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Ecosystem services and the perception of beach visitors in Pernambuco

Serviços ecossistêmicos e percepção de frequentadores em praias no estado de Pernambuco

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ABSTRACT: Ecosystem services are tangible and intangible benefits provided by ecosystems that benefit human well-being. The aim of the present research is to address these services' distribution throughout the Recife and Jaboatão dos Guararapes' beaches, Northeastern Brazil. The importance of acknowledging how ecosystem services affect beach environments, which were modified by uncontrolled urbanization in the Brazilian coast, and the consequent erasure of this region's ecosystems are quite clear. Rates recorded for pre-selected parameters resulting from data collection evidenced significant ecosystem services' loss in places presenting higher urbanization rates, such as Candeias and Boa Viagem counties, which present short extension beach line due to coastal erosion. Results from 120 semi-structured questionnaires have shown that beach visitors see these environments as important element for human well-being maintenance, as well as encourage environmental education practices and conservation-related public policies. Highlighting how ecosystem services are organized and affect urban beaches is essential for decisions made about projects aimed at wakening visitors and residents' awareness about them, but to make this population think of mitigation actions to reduce the impacts of the herein shown loss on them, in the long run.

Keywords: coastline; ecosystem; beach; coastal zone.

RESUMO: Serviços ecossistêmicos são todos os benefícios tangíveis e intangíveis que os ecossistemas propiciam e que dão benefícios ao bem-estar dos seres humanos. O trabalho aborda a distribuição dos serviços ecossistêmicos e a percepção dos frequentadores sobre estes serviços nas praias dos municípios do Recife e Jaboatão dos Guararapes, Pernambuco. Com a alta urbanização ocorrida no litoral brasileiro e a consequente supressão dos ecossistemas costeiros, fica clara a importância da constatação da forma com que os serviços ecossistêmicos atuam em ambientes de praia com modificações causadas pelo ordenamento urbano desenfreado. Com base em índices formados com a coleta de informações a partir de parâmetros pré-selecionados, chegou-se à conclusão de que houve perda significativa dos serviços ecossistêmicos onde a urbanização é mais acentuada, como, por exemplo, nos bairros de Candeias e Boa Viagem, devido à curta extensão da linha de praia causada pela erosão costeira. A partir dos resultados obtidos através de 120 questionários semiestruturados, foi possível notar que os frequentadores consideraram importante a função da praia para a manutenção do bem-estar humano, incentivando práticas de educação ambiental e políticas públicas de conservação. O esforço para demonstrar como os serviços ecossistêmicos se arranjam e influenciam em praias urbanas é essencial para a tomada de decisão em projetos, tanto para a conscientização por parte de frequentadores e moradores locais quanto para a melhoria futura desses ambientes em ações mitigadoras.

Palavras-chave: litoral; ecossistemas; praia; zona costeira.

1. Introduction

The significant urban expansion in coastal environments, driven by the formation of big cities on seashores, has contributed to degrade original environmental conditions due to countless interventions in landscape, such as intense construction of buildings and its effects on the built space (Macedo, 1999; De Paula *et al.*, 2019).

On the other hand, coastal urban areas also account for more intense visitation to their beaches by visitors for leisure, and physical and mental well-being purposes. Therefore, it is important addressing the role of beaches in Ecosystem Services (ES) (Coriolano & Mello and Silva, 2005).

Thus, ESs were initially conceived by Westmann (1977) from economic and nature-conservation biases. Nevertheless, according to DeGroot (1987) and Constanza (1989), these services were related to the sense of social well-being, rather than just to the prevailing economic concept. New reflections have evidenced great efforts to seek the standardization of an ES analysis method to theoretically and methodologically contribute to research on this topic[1]. Categorizing these services must be a good way to contribute to their concept to become more didactical and understandable from the scientific viewpoint.

Accordingly, option was made for using the definition developed by the Millennium Ecosystem Assessment (MEA, 2005) program, which describes Ecosystem Services as ecosystems' products that, directly or indirectly, trigger human well-being. MEA also splits ESs into the following categories: provision, regulation, cultural and support services.

Provision services include products gotten from ecosystems, such as food, raw materials for fuel production and energy sources. Regulatory services, in their turn, are related to ecosystem processes' features that contribute to air-quality

[1] Constanza (1989), Costanza *et al.* (1997), Daily (1997), De Groot *et al*. (2002), Hein *et al.* (2006) and Andrade and Romeiro (2009) are some of the authors who suggest the standardization of ecosystem services (N. A.)

maintenance, to weather regularity and to erosive process control, among others (Romeiro & Maia, 2011).

Support services are the ones seen as essential for other ESs to work, such as the case of habitat provision for different species. Finally, cultural services regard the role of ecosystems in the multiplicity of different cultures, and in religious and spiritual values (Andrade & Romeiro, 2009).

Environmental perception results from cultural or personal attitudes by man towards the environment, which are directly or indirectly influenced by biological, psychological and socio-cultural aspects. Tuan (1980) stated that the time a human being takes an action, because of some aspects of the medium, it is open to perceptions.

Overall, coastal urban areas are spaces that have been quite changed by human action, so that studies focused on ES scan lead to diagnostics about their current conservation status. Therefore, the aims of the present study were to quantify Ecosystem services' status at beaches located in Recife and Jaboatão dos Guararapes counties, Pernambuco State, and to connect these services to beach visitors' perception about the herein analyzed beaches. It must be done in order to encourage public policies focused on better managing the coast, given its relevance to the understanding of ESs dynamics in coastal areas presenting high population density, within large urbanized areas, such as the herein investigated counties.

2. Materials and methods

2.1. Study site

The study site comprises the coastal shore in Recife and Jaboatão dos Guararapes counties, Pernambuco State, Northeastern Brazil macro-region (Figure 1), which encompasses six beaches; three of them in Recife: Brasília Teimosa, Pina and Boa Viagem - from North to South. Beaches in Jaboatão dos Guararapes are Piedade, Candeias and Barra de Jangada – in the same direction.

According to IBGE, the estimated population for Recife City, back in 2021, was 1,661,017 habitants, and 711,330 habitants in Jaboatão dos Guararapes.

Based on data from the last demographic census (IBGE, 2010), the three coastal neighborhoods in Recife's coast - Brasília Teimosa: 18,334; Pina: 29,176; and Boa Viagem: 122,922 – altogether, accounted for 170,432 habitants; this number represents 11% of the city's population at that time.

Back in 2010, Jaboatão dos Guararapes housed 644,620 inhabitants, and 165,304 of them lived in its three coastal neighborhoods: Piedade: 64,503; Candeias: 64,587; and Barra de Jangada: 36,214 inhabitants. Altogether, these three neighborhoods represented 25% of the county's population. Similar to Recife, Jaboatão dos Guararapes presents significant construction of high buildings on its coastal shore, mainly in Piedade and Cadeias neighborhoods, whose building construction expansion led to urban overflow (Souza; Bitoun, 2015).

Pina and Boa Viagem coasts have high building construction rates, and their buildings have high housing standards (Costa *et al*. 2008). Howe-

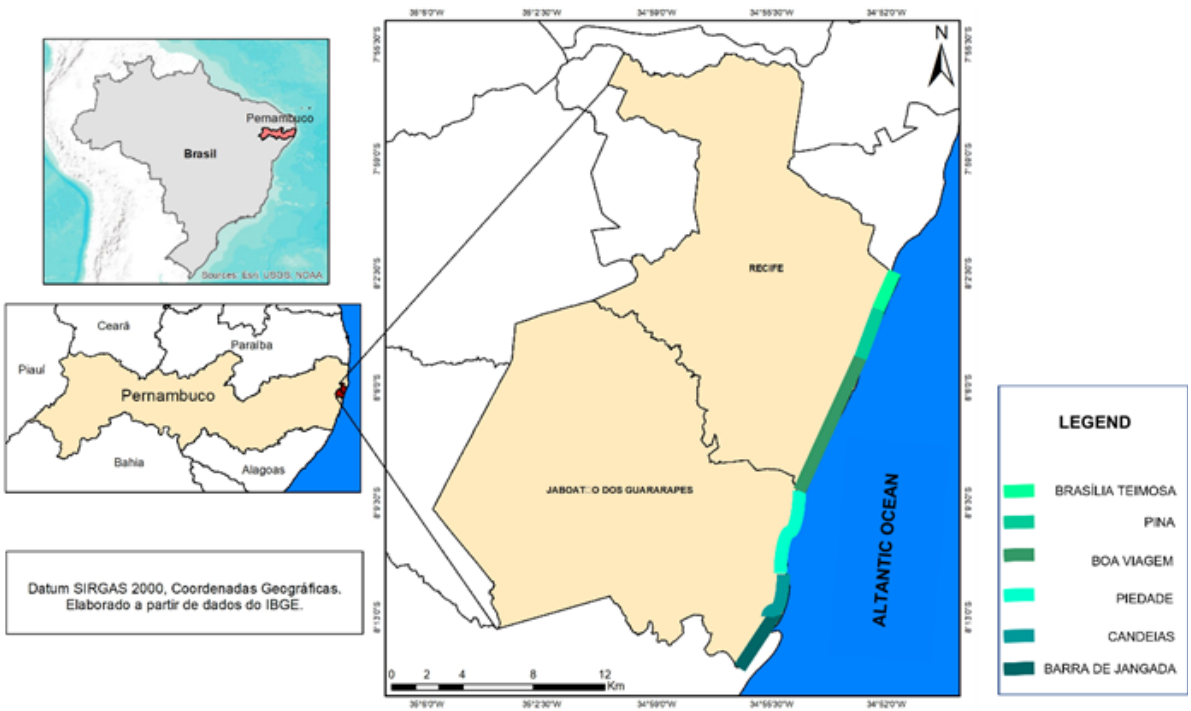

FIGURE 1 – Study site location
SOURCE: Elaborated by the authors based on research data.

ver, some areas located far from the coast, mainly in Pina, also house poor communities whose urban infrastructure and housing conditions are quite precarious. Brasília Teimosa, in its turn, belongs to a Special Social Interest Zone, also known as ZEIS, where housing and urban infrastructure conditions are precarious in the whole neighborhood (RECIFE, 2019).

Similar to many other cities in the Brazilian coast, the urbanization process in the coastal zone has grown from the beach shore and from associated ecosystems (Borelli, 2007), such as *Restinga* and mangroves. This situation gets even worse due to precarious basic-sanitation conditions (Dantas *et al*., 2012).

However, the beach shore is essential for the herein assessed counties, since it provides important ecosystem services to their populations. Barra de Jangada Beach, for example, besides having a coastal environment, also counts on the joint estuary of Jaboatão and Pirapama rivers, where one finds mangroves and *restinga* areas (Torres; Guerra, 2008).

Barra de Jangada neighborhood houses the estuaries of Jaboatão and Pirapama rivers and is seen as important factor for ES offer, mainly of Regulation, Support and Provision services (Figure 2), given the influence of mangrove areas and, con-

sequently, the provision of habitat for species living in there; and of marine and river environments.

The intense urbanization process felt since late 20th century led to vegetation and coastal shore loss. The significant construction of tall buildings on the beach shore, from Pina to Candeias, had strong impact on it, since this process led to higher demand by the population for ESs related to this coastal environment, as stated by Manso *et al*. (2018) (Figure 3).

FIGURE 2 – Joint estuary of Jaboatão and Pirapama rivers, in Barra de Jangada neighborhood, Jaboatão dos Guararapes County/PE.
SOURCE: CPRH (2006).

2.2. Methodology

The present research focused on the qualitative-quantitative approach to reinforce the link between two key elements. It was done to work with ecosystem services' supply and beach visitors' perception about these spaces in Recife and Jaboatão dos Guararapes counties.

FIGURE 3 – Tall buildings built at Boa Viagem Beach, Boa Viagem neighborhood, Recife City/PE.
SOURCE: CPRH (2006).

Four field visitations were carried out in April 2019 to better understand ESs in the herein assessed beaches, according to adaptations made in the methodology applied by MEA (2005), Santos and Silva (2012) and Oliveira (2015) for classifications and to classify Ecosystem services' parameters. Thus, data collection was performed and beach shores were sub-divided into sectors. Data were tabulated, normalized and generated in SPPS statistical software.

All ESs presented definitions that will help better understanding functionality in a given coastal ecosystem. According to Santos and Silva (2012), and Oliveira (2015), the association between Ecosystem Services and environments is explained, and it is possible understanding its functioning in practical terms (Table 1).

The proposition by Santos and Silva (2012) was taken as reference to set indices recorded for ESs within the analyzed sectors in order to reach Ecosystem Service Indices (ESI) in each sector. Values 1 (low), 2 (intermediate) and 3 (high) were attributed to each assessed sector, based on authors'

TABLE 1 – Ecosystem services and their definitions

N.	Ecosystem Service	Definition/examples
REGULATION AND SUPPORT ECOSYSTEM SERVICES		
01	Natural sediments' retention	Related to the presence of vegetation in post-beach areas or in dune lines by taking into consideration the root system as natural sediments' holder to mitigate coastal erosion consequences.
02	Aquifers' reload	It is associated with the presence of permeable geological units such as marine sandy terraces; it is found in coastal zones close to the beach
03	Water control and flow	It refers to the presence of moistened lands and/or of mangroves, since these ecosystems act as water accumulators and regulate groundwater levels, besides balancing local temperature
04	Assimilation and recycling of pollutants	It is related to moisture land and/or to mangroves because the sandy soil works as natural purifier; most of the time, it assimilates and recycles pollutants and respects resilience limits.
05	Wave energy dissipation	It is related to the presence of surf zones and takes into account that, the larger the surf zone and the larger the number of surf areas, the higher the energy dissipated before reaching the beachfront.
06	Natural protection of the beachfront zone	Presence of construction sites that allow beachfront zone protection
07	Natural protection of the post-beach zone	It refers to the presence of dune lines and promotes natural protection to close coastal zones, mainly when there are extreme events, when big waves can reach the coast.
08	Anthropic protection to the beachfront zone	Presence of construction sites that allow beachfront zone protection
09	Anthropic protection to the post-beach zone	Presence of construction sites that allow protecting and/or the permanence of the post-beach zone.
10	Marine refuge and/or nursery	It mainly allows the continuity of primary yield; it is associated with the presence of estuaries
11	Transition refuge and/or nursery	It also allows primary yield maintenance and is related to the presence of mangroves, resting or Atlantic forest areas close to the coastal shore
PROVISION ECOSYSTEM SERVICES		
12	Natural food production	It is associated with activities that provide food resources such as fishing, shellfish or vegetables, besides resources from crops
13	Food production in cultivated areas	It is associated with the supply of food resources coming from cultures, such as livestock, fish farms, among others
14	Water resources	It regards the presence of rivers, lakes, aquifers, among others, that are useful for human use
15	Ornamental resources	It refers to the presence of resources capable of being used for ornamental and handcrafting purposes, such as oyster shells, minerals, dead wood, fish leather scraps
16	Genetic resources	It is associated with the presence of heterogeneous ecosystems with high biodiversity and that allow high genetic flow.
CULTURAL ECOSYSTEM SERVICES		
17	Ecotourism services	It is associated with the presence of locations used for ecotourism activities, such as trails, diving points, among others.

18	Cultural and/or historical tourism	Presence of construction sites or of areas accounting for historical and/or cultural value for the local society
19	Landscape attractiveness	It is associated with the presence of natural attractions that boost the local visitation, besides the sand and marine line, which are set through the analysis applied to the conservation status of beaches' coastal scenario and its landscape aspects
20	Recreation and leisure	Related to recreational quality on the beaches

SOURCE: Adapted from Santos and Silva (2012), and Oliveira (2015).

interpretations of the established parameters, depending on the availability of each ES.

In total, 23 sectors were pre-selected along the assessed beaches to make a detailed analysis of them and to assumingly find different features (Figure 4).

The sectors did not have the same extension, since natural, artificial and municipal administrative limits were respected, such as the presence of parks, squares, the presence and/or lack of sand lines, so that the analyses could be integrally made. The beach line where one finds a border line between the two counties was taken into account to separate the X limit of Recife from the Y limit of Jaboatão dos Guararapes.

Data normalization was carried out based on the recorded indices, according to criteria set by Mittag and Rinne (1993) in the descriptive formula, below, to find associations between Ecosystem Services categories (ES 01 to ES 11 – Regulation

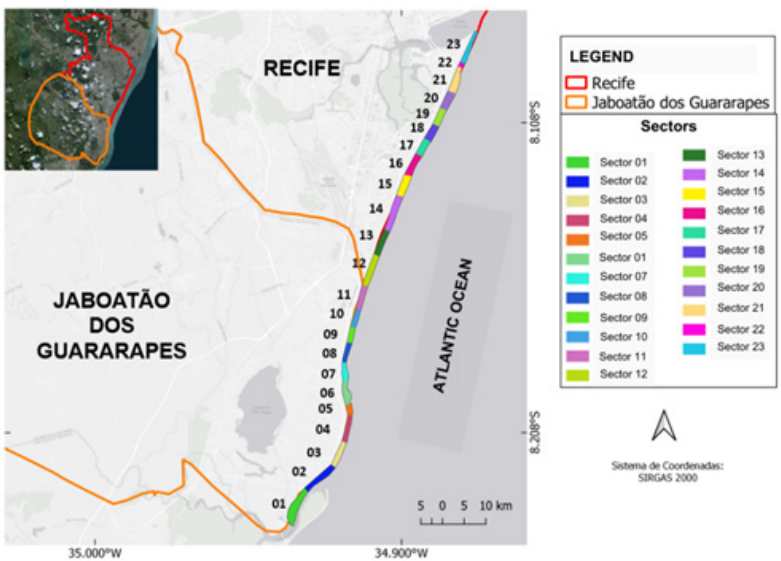

FIGURE 4 – Distribution of 23 sectors along the beaches in Recife and Jaboatão dos Guararapes counties/PE, based on the South-North sequence
SOURCE: Elaborated by the authors, based on research data.

and Support; ES 12 to ES 16 – Provision; ES 17 to 20 – Cultural)

$$X_{changed} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

If one has in mind that the most recurrent uses in beaches, recreation and leisure ES was the one chosen to analyze how beach visitors evaluate beaches' recreational conditions. Such a choice is relevant, because these two coastal cities present significant population density in coastal neighborhoods. Accordingly, a semi-structured questionnaire based on Vousdoukas (2008) was applied.

Interviews were carried out with visitors in each beach sector, in three different days, based on results recorded for cultural ES normality through indices' collection and contingency.

Points laying on the mean line, right above zero, in normality, were considered suitable for questionnaire application. The number of questionnaires (120) was defined based on data recorded for recreation and leisure ES. Thus, sites suitable for questionnaire application were split into three sectors: Northern Recife, Southern Recife and Jaboatão.

The questionnaire also included socioeconomic questions in order to define beach visitors' income and life conditions. Questions at scale 0 to 10 were approached to find how beaches' importance and coastal environments were perceived, for analysis purposes.

A section was included in the questionnaire to define which infrastructure indicators defined by Oliveira (2015) are seen as the most essential ones based on visitors' perception. Furthermore, there was a question about what actions could be taken to conserve the beach environment.

3. Results and discussion

3.1. Ecosystem services provided at the beaches

The representation of indices exposed by sectors in each ecosystem service translate the geo-environmental conditions in each site, besides featuring the sites presenting the largest real-estate occupation and, consequently, what could be understood from Figure 5, from the total number of 23 selected ESI.

The highest concentration of indices recording the maximum value was observed for South to Jaboatão dos Guararapes County – Jangada neighborhood -: 11% of all recorded indices. This neighborhood also showed the highest concentration of mean-value indices (10%). These data represent natural conditionings' influence, such as that of waterbodies and vegetated sites, as ecosystem service boosters.

The largest ESI was observed in Sector 01 (Barra da Jangada neighborhood), and the smallest one was found in Sector 04 (Candeias neighborhood); both neighborhoods had their own environmental features. Sector 01 recorded the largest amount of vegetation cover and refuge to marine and transition species. Sector 4 showed lack of protection to the coastal line and, consequently, high coastal erosion.

Figure 6 depicts beaches based on the means recorded for categorized ESs, according to normality found through the mean indices of each

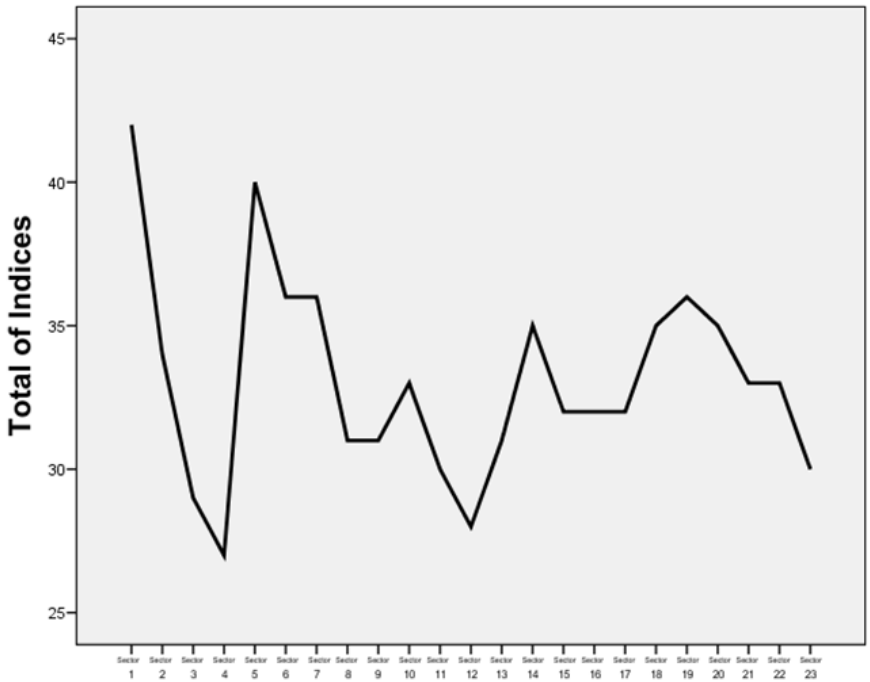

FIGURE 5 – Total of indices recorded for the assessed sectors in Recife and Jaboatão dos Guararapes beaches, Pernambuco.
SOURCE: Elaborated by the authors based on research data.

ecosystem service in the herein set sectors. The first inference lies on the regulation and support ES/ provision ES association. It is possible observing that they are on the same normality line in Barra de Jangada, and it shows the link between them.

Boa Viagem neighborhood evidences cultural ESs independence (ES 17 to ES 20) from the other two categories. One must take into consideration that this is the most populous neighborhood in Recife City, with approximately 123 thousand inhabitants (IBGE, 2010). There are several coastal erosion points on the coastal line due to the pressure put by coastal shore buildings that compromise both ES 01 (natural retention of sediments) and ES07 (natural protection to the post-beach zone).

Accordingly, one can assume that the space previously used for ES provision and regulation is nowadays taken by infrastructures that provide local residents and visitors with leisure experiences. Manso (1995) stated that human occupations in post-beach environments potentiate coastal erosion, as observed in the two herein assessed counties.

Beach-replenishment works taking place from 2013 onwards may have contributed for the high indices recorded for natural retention of sediments and to post-beach zone protection in Piedade.

Discrepancy among the three ES categories is bigger in Brasília Teimosa, and it can be explained by the significant urbanization in it, which contributed to lack of genetic and ornamental resources. Guerra *et al*. (2015) states that it results from pressure put over this environment, as the consequence of continuous biodiversity and habitat loss that have led to reduced ecosystem services' offer.

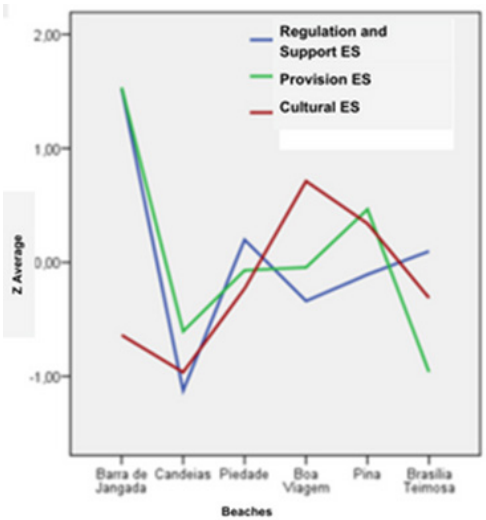

FIGURE 6 – Distribution of Ecosystem Services based on grouping categories in Recife and Jaboatão dos Guararapes beaches / PE.
SOURCE: Elaborated by the authors based on research data.

It is also possible analyzing the ES10 (marine refuge and nursery) and ES11 (transition refuge and nursery) cases, because they have similar behavior. ES10 was observed in Jaboatão dos Guarara County, because of the presence of the joint estuary of Jaboatão and Pirapama rivers, and because it presents shark species (Figure 7), besides sheltering several species, either marine and freshwater species, as stated by Coelho *et al*. (2018), who assessed Jaboatão River estuary and mangrove influence on local species.

Regulation and Support ES present more differences in its normal line, in Barra de Jangada neighborhood, than the other ESs due to the presence of Jaboatão and Pirapama rivers mouth.

ESs analyzed in Barra da Jangada did not reach the standard from the normality viewpoint in comparison to the other assessed beaches (Figure 6). ES12 (natural food production) presented uneven line because fishermen use specific areas at the beaches to fish, as seen in the collected data. ES13 (food production in cultivated areas) is one of the two ESs that have shown equal index in all assessed sectors; this is why their line was so straight (Figure 8).

However, current conditions observed in the beaches led to reduction trend in fishing activities, as stated by Seixas *et al.* (2014), who analyzed changes in environmental conditions and how the perception of fishermen living in São Paulo's Northern coast was affected by them.

Cultural ESs (17, 18, 19 and 20) showed upward-line trend in Boa Viagem and Pina beaches, Recife City, given the input in recreation infrastructure set at Boa Viagem Avenue, as already mentioned. This scenario reflects on quality-of-life improvement for residents and visitors at these beaches. This finding corroborates with Raimundo and Sarti (2016) about the importance of landscape complexes (such as parks and squares) for society, since it is a relevant factor for regulation services.

ES17 (Ecotourism) presented normal line because of evenness throughout the whole study site, given lack of ecotourism activities. SE18 (Cultural and Historical Tourism) recorded fluctuations along the beaches, and this same aspect was observed from

FIGURE 7 – Plates warning about the risk of shark attacks in the mouth of Jaboatão and Pirapama rivers/PE.
SOURCE: Elaborated by the authors based on research data.

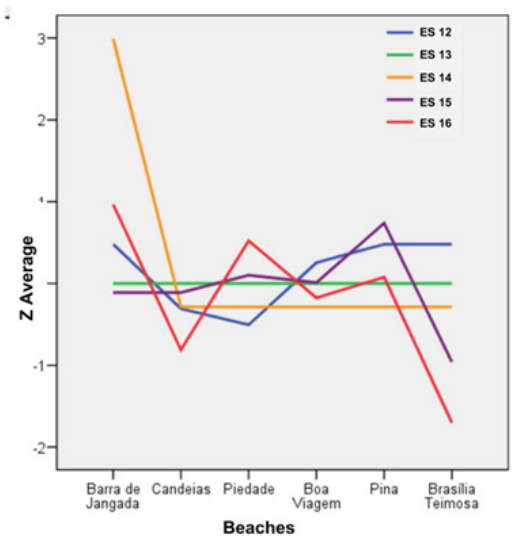

FIGURE 8 – Distribution of Provision Ecosystem Services based on beach sectors in Recife and Jaboatão dos Guararapes/PE
SOURCE: Elaborated by the authors based on research data.

the perspective of presence or lack of this service's equipment in the herein assessed beaches. SE19 (Landscape Attractiveness) did not stand out in any of the assessed beaches, except for Boa Viagem, given the more significant presence of equipment in it (parks, squares, gardens and sports courts).

SE20 (Recreation and Leisure) presented progressive line along the whole study site, except for decrease in Brasília Teimosa, although it was higher than that in Jaboatão dos Guararapes County (Figure 9).

The sidewalk by Boa Viagem and Pina beaches has a linear park (7,800m long). It is an important public space in Recife City, which makes available space for recreational activity practices, because it provides bike path, Jogging track, sports courts, seats, playgrounds for children, kiosks, restrooms, among others (Figure 10).

This set of equipment are related to cultural ESs, and it contributes to increase the indices recorded for these elements in both beaches. Daniel *et al*. (2012) stated that cultural services are essential for the structure of ecosystem services because they

are the entrance gate for humans to experience the benefits from other service categories.

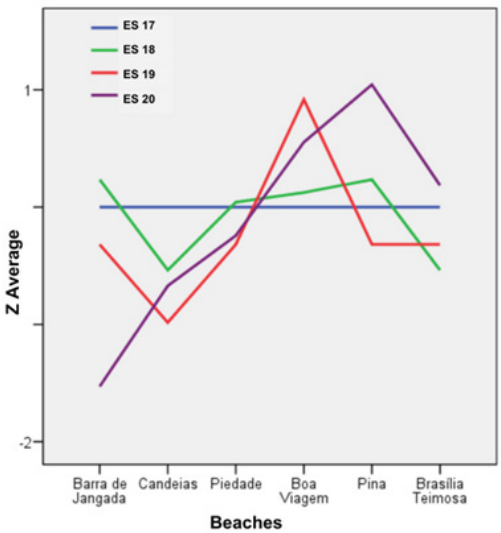

FIGURE 9 – Distribution of Cultural Ecosystem Services based on beach sectors in Recife and Jaboatão dos Guararapes/PE
SOURCE: Elaborated by the authors based on research data.

FIGURE 10 – Linear Garden in Boa Viagem, Recife City/PE.
SOURCE: Elaborated by the authors based on research data.

ESs' distribution along Recife and Jaboatão dos Guararapes coastal shore is heterogeneous and depends on socio-environmental conditions. The mouth of Jaboatão and Pirapama rivers influence regulation and support services' indices in the first sectors, and the *restinga* area in Pina Beach has the same function in the final sectors, in Recife City.

Provision services were only represented by natural food production along the whole coastal shore (Figure 11). The watercourse only influenced few sectors (01 and 02); overall, it did not put this ES category in the mainstream.

FIGURE 11 – Fishing boats at Jaboatão dos Guararapes' coast/PE
SOURCE: Elaborated by the authors based on research data.

3.2 Visitors' perception about recreation and leisure quality in the assessed beaches

Users use the beach space along the whole coast to their leisure moments, be they only to go sunbathing or to exercise. These functionalities well represent cultural ecosystem services.

Leisure spaces are spread over most sectors; they were more concentrated in Recife City than in Jaboatão dos Guararapes. This finding reflects on the larger number of people observed at Viagem, Pina and Brasília Teimosa beaches than at Barra de Jangada, Candeias and Piedade beaches.

Figure 12 shows the locations selected for questionnaire application to beach visitors based on the following sub-divisions: Jaboatão; Southern Recife, concerning Boa Viagem Beach; and Northern Recife, concerning Pina and Brasília Teimosa beaches.

Table 2, below, shows the general features of the 120 interviewees.

There are different standards in some questions, such as whether interviewees know what ESs are. Answers given to this question in "Southern Recife" were more balanced, whereas questions given to it in Jaboatão were more uneven, between "yes" and "no" answers. Answer "no" prevailed in sectors composing Northern Recife, and it had negative impact on answers' results.

The most important benefit type also changed depending on the areas where questionnaires were applied in. Accordingly, respondents' perception in Jaboatão dos Guararapes about the main benefit provided by the beach was recreation and leisure (50%).

Sectors composing Southern and Northern Recife areas recorded prevention of natural disasters as main benefit (35% in Southern Recife and 40% in Northern Recife). Overall, the most important benefit for interviewees was recreation and leisure (32.5%) (Table 3).

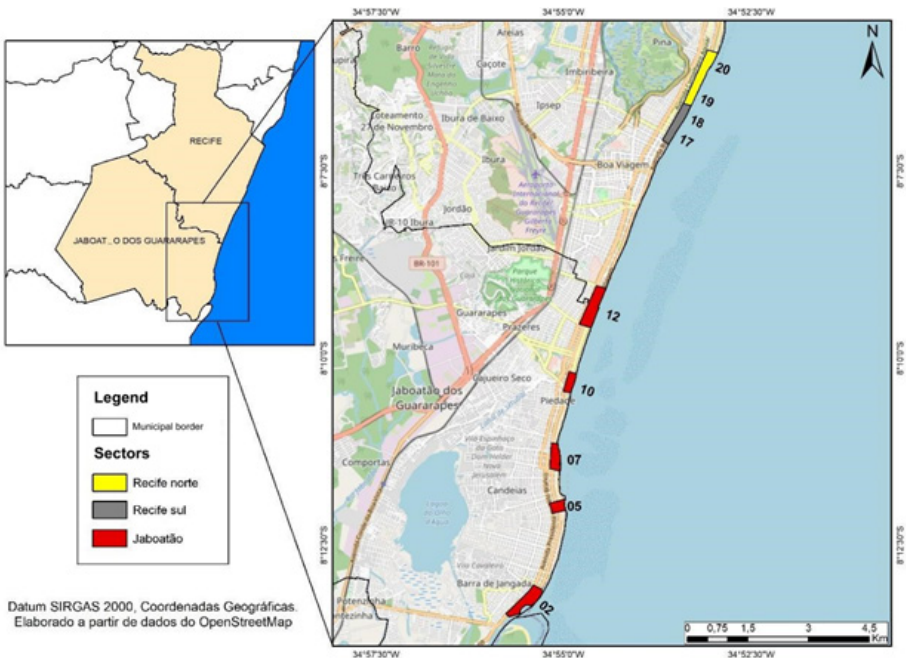

FIGURE 12 – Sectors in Recife and Jaboatão dos Guararapes coast/PE, where questionnaires were applied.
SOURCES: Elaborated by the authors based on research data.

TABLE 2 – Overall features of interviewees

Age	18 – 25 **(22.5%)**	26 – 35 **(19.2%)**	36 – 50 **(35%)**	51 + **(23.3%)**
Sex	Male **(41.7%)**		Female **(58.3%)**	
Schooling	Elementary school **(14.2%)**	High School **(50.8%)**	Higher education **(30.8%)**	Post-Graduation **(4.2%)**
Monthly income	0 to 1 minimum wage **(37.5%)**	2 to 3 minimum wages **(41.7%)**	3 to 4 minimum wages **(7.5%)**	More than 4 minimum wages **(13.3%)**
Current residence	Recife **(38.3%)**		Jaboatão **(26.7%)**	Other counties **(35%)**
How many times did you go to the beach in the last 12 months?	0 – 5 times **(36.7%)**	5 – 10 times **(23.3%)**	10 – 15 times **(11.7%)**	15 – 20 times **(5%)**	+ 20 times **(23.3%)**

SOURCE: Elaborated by the authors based on research data.

TABLE 3 – Visitors' perception about the most important benefits from the respective sectors where the 120 questionnaires were applied

Beach sector	Hazardous events prevention (%)	Food production and biodiversity (%)	Recreation and leisure (%)	Support to beach environment (%)
Northern Recife	40	15	25	20
Southern Recife	35	28	15	22
Jaboatão dos Guararapes	15	17	58	10

SOURCE: Elaborated by the authors based on research data

The influence of oil leaks in Northern Brazil coast (Lourenço *et al.*, 2020) caused environmental disaster in the second half of 2019; moreover, the use of beaches for leisure has increased leisure activities and hazardous events' prevention. Silva *et al.* (2012) stated that high-geo-environmental quality beaches are much more visited for leisure purposes, and this finding reflects on the most assertive answers about the relevance of regulation ecosystem services.

This logic is different in each of the assessed beaches, because urban expansion reflexes, on both cases, were intense and caused stress in local coastal environments. However, it is expected to happen, because beaches must have the least environmental conditions to be used for leisure; at the same time, they must be able to conserve their environmental quality from the viewpoint of their natural resources, which involves their biota and mineral resources.

All points selected for questionnaire application provided standard answers for the question "among these indicators, list the most important ones for you, at the beach". Options "restrooms", "life guards" and "presence of ramps and steps to

access the beach" recorded the highest repetition rates (Figure 13).

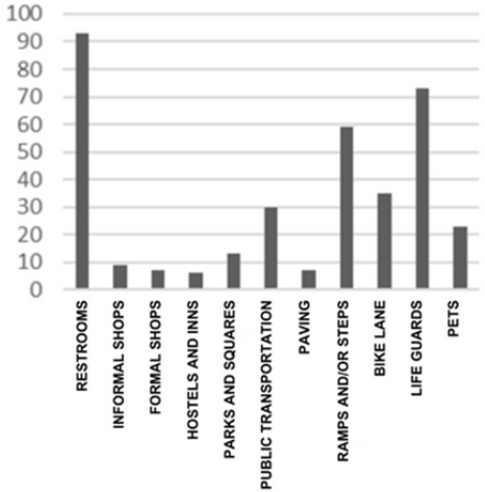

FIGURE 13 – The most important infrastructure indicators for the 120 questionnaires applied at Recife and Jaboatão dos Guararapes beaches/PE

SOURCE: Elaborated by the authors based on research data.

However, by observing the standards in each sector selected for questionnaire application, it was possible assessing the priorities of each public visiting the beaches. On the other hand, items "access to the beach's pavement" and "formal shops" were not mentioned, whereas "parks and squares", "hotels, inns and hostels" and "informal shops" were only mentioned once. This finding can represent that the public visiting Jaboatão dos Guararapes' beaches does not use the services available at them.

Indicators "formal shops", "informal shops", "hotels, inns and hostels" and "access to the beach's pavement" presented only few repetitions.

Despite the easy access to the consumption of products sold by informal shops (such as street venders), visitors did not see them as essential for well-being at beach environment.

According to Oliveira (2015), who has assessed ecosystem services and recreation indicators at beaches in Florianópolis County, natural landscape makes the environment more attractive. Consequently, it makes constructions focused on leisure less important for users, since they seek "natural" spaces, rather than artifacts produced by man.

Beaches' use by visitors, identified at Ponta Negra Beach, Natal/RN, in Recife and Jaboatão do Guararapes meet what Araújo *et al*. (2018) stated about cultural services (category "recreation and leisure" ESs are inserted in). According to them, these services are mainly seen as exercising, sunbath and sea areas. Besides, De Groot *et al.* (2002) agree with the relevance of the natural environment for daily relationships of man, since contact with nature is beneficial for well-being.

4. Conclusion

Based on the contingency of indices in the 23 selected sectors and on the carried out analyses, it was possible observing that, overall, ecosystem service indices had similar behavior in beaches in the herein assessed counties. Values were homogenous and presented evenness.

However, the classification of ecosystem services based on quantitative indices presented relevant differences along these counties' coast. These differences were caused by environmental and/or socio-economic factors, because the occupation and population density profile in the two assessed cities are different.

Occupation in Recife is far from the coastal line due to the presence of Boa Viagem Avenue; occupation in Jaboatão dos Guararapes took place on the coastal line. The presence of the joint estuary of the Jaboatão and Pirapama rivers has boosted the indices recorded in the first sectors when it comes to regulation and provision services; high-standard demographic pressure in Boa Viagem, in its turn, boosted cultural service indices in the sectors distributed in this neighborhood.

On the other hand, cultural services were not dependent on favorable environmental conditions. This service category recorded good indices in locations presenting recreation infrastructure on the beach shore, such as the case of Piedade SESC, Dona Lindu Park, Boa Viagem Square and sports courts in Pina neighborhood.

Because we are talking about coastal counties with high demographic density, recreation and leisure conditions were always important for users' visitation, besides public policies focused on tourism. However, the perception observed through the questionnaires emerged opposite to this reality, because most questionnaires pointed out issues related to beaches' quality and conservation.

It is important highlighting that respondents have acknowledged the relevance of beach environments for them and for society, and that further studies on this topic are essential for the maintenance and improvement of coastal areas' quality. It is essential highlighting the concern with environmental disasters on the Brazilian coast that, even addressed by the target-public, was also mentioned in several occasions.

From all the aforementioned aspects, ecosystem services are essential for society, because they promote human well-being and their availability is closely related to favorable natural conditions and to how such a factor is positively perceived by visitors in the herein assessed beaches.

Because the assessed counties have high demographic density, including in their coastal shore, it was possible observing great changes in the ability of ecosystem services to act in an effective way; the most recorded indices regarded sectors where real-estate speculation did not reach its total power.

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