

ENVIRONMENTAL PERCEPTION AS INFORMATION TOOLS FOR IMPACT STUDIES AND COASTAL MANAGEMENT: THE CASE OF RESTINGA DE BERTIOGA STATE PARK, SP, BRAZIL

Percepção ambiental como ferramenta de informação para estudos de impacto e gerenciamento costeiro: O caso do Parque Estadual Restingas de Bertioiga, SP, Brasil

Gisele Luiz da Silva¹, Juliana de Souza Azevedo^{1,2}

¹ Postgraduate Program in Integrated Environmental Analysis, Institute of Environmental, Chemical and Pharmaceutical Sciences, Federal University of São Paulo. São Nicolau Street, 210, Centro, 09913-030, Diadema, São Paulo, Brazil. Email: gisele.silva@unifesp.br

²Department of Environmental Sciences, Institute of Environmental, Chemical and Pharmaceutical Sciences, Federal University of São Paulo, São Nicolau Street, 210, Centro, SP, 09913-030, Diadema, São Paulo, Brazil. Email: juliana.azevedo@unifesp.br

ABSTRACT

The Restinga de Bertioiga State Park (RBSP) boasts remarkable diversity, necessitating the identification and analysis of numerous unique interactions, such as those between restinga, mangrove, and estuarine ecosystems. The Itaguaré River Estuary (IRE) and its surrounding vegetation, all encompassed within the RBSP, were the focal points of this study. This area serves as an ecological corridor, buffering the impact of marine energy and providing refuge for various flora and fauna species. The present study aimed to assess the relationship between humans and the environment in this region by gathering primary data on the IRE and the local population's perception. Primary data were collected through interviews with individuals in the Itaguaré region, focusing on their environmental awareness. Most respondents demonstrated a lack of awareness regarding estuary definition, associating the RBSP with a protected area. The lack of awareness, combined with escalating real estate development in the area, raises concerns about potential scenarios that could disrupt the ecosystem balance in the region, particularly impacting the estuary's mixing process.

Keywords: Coastal zone, conservation, estuary, sustainability

RESUMO

O Parque Estadual Restingas de Bertioga (PERB) possui uma grande diversidade que exige a identificação e análise de inúmeras interações singulares, como as relações entre os ecossistemas de restinga, manguezal e estuário. O estuário do rio Itaguapé (ERI) e toda a vegetação do seu entorno estão incluídos no PERB e foram o foco deste estudo. Essa região atua como corredor ecológico, zona de amortecimento da energia do ambiente marinho e refúgio de diversas espécies da flora e fauna. Este estudo teve como objetivo avaliar a relação entre o homem e o ambiente nesta região, através da obtenção de dados primários sobre o ERI e a percepção da população sobre a região. Os dados foram obtidos a partir de entrevistas realizadas com usuários da região de Itaguapé, com o foco de avaliar a percepção ambiental dessas pessoas. Nas respostas dos entrevistados, a maioria desconhece a definição de estuário e associa o PERB a uma área protegida. A falta de conhecimento sobre estuário, combinada com o crescente desenvolvimento imobiliário na região, suscita preocupações sobre potenciais cenários que podem perturbar o equilíbrio do ecossistema na região, afetando particularmente o processo de mistura do ERI.

Palavras-chave: Zona costeira, conservação, estuário, sustentabilidade

INTRODUCTION

Based on the assumption that preservation prioritizes the maintenance of native ecosystems in their original form, without human disturbance and full protection against any direct use of natural resources, such as hunting, gathering, handling, agriculture, livestock, and mining, in areas under a regime of preservation, only indirect uses of natural resources are accepted, such as leisure and recreation, environmental education and scientific research (Ganem, 2010). According to the green economy, the direct use of natural resources is attributed to an environmental resource used directly, for example, in the form of extraction, visitation, or other activity of production or direct consumption. On the other hand, indirect uses are attributed to an environmental resource when the benefit of its use derives from ecosystem functions (Motta, 2011).

Nature conservation covers human action aimed to maintain ecosystems in their natural state, from their preservation to the recovery of degraded areas, including sustainable use and handling (Ganem, 2010). Thus, in the context of conservation, it is essential to guarantee the sustainable use of any ecosystem, since they help with temperature control, rainfall balance, humidity, carbon capture, soil formation, matter and energy production, and matter recycling, in addition to maintaining the balance of gasses in the atmosphere. Thus, climatic conditions are dependent on the conservation of ecosystems (Ganem, 2010).

The level of human awareness and practice about conservation and preservation of the environment can be raised by Environmental Perception, which can be understood as the human being's awareness of the environment in general (Whyte, 1978), where everyone understands in a unique way the different processes of the environment in which they are inserted. Thus, the way everyone responds to these processes is the product of Environmental Perception. Therefore, it is possible to qualify and quantify the interrelationships between man and his surroundings.

Created in 2010, as an Integral Conservation Unit by Decree No. 56,500/2010, the *Restinga de Bertioga State Park* (RBSP), located on the coast of São Paulo (Brazil) has a wide diversity, with numerous unique interactions to be identified and analyzed in several areas of knowledge, such as the relations between the restinga, mangrove and estuary ecosystems,

which are connected. Such interactions must be analyzed carefully to comprehend and better understand this complex and integrated system. The park also protects the Itaguapé and Guaratuba river sub-basins, which provide quality water resources and support coastal ecosystems, especially estuaries, and mangroves (<https://www.infraestruturameioambiente.sp.gov.br/fundacaoflorestal/park-state-restinga-de-bertioga/>). Both estuaries suffer anthropological pressures that change their physical, chemical, and biological dynamics. RBST offers high conservation of plant physiognomies that are underrepresented in the São Paulo System of Conservation Units. Studies carried out by the NGO WWF-Brasil and for the Handling Plan of the Serra do Mar State Park reveal that the park, also called Polígono Bertioga (*ertioga polygon*”), is a biological corridor of relevant value, which unites the marine-coastal ecosystems, restinga and Serra do Mar. Thus, protection over the corridor is necessary to ensure the perpetuity of existing ecological processes and gene flows (Fundação Florestal, 2022).

Among the coastal ecosystem components present in the RBST, the region under the influence of the fluvial-marine axis of the Itaguapé River, which connects different ecosystem components, such as the estuary, the restinga, and the mangrove, stand out. This area is under the influence of different anthropogenic actions, mainly those related to the real estate expansion in the Riviera de São Lourenço region, which is located 3.5 km from Itaguapé in the southwest direction, and 10.1 km from the Boracéia region through the east direction.

The importance of coastal areas is known as an important buffer area for marine energy (Garrison, 2016; Castro & Huber, 2012). Therefore, ecological patterns, and processes, such as the extension of the beach area, the diversity of marine organisms, and biogeochemical dynamics, are subject to change due to the compression of the coastal area by real estate development. The fluvial-marine axis of the Itaguapé River, with approximately 2 km, is one of the few coastal aquatic environments in the Bertioga region (São Paulo, Brazil) with the highest degree of conservation, being the main point of shelter and reproduction of several regional species. (www.infraestruturameioambiente.sp.gov.br/fundacaoflorestal/parque-estadual-restinga-de-bertioga/). Most studies conducted in the RBSP or its surroundings are related to floristic composition (Martins et al., 2008; Pinto Sobrinho et al., 2011; Souza et al., 2012) and sedimentary deposition (Guedes et al., 2017). As for the aquatic system, most works focus on the study of the ichthyofauna of the Itatinga River and the Bertioga Channel (Serra et al., 2007; Barbanti et al., 2013), aquatic environments that are located 18.5 km from the mouth of the Itaguapé River. Thus, the scarcity of data regarding studies of aquatic fauna in the region of Itaguapé is notorious.

The existing knowledge gap on the environmental dynamics in the RBSP, in the Itaguapé River and its surroundings are aspects that can facilitate human expansion strategies in the region, especially about the anthropogenic pressure associated with real estate speculation in the area. Thus, this study aims to evaluate the environmental perception of residents and users of the region under the influence of the fluvial-marine axis of the Itaguapé River, based on the understanding of the environmental relationship between man and nature.

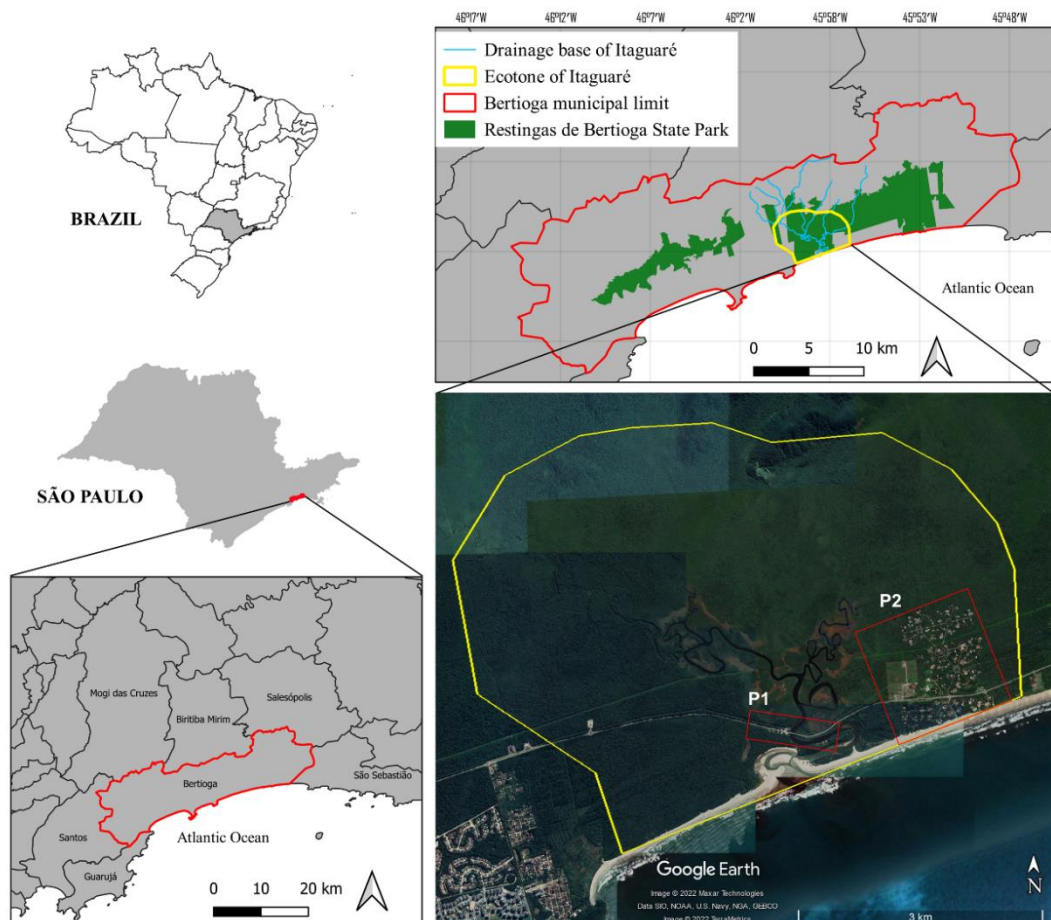
METHODS

Qualitative research has an interpretive approach, with the participation of the researcher in the field to collect empirical data regarding the experiences of the interviewees (Creswell, 2007). Therefore, this is quali-quantitative research, developed with interviews with residents and users of the region of the Restinga de Bertioiga State Park (RBSP).

Study area

The fluvial-marine axis of the Itaguapé River is located inside the Restinga de Bertioiga State Park, in the coastal area of the Baixada Santista, in the São Paulo State, Brazil ($23^{\circ}47'27''\text{S}$, $45^{\circ}59'24''\text{O}$; $23^{\circ}46'23''\text{S}$, $46^{\circ}0'27''\text{O}$; $23^{\circ}44'56''\text{S}$, $46^{\circ}0'15''\text{O}$; $23^{\circ}44'54''\text{S}$, $45^{\circ}57'1''\text{O}$; $23^{\circ}46'24''\text{S}$, $45^{\circ}56'30''\text{O}$) (Figure 1). To consider the inclusion of the main residential condominium (ei: Costa do Sol), the large part of the vegetation, and take into account the Itaguapé river route, a perimeter of 2 Km of the region near the Iguapé estuary was called here as “ecotone” and established as studied area (Figure 1). Maps were made using the free software QGIS, using the projected coordinate system Datum: Sirgas 2000. Information such as water bodies, conservation units, and limits of cities and states, were obtained from the IBGE (2019) (https://geoftp.ibge.gov.br/cartas_e_mapas/bases_cartograficas_continuas/bc250/versao2019/shapefile/).

Figure 1 – Study area in Bertioiga (São Paulo State, Brazil), with identification: Restinga de Bertioiga State Park (RBSP), Itaguapé ecotone, and the interviews areas (P1: near the Itaguapé river; P2: Costa do Sol Residential Condominium)



Assessment of environmental perception

Environmental perception data were obtained from field research with the application of a semi-structured form, which allows an intermediary between the modalities of open interview - where the informant freely approaches the proposed theme and structured - which imply questions previously formulated. The form consisted of 52 questions, 19 open and 33 closed, covering two axes: 1) Characterization of the interviewee with questions about age, gender, education, occupation, and basic characteristics of the building, such as location and type; and, 2) Environmental characterization and perception with questions about the interviewee's knowledge about the RBSP, the importance of the estuary, purposes, and uses of the estuary's water and issues related to regional perception, such as estuary qualities and knowledge about the Riviera de São Lourenço residential condominium.

The interviews were only started after the interviewee agreed to participate in the research via the Free and Informed Consent Term, in which the conditions for voluntary participation in the research, the guarantee of anonymity, and the possibility of the interviewee withdrawing at any stage of the research were presented. Three field interventions were carried out for the interviews, reaching a sample number of 14 interviewees, all over 18 years old. The questions were read orally by the researcher, using a dialogic approach. For the compilation and analysis of the results, the data obtained were grouped based on the respondent's situation and connection with the region, namely: merchant, resident, or sporadic visitor.

RESULTS AND DISCUSSION

Field interventions were carried out in different locations of the Itaguaré ecotone polygon (Figure 1), comprising mainly the surroundings of the Itaguaré River (43%) and the Costa do Sol Residential Condominium (57%). 57% of respondents identified themselves as male and 43% as female. Although the number of users in the region on the dates of the interventions and application of the forms was low, all the individuals approached agreed to participate in the research and demonstrated a close relationship with the region. The profile of the respondents can be seen in Table I. The age group of most respondents was between 51 and 63 years old (43%), followed by 38 to 50 years old (36%), and 27 to 39 years old (21%). Complete Higher Education was the level of education with the highest prevalence (43%), followed by Incomplete Elementary Education (14%). In general, women had a higher level of education than men. Half of the respondents (50%) are residents of the region. Regarding work and leisure activities, women prevailed as seasonal visitors (33%) and men as activities for work purposes (38%).

The profile of the interviewees can provide information about the main relationships between the user and the region. Seasonal visitors, depending on their knowledge of the region's environmental value, will treat the environment in different ways. On the other hand, it is expected that the residents have a greater affective bond with the place, and the employees only as their source of income. When observing the participation of users in other interviews, 67% of respondents had never participated in any type of intervention.

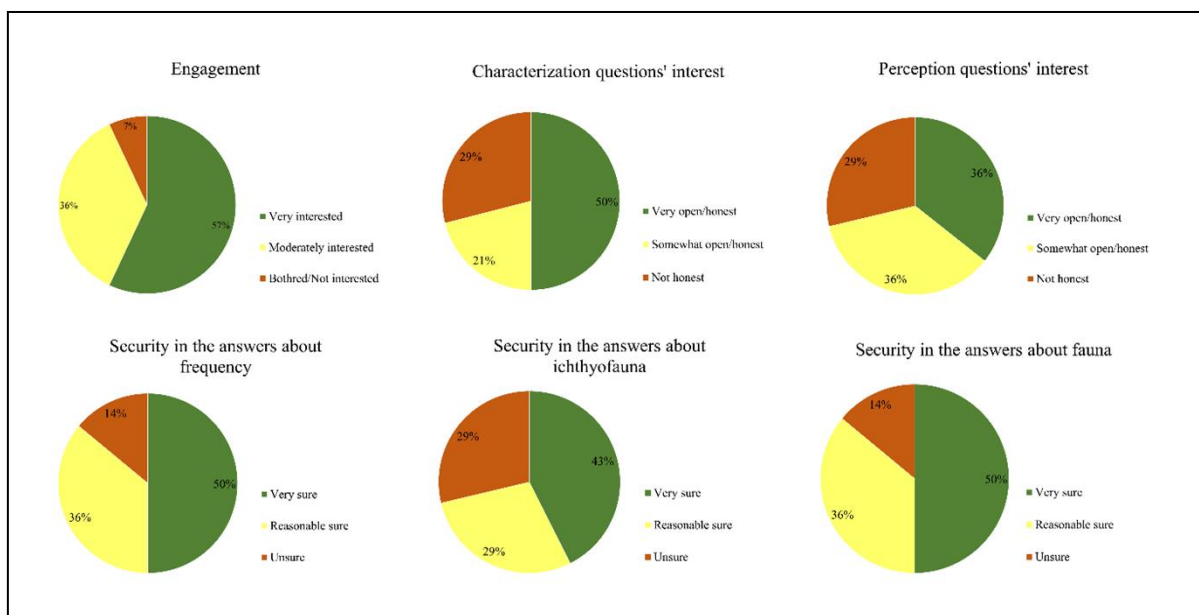
The fact that users and residents of the region have not been interviewed before may be related to the lack of interest in socio-environmental studies and/or survey data from the municipality's own research on the information that is taken to the community.

After carrying out each of the interviews, the researcher filled out an accuracy form, in order to determine the reliability of the responses of each interviewee. Most respondents showed a lot of interest and precision in the answers about environmental characterization, frequency, and sighting of the fauna (Figure 2). However, regarding ichthyofauna, only 43% of respondents showed great certainty in their answers. The similarity in the proportion of accurate and inaccurate respondents (36%) regarding the perception questions may be associated with the age of the respondents since the predominant age group was characterized by individuals over 50 years old.

Table 1 – Profile of interviewees, users of the Restingas de Bertioiga Skate Park (RBSP)

Age group	Men	Women	Total
27-38 years	38%	0%	21%
39-50 years	25%	50%	36%
51-63 years	38%	50%	43%
Education Level			
No schooling	13%	-	7%
Incomplete Elementary School	13%	17%	14%
Complete Primary Education	13%	-	7%
Incomplete High School	-	-	-
Complete High School	13%	-	7%
Incomplete Technician	-	-	-
Complete Technician	13%	-	7%
Incomplete University education	-	-	-
Complete University education	38%	50%	43%
Postgraduate	-	17%	7%
Unknown	-	17%	7%
User characteristics (interviewee)			
Local employee	38%	17%	29%
Resident	50%	50%	50%
Seasonal visitor	13%	33%	21%
Participation in other interviews			
Environmental Importance	0%	14%	7%
Ecotourism	13%	14%	13%
Others	13%	14%	13%
Never participated	75%	57%	67%

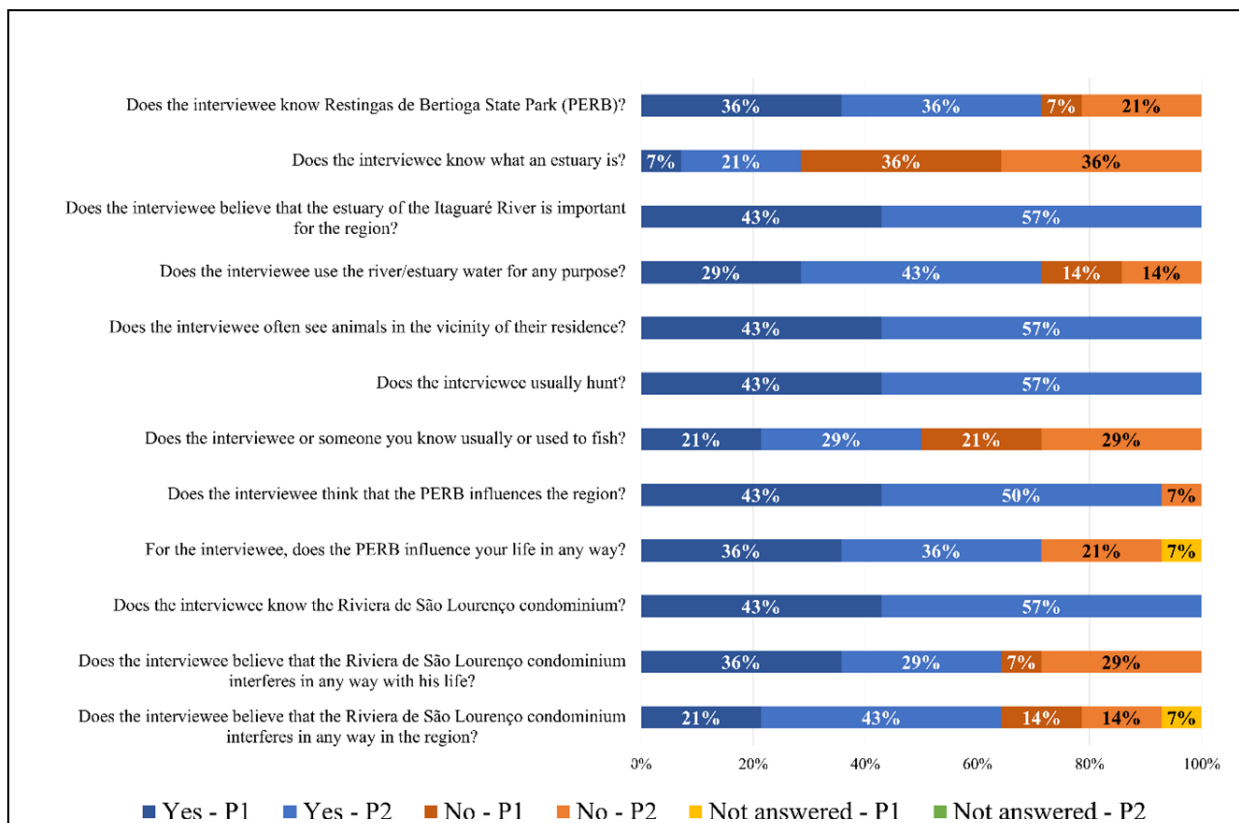
Figure 2 – Confidence of the interviewee's answers



It is noted that despite most respondents (72%) knowing the RBSP and stating that the park influences their lives, this same percentage does not know what an estuary is. Still, 93% of respondents say that the RBSP has a positive influence on the region of Itagaré. As for activities

related to the region, 71% use the water from the river/estuary of Itaguapé for some purpose, and 50% say they usually fish or know someone who fishes in the region. Finally, in relation to the possible impact of the presence of condominiums in the vicinity of the RBSP (ie. Riviera de São Lourenço residential condominium), 64% of the interviewees believe that the development interferes in the region of Itaguapé or in their lives, positively and negatively. These data are presented in Figure 3.

Figure 3 – Answers to closed questions (Yes or no). Data are shown in percentage (%)



In the comparison between the two sampling points, it is evidenced that in the life of the interviewee in the surroundings of the region of Itaguapé (P1) the interference of the Riviera de São Lourenço is greater than in the life of the interviewee in the Costa do Sol residential condominium (P2), 36% and 29%, respectively. However, regarding the interference in the Itaguapé region, resulting from the activities of Riviera de São Lourenço, 43% of respondents in P2 believe in this inference, while 21% of respondents in P1 as well. This change in the predominance of interference at each sampling point may be related to the interviewees who have their source of income in the Itaguapé region. Therefore, they relate the interference of Riviera de São Lourenço in their work but do not associate this interference with the region.

The perception of the faunal diversity of the study region was also considered (Figure 4). In this sense, 100% of respondents reported that they usually see animals in the vicinity of their homes. Despite the diversity of taxon's reported, in general, birds and small rodents were the most recurrent groups, with 31% and 20%, respectively. This high number of individuals sighted demonstrates that the ecotone has a high species richness, which is one of the main reasons for the creation of the Restinga de Bertiooga State Park (Fundação Florestal, 2022). Of the respondents, 72% see animals every day; 14% sight once a week; 7% sight once a year; and 7% did not know how to answer the frequency.

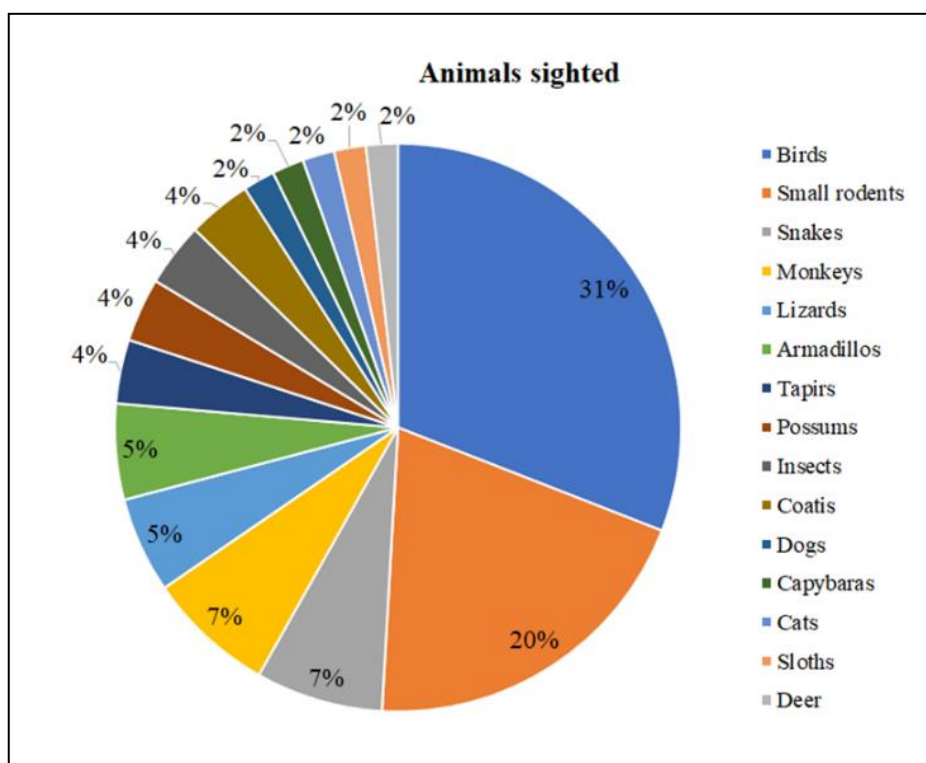


Figure 4 – Main animals seen by interviewed

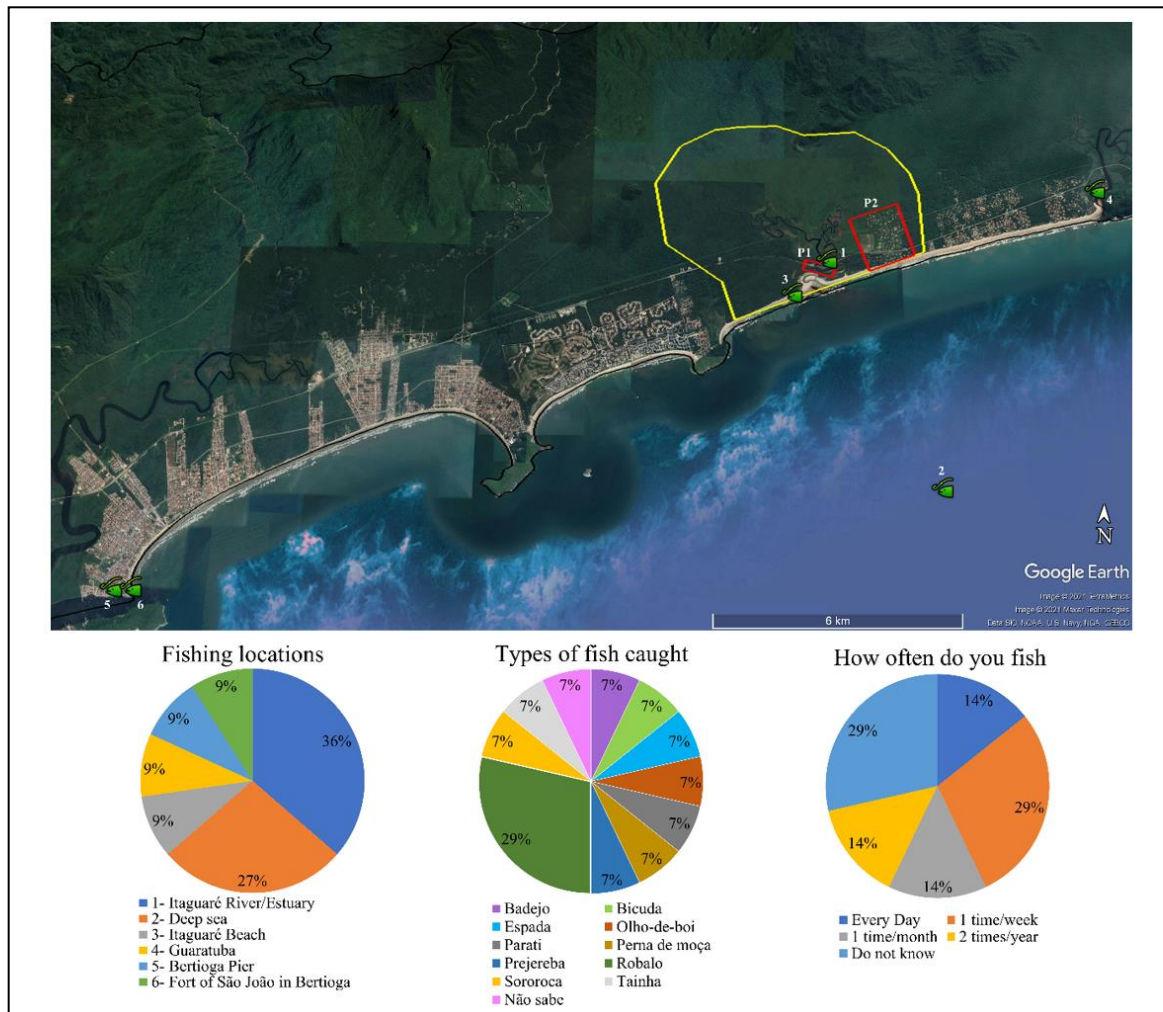
Regarding fishing (Figure 5), the river/estuary of Itaguaré was the most reported place for this activity (36%), followed by deep sea fishing (27%). Although diversity was observed in terms of the types of fish targeted for fishing, Bass proved to be the preferred fish for capture (29%). As for the frequency with which they usually fish, 29% fish once a week. However, another 29% could not inform. The other fishing frequencies appear at the same rate for each, 14%. Despite fishing being carried out in the RBSP area, 86% of respondents stated that the fish consumed by them come from outside the region and only 7% said they consume the fish from the river/estuary of Itaguaré.

Regarding knowledge and the ways in which the RBSP influences the lives of the interviewees, it was observed that, in general, they are associated with preservation (Figure 6). Most respondents (53%) relate the RBSP as a conservation area, 27% have no knowledge of the RBSP, and another 21% are equally divided between the lack of respect that the park has with the local community since they are the main actors in local conservation; the park's goal of preventing subdivisions; and it was mentioned: "heard comments about the park".

When the question is focused on the influence that the RBSP has on the region and the interviewee, the answers remain mostly about preservation. For the region, 62% responded that it influences preservation, 30% were divided in preventing real estate speculation and environmental crimes and the influence on tourism, and 8% that it has a rigorous influence, but does not exemplify this influence. For the life of the interviewee, 36% answered that it influences preservation, 28% were divided between the lack of protection and support and tourism, 7% on the impediment of subdivision, 7% did not know how to answer it and 21% said it did not influence.

In the region of the Itaguaré ecotone is the estuary of Itaguaré. According to Cameron and Pritchard (1963), estuaries are: "Coastal bodies of water with a free connection with the sea, in which river and maritime water meet, forming water called brackish". Knowing about the use of the estuary for bathing and leisure by most users in the region, the question was asked about what an estuary would be for the interviewee. The majority, 71%, did not have any knowledge of an estuary, 14% related it to the "meeting of the waters", 7% to a conservation area, and 7% to a place for animal reproduction. This high lack of knowledge of environmental use reinforces the lack of environmental education in the region in order to raise awareness of the importance of different ecosystems, such as the estuary.

Figure 5 – Fishing sites, types of fish caught and frequency of fishing in the region



For the reasons why the estuary/mouth of Itaguapé is important, 44% related its importance to the preservation, 17% to tourism, 11% to the supply of food, 11% did not know how to answer it, and 18% were equally divided between the supply of oysters (forms applied to local officials), fish nursery and supply of nutrients to aquatic ecosystems.

For the use of the river/estuary of Itaguapé by the interviewees, 43% use the region for bathing and leisure, 21% pack the oysters for local trade, 7% use the water for local sanitation and 29% do not use the region for any purpose. As for the use of water for human consumption, all stated that they do not use water from the river/estuary of Itaguapé.

Regarding the influence of the Riviera de São Lourenço residential condominium on the interviewee's life, 23% say that it influences in a way to degrade the region; 40% are equally divided, with 8% each, between influence on local commerce, job offers, tourism, positive influence (not exemplified) and negative real estate interest; 31% say that the condominium does not influence the region and 8% did not know how to answer it.

In relation to the influence of the Riviera de São Lourenço residential condominium in the region of Itaguapé, 38% affirm that the condominium influences in a way that makes preservation difficult through degradation; 13% say it helps in tourism; 18% are equally divided, with 6% each, in offering a source of income for the community, in benefiting residents and in the impossibility of free access to the beach; 25% say it does not influence; and 6% did not know how to respond it.

Figure 6 – Knowledge about the Restinga de Bertioga State Park (RBSP), the Itaguapé estuary and the importance and influence of the RBSP to the region



After carrying out each of the interviews, the researcher filled out an accuracy form to determine the reliability of the answers given by each interviewee. Most respondents showed great interest and precision in the answers about environmental characterization, frequency, and sighting of the fauna (Figure 6). However, regarding ichthyofauna, only 43% of respondents showed great certainty in their answers. The similarity in the proportion of precise and inaccurate respondents (36%) in terms of perception questions may be associated with the age

of the respondents since the predominant age group was characterized by individuals over 50 years old.

Very close to the Itaguapé estuary, it was possible to interview two residents of the region. These residents reported that the advancement of the Riviera de São Lourenço residential condominium was extremely worrying, as the condominium intended to take possession of the Itaguapé region to privatize it. As the residents did not have the deed to the land, as it was a family heirloom, they felt threatened by the action of the condominium, anticipating that they would soon be evicted. However, an action by the Secretary of the Environment in 2010 officially made the region a Conservation Unit, thus called Restingas de Bertioga State Park. This decision reassured the residents of the region.

Regarding the residents of the Costa do Sol residential condominium, some reported dissatisfaction on the part of the condominium management. The Costa do Sol condominium is located close to the RBSP preservation areas and thus has an internal rule regarding the percentage of area to be built per lot. According to the interviewees, since some residents of the condominium disrespected the rule, the condominium prohibited the suppression of any vegetation, even within the regularized percentage.

From the results obtained, it is noted that the interviewees do not have a clear knowledge of the importance of RBSP for their lives and for the region. For residents, traders, and sporadic visitors to recognize that the RBSP is important for the conservation of species and the estuarine ecosystem, an environmental education action is essential for them to strengthen the feeling of belonging and care for the region, being active actors in the conservation of the region.

Although there is a diversity of scientific work being carried out in the region of the municipality of Bertioga (Silvano et al., 2006; Serra et al., 2007; Martins et al., 2008; Begossi et al., 2011; Barbanti et al., 2013; Cavarzere et al., 2014; Geribello, 2018), there is still a lack of information regarding coastal management and socio-environmental aspects for the Itaguapé region and consequently the Restingas de Bertioga State Park (Decree 56,500/2010).

Finally, since the main purpose of creating State Parks is the preservation and conservation of flora, fauna, and ecosystem functions, in RBSP in addition to these conservations, there was the benefit of riverside residents, who are part of the ecotone, demonstrating that parks can be created so that traditional communities are maintained. Thus, the RBSP fulfills the function of preserving and conserving the region as a Conservation Unit, protecting the fauna and flora. However, it does not provide information regarding the ecology and importance of the region, which makes the community susceptible to underestimating the region. Therefore, projects and awareness campaigns in the region with the scientific community and residents would better convey the importance of the region for the ecosystem and for life.

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