8	13	6	4	3	6	8	9	2	17	5	6
other state	1	1	3	1	0	1	1	0	0	1	0	1
Total	15	26	`15	17	8	14	15	11	10	25	7	10

3.4. Influence of awareness activities

The presence of litter in the study area previously cleaned both on Saturday and Sunday during weekend work, allowed us to observe that not all individuals who were targeted by the activity were sensitized. Our analysis indicated a significant difference (p-value < 0.01) in the weight (Kg) of litter collected person^{-1} between Saturdays (days without awareness activity) and Sundays (days with awareness activity). Saturdays presented comparatively higher values of 0.08 ± 0.02 (mean ± standard deviation) Kg litter.person^{-1} han Sundays which presented 0.04 ± 0.01 Kg litter.person^{-1} (Figure 4). This shows that the activity was effective and sensitized a portion of the beachgoers. The information passed did not allow changing their attitude in relation to the correct destination for their litter on Saturday. However, such information could change their behavior if they returned to the beach the next day.

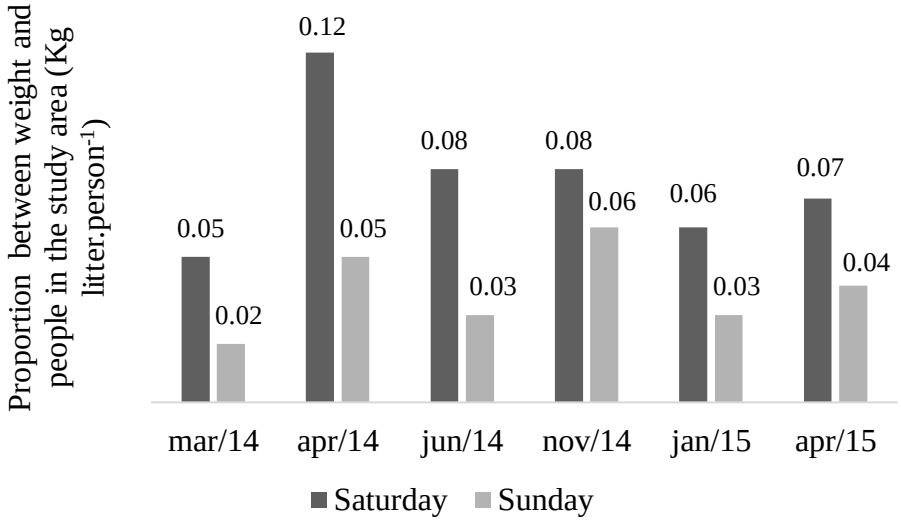

Figure 4: Proportion of litter (Kg) by person on Itaipu beach on the different dates sampled.

On the other hand, itens.person^{-1} showed a marginal difference between Saturdays and Sundays (p-value = 0.08). The values itens.person^{-1} were 0.68 ± 0.16 and 0.52 ± 0.11 (mean ± standard deviation) for Saturdays and Sundays, respectively (Figure 5). With the exception of April 2015, in every month Saturdays exhibit higher values than Sundays. Considering that

awareness has not reached everyone, including some individuals claiming to leave the anthropogenic litter on the beach, this may explain this result.

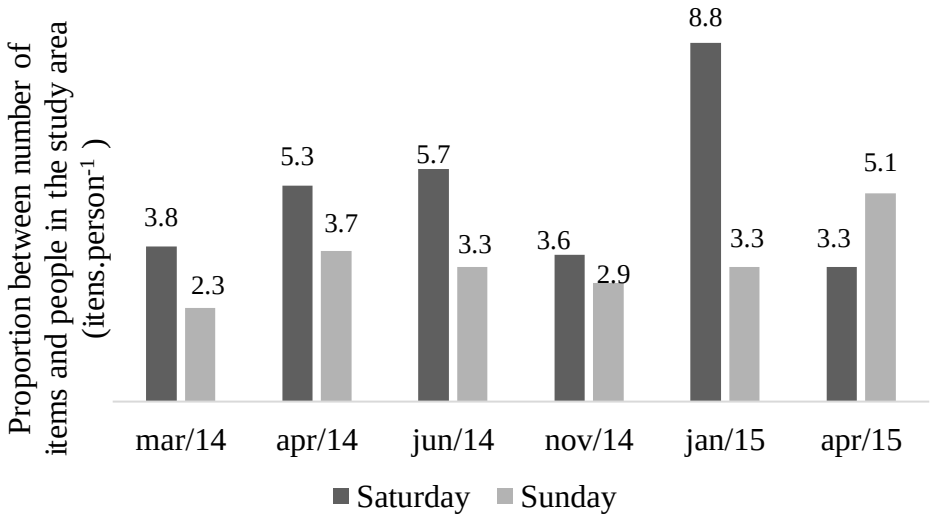

Figure 5: Proportion of items/person (itens.person^{-1}) on Itaipu beach on the different dates sampled.

Despite the difference in the values of weight and units of litter collected observed between the two days of the weekends, the number of items and weight found on Sunday, when there was awareness-raising activity, was considerable. Several interviewees commented after the awareness activities, especially on Sunday, problems related to the presence of litter and part of them collected the litter generated by them in the sand strip. This also occurred on Boa Viagem beach, in the state of Pernambuco, as reported by Dias-Filho *et al.* (2011). A single quick encounter may not be enough to raise enough awareness to certain individuals to the point that they reflect on their behavior.

At the end of the day on Sunday, we observed that the individual interviewed from the family informed the other members to collect the litter generated by them in the environment to give some destination, demonstrating once again that the activity had some effect, including making comments to the interviewer/observer of their behavior on the beach. Environmental awareness activities are important, because through these activities, information about certain environmental problems is transmitted to lead the individual to reflect on how they behave in the face of this problem.

This allows the individuals to change their behaviors and make them want to start acting in favor of reducing this problem (Jefferson *et al.,* 2015).

According to Faggionato (2002), the perceptions, reactions, and responses of each individual about their actions in the environment in which they live are unique and individual. Despite the discourse of most of the interviewees reinforcing that litter on the beach is a nuisance, in addition to an environmental problem, caused, among other things, by the lack of education of the people, litter continues to be discarded inappropriately, as demonstrated by its presence in the sand.

4. Conclusions

Assessing the perception of beachgoers can assist in the development and implementation of awareness activities, which have been demonstrated and must be carried out frequently, in order to change the behavior of these regulars, who are mentioned as the main ones responsible for the presence of anthropogenic litter in the sands. Indeed, our findings indicated significantly higher items per person (itens.person^{-1}) and proportion between weight and people (Kg litter.person^{-1}) on Saturday compared to Sundays, after the awareness activity occurred.

It is recommended to place trashcans by Niterói City Hall on the beaches and by cleaning beaches must be carried out more effectively with different equipment and vehicles such as sand tractors, wheel loaders, and compactor trucks in an integrated system. The beaches of the city of Rio de Janeiro can be considered an example of success with the installation of trashcans and an integrated cleaning system, which allowed greater efficiency in the collection of waste. The absence was also mentioned as a responsibility for contributing to the presence of litter in the environment, and the ban of disposables items, the main types of litter collected on the studied beach, by the bars, street vendors, and greater oversight by the government. Such measures associated with better management of litter will be fundamental to mitigate the problem in these environments.

CRediT authorship contribution statement

Alain Alves Póvoa - Formal analysis; Investigation, Writing - Original Draft, Writing - Review & Editing, Visualization. Caroline Souza de Andrade Imsaurriaga - Formal analysis; Investigation, Writing - Original Draft, Writing - Review & Editing, Visualization. Patrick Derviche – Statistical analysis, Writing - Original Draft, Writing - Review & Editing. Fábio Vieira Araújo - Conceptualization; Formal analysis; Investigation; Methodology; Supervision; Validation; Writing - review & editing.

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