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Landscape ecology and social representations as tools for ecological restoration of *restinga* landscapes

Bruno Borges¹, João Carlos Ferreira de Melo Júnior², Sandra Paschoal Leite de Camargo Guedes², Mariluci Neis Carelli²

¹Secretaria do Meio Ambiente da Prefeitura de São Francisco do Sul, Santa Catarina, Brasil. ²Programa de Pós-graduação Stricto Sensu em Patrimônio Cultural e Sociedade, Universidade da Região de Joinville, Santa Catarina, Brasil. E-mail: joao.melo@univille.br (corresponding author)

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ABSTRACT

Restingas are subjected to several elements of degradation, making their restoration necessary for the continued existence of this ecosystem. The involvement of local communities in restoration processes is extremely important; however, efforts to involve the users of beach environments in their restoration are still incipient. This study aims to evaluate landscape attributes and to understand societal representations of the process of landscape transformation as management tools for the ecological restoration of *restinga* on the beaches of Itaguaçu/Ubatuba, São Francisco do Sul, SC. Interviews were conducted with people between the ages of 18 and 82; residents, or not, of the area; users, or not, of the beaches; and directly, or not, linked, or not, to organizations and institutions that exercise some kind of influence or governance of the beaches. Interviews employed a research form on which were recorded data regarding the identification and description of the interviewee, and answers to questions designed to understand interviewees' representations of the *restinga* and its attributes as a clipping of the coastal landscape. In total, 73 interviews were carried out, which documented the population's general lack of knowledge regarding the *restinga* environment and its ecological importance, as well as their representations of this environment. This study serves to highlight the need for pre-restoration environmental programs with different social actors with an emphasis on education and participation in the management of natural heritage.

Keywords: environmental heritage, natural landscape, landscape ecology, social representation, coastal plain, environmental restoration

Introduction

Of the almost 8,000 km of Brazilian coastline, the 460-km long sandy coastal plain of the state of Santa Catarina is covered, from a few meters above sea level inland for 7 km, by a pioneering vegetation known as *restinga* (Fernandes, 2006).

Restinga has been scientifically characterized by a variety of conceptual interpretations, but biologically it is considered to be a set of physiognomically distinct plant communities under marine and fluvial-marine influence. It is distributed among a mosaic of areas of great ecological diversity that are subjected to extreme environmental conditions (Melo Júnior and Boeger, 2015). From a geological perspective,

restinga are sandy formations comprising parallel corded clusters, such as inlets or angles caused by islands or rocky points, whose origin is directly related to the existence of secondary coastal currents that continuously transport sediment (Bigarella, 2001). From a biological perspective, *restinga* is defined as a set of ecosystems that comprise floristically and physiognomically distinct plant communities located on predominantly sandy quaternary lands of marine, river, lagoon or windy conditions, or combinations of these, usually with poorly developed soils (BRASIL, 1999). Records from over the last 8000 years indicate that human activity has progressed more and more towards the sea, thereby increasingly impacting *restinga* formations. Knowledge regarding the conservation of Brazilian *restinga* is limited (Rocha, 2003);

however, it is known that *restingas* are subjected to several elements of degradation, particularly the removal of vegetation for the construction of roads and sidewalks; destruction by trampling, urban occupation, auto traffic and trash disposal; the establishment of residences, kiosks and parking lots; and the extraction of plants and sand (Rocha, 2003).

Restingas are considered one of the most difficult ecosystems to restore because of the lack of knowledge about the biology and ecophysiology of the species that inhabit them (Rodrigues et al., 2001). Nonetheless, degradation of this ecosystem has made ecological restoration essential for its continued existence (Zamith and Scarano, 2006). On the other hand, efforts of ecological restoration of *restinga*, mainly post-beach formations which are generally the most affected by anthropic activities, involve three relevant premises: A) knowledge of local flora and its community structure; B) ecological knowledge of genetic and functional diversity, and the formation of functional groups in the *restinga*; and C) involvement of the local community in any and all ecological restoration processes. In this way, ecological restoration must be done in harmony with society, landscape ecology, and social representation so that actions are accepted and/or implemented by the population directly linked to these spaces (Metzger, 2001; Moscovici, 2003). Landscape ecology is defined as an interdisciplinary science that considers the interactions between societies and the spaces where they live, whether natural or constructed (Naveh and Lieberman, 1994). The theory of social representation holds that when we know the representation of a certain society, it is possible to better understand the practices they employ regarding an object of interest; in the case of the present study, the object of interest is the *restinga* (Moscovici, 2003).

“Landscape” is defined as everything that our eyes can see, which is interpreted in different ways by different people depending on their social and formative contexts (Santos, 1997). In addition to its visible form, there are also different landscape representations in the memory relations of individuals and societies (Schama, 2009). This extension of the definition of landscape is with the understanding that it is the place in which we are inserted, even prior to it being an object of contemplation and creation (Besse, 2013). This understanding is necessary because we do not fully grasp the concept of landscape when we look at it as if from the outside or distant from ourselves. The

notion of landscape corresponds to involvement in the world. In this construction, the subject is implied in a spatial context, and human imagination circumscribed from referential ideas. Thus, “landscape” is understood to be not just a construction, appearance or aesthetic, but also represents a sense of need to satisfy and share experiences and coexistence with the local and global community surrounding it (Besse, 2013).

According to Pires (2001), there are three conceptual dimensions to the meaning of “landscape”: a) the aesthetic or visual dimension, which considers sensory reaction and human response to the visual expression of a landscape; b) the cultural dimension, which considers the landscape as a resource in the sense of its modification by humans; and c) the ecological dimension, which considers the landscape as a result of a set of interrelationships among a variety of non-human and/or human components.

The coastal landscape of Brazil has experienced continuous anthropic pressure due to the concentration of the development of Brazilian societies in the region (Dean, 1997). In the state of Santa Catarina, systematized mapping of *restinga* vegetation along shoreline areas has been undertaken, and has provided a better understanding of the ecology and biotic elements of the coastal landscape (Korte et al., 2013, Melo Júnior and Boeger, 2015). This information is of particular value for restoration efforts as well as understanding the relationship between environmental and social factors.

However, studies of communities that utilize beach landscapes with the aim of achieving more successful restoration actions by integrating the human dimension are still incipient. According to Dearden (1981), numerous attempts to include communities in landscape restoration research have been very successful in terms of the level of interest, public participation and influence on the final product. From this perspective, understanding societal representations of a natural landscape that will undergo ecological restoration, as well as the perception of the elements that comprise the landscape (Tuan, 2012), can contribute to decision making by environmental managers. Furthermore, this understanding will help direct future implementation of actions for community awareness regarding the conservation of environments, thus contributing to the development of a public policy of shared management of nature (Jodelet, 1989; Ollagnon, 1997).

The present study aims to evaluate societal representations of the process of natural landscape transformation on the beaches of Itaguaçu and Ubatuba located in the coastal municipality of São Francisco do Sul, state of Santa Catarina, Brazil, as a landscape management tool for the ecological restoration of *restinga*.

Material and methods

The study area comprised the beaches of Itaguaçu (26°12'34.95" S, 48°31'31.30" W) and Ubatuba (26°10'45.72"S, 48°31'35.23" W), both located on the east coast of the municipality of São

Francisco do Sul, of the coastal plain of the state of Santa Catarina, Brazil (Figure 1). These areas were chosen because they were targets of a project of the municipal government of São Francisco do Sul to recover degraded areas. Thus, scientific research into social representation, landscape ecology, and the transformation of landscapes can contribute to public policies. These policies can serve an important role in the construction of identities and environmental education programs that sensitize residents and the seasonal population to the importance of the conservation of natural landscapes and, consequently, of the *restinga* environment, as integral parts of environmental patrimony.

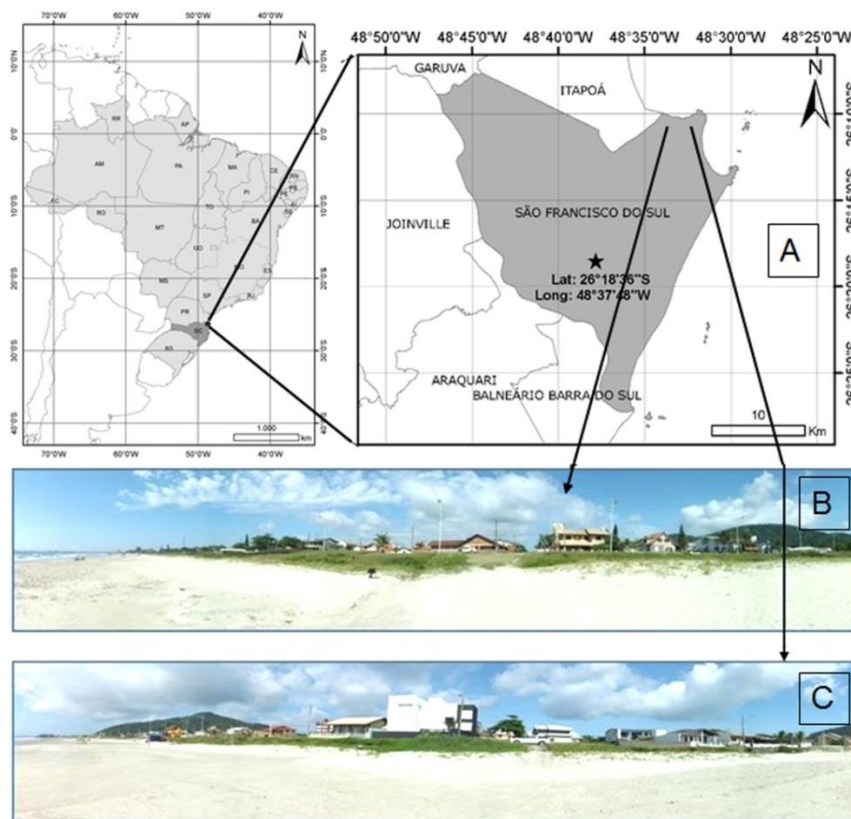


Figure 1. Location of study area. A: municipality of São Francisco do Sul; B: partial view of Ubatuba Beach; C: Partial view of Itaguaçu Beach.

The interdisciplinary nature of the present research incorporated methodologies of landscape ecology and social representation, both in the collection of data and in its interpretation. This was accomplished by using structured interviews with both open and closed questions of public interest. The interviews were performed with standardized forms and took place between December 2014 and June 2015.

The target audience consisted of people between the ages of 18 and 82 years of age who were residing, or not, in the study area; used directly, or not, the studied beaches; and were linked, or not, to organizations or institutions that exercised some kind of influence or governance over the beaches. Given these conditions, individuals of the target audience were categorized as: a) residents; b) vacationers; c) tourists; d) fishermen; e) representatives of

environmental agencies; f) representatives of non-governmental organizations (NGOs); and g) network representatives. For interviews with residents, vacationers, tourists and fishermen, home visits were made. In order to carry out interviews with individuals of environmental organizations, NGOs and network representatives, previously scheduled visits were made to the offices of each. The interview questionnaire requested data regarding the identification of the interviewees and posed questions regarding their perceptions of the *restinga*, and its attributes, as part of the coastal landscape. In addition to the questions directly related to the subject of *restinga*, the respondents were also asked questions regarding their profile, including their

name, age, gender, nationality, naturalness, origin and profession, as well as the frequency of visits they make to the beaches of Itaguaçu and/or Ubatuba.

Evaluation of what the interviewees consider the ideal landscape provides insight into their perception of landscape transformation. This evaluation was made in a comparative context by exhibiting photographs depicting landscapes of *restingas* from other locations in Brazil and other countries (Figure 2). This methodology followed Forman and Godron (1986), who used photographs to document how people perceived a landscape, and Bley (1999), who used photographs in landscape evaluation questionnaires.

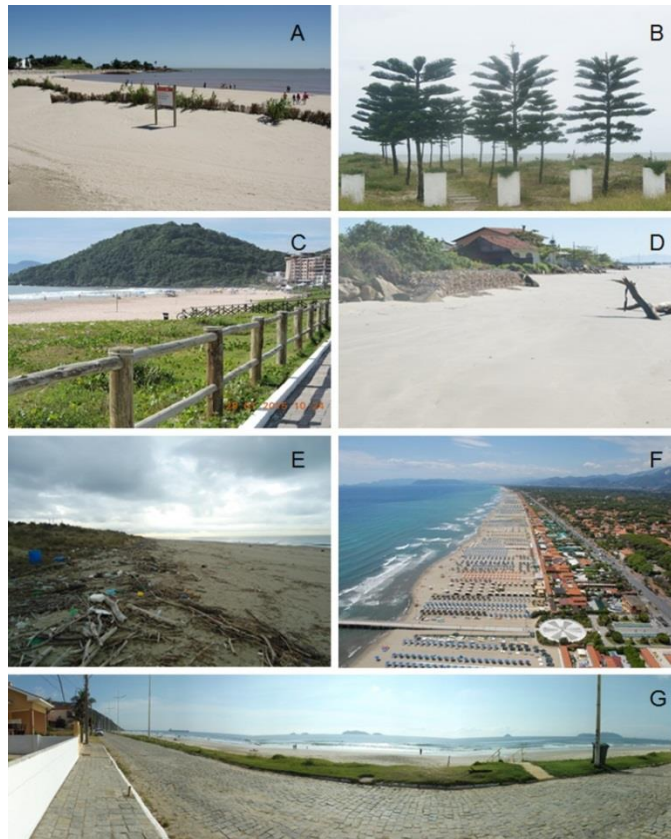


Figure 2. Coastal landscapes used in photographs for the selection of landscape preferences by the interviewees; A: Uruguayan Beach. B: Ervino Beach, San Francisco do Sul, SC. C: Brava Beach, Itajaí, SC. D: Itapoá Beach, SC. E-F: Beaches of the Italian coast. G: Itaguaçu Beach, São Francisco do Sul, SC.

This methodology allowed the interpretation of how the interviewees viewed the ideal place to live or to spend vacations. The photographs selected for the interview were chosen to include landscapes that represented different realities regarding the present state of conservation of *restinga* and the coastal

environment in Brazil and other coastal countries. All photos were developed on A4 matte photo paper, laminated and included with the questionnaire to standardize the presentation of the photographs and eliminate any bias due to their quality. Information regarding locations of the landscapes depicted in the

photographs (city, country) was not revealed during the interview. The resultant data were evaluated qualitatively in order to determine which attributes of the landscape were more significant in assessing the *restinga* environment. Responses given by interviewees were statistically analyzed using a contingency test in the R environment (Bocard et al., 2011).

Results and discussion

Based on the qualitative research principle (Gonçalves et al., 2014), the number of interviews carried out within each group of social actors varied, with a total of 73 forms being applied to residents (20), vacationers (20), tourists (20), fishermen (10), representatives of environmental agencies (1), representatives of NGOs (1) and representatives of educational networks (1). Of this total, 40 interviewees were male and 33 female. Ages ranged from 18 to 82 years, with the majority belonging to the age group of 61 to 70 years (26%), followed by 51 to 60 years (20.5%), 18 to 30 years and 41 to 50 years (19.2% each), 31 to 40 years (8%) and 71 to 82 years (4.1%). Most interviewees were Brazilian (70) and from the states of Pernambuco (1), Paraná (4), Rio de Janeiro (2), Rio Grande do Sul (5), Santa Catarina (54) and São Paulo (3); the others were of Portuguese nationality (3). The Brazilian respondents had fixed residences in the Joinville city (50.7%) and São Francisco do Sul (36.9%), while the others were from the municipalities of Curitiba (9.6%), Blumenau and Jaraguá (1.4% each). Most interviewees had a college education (50.7%), followed by secondary education (21.9%), specialization (13.7%), elementary education (10.9%) and doctoral studies (2.7%). The interviewees visited the studied beaches, in general, only once a year (32.9%). The most frequent lengths of visits were from 5 to 25 days (24.2%), 50 days (6.8%), 100 to 150 days (10.9%) and the entire year (13.7%).

Although the definition of *restinga* has been permeated by expressions that do not fully contemplate the scientific meaning attributed to it as an ecosystem, 68% of the respondents contextualized *restinga* as a vegetation formation associated with the coastal region (Figure 3A). In this sense, respondent category was positively related to knowing the meaning of *restinga*, with the categories residents, fishermen, tourists and vacationers having a greater and positive influence on sampling and differing significantly from the other categories of

respondents ($\chi^2 = 139.83$, 66 , $p < 0.0001$). Profession was also a determining factor for defining *restinga*, with the categories of fishermen and retired being the positively determinants ($\chi^2 = 447.10$, $gl = 341$, $p < 0.0001$). The level of schooling ($\chi^2 = 44.38$, $gl = 44$, $p = 0.45$), age ($\chi^2 = 416.68$, $gl = 418$, $p = 0.50$) and frequency of visits ($\chi^2 = 100.32$, $gl = 99$, $p = 0.44$) were not related to conceptualization of *restinga*. The words or expressions commonly used by the interviewees were similar to those described in environmental laws (CONAMA Resolution 261/1996), indicating an influence of scientific knowledge on the representations that the studied population has of the *restinga*. The same representation, that the *restinga* is a coastal vegetation, can be found when examining just the social group of the inhabitants of these localities.

For 39% of the respondents, the true ecological function of the *restinga* was unknown and was associated with something bad that causes annoyance to people. Only 1% of the respondents associated the *restinga* with the idea of ecosystem equilibrium (Figure 3B). Answers related to the ecological function of the *restinga* are quite different from those advocated by legal documents (BRASIL, 2012), which highlight the *restinga* as a dune-fixing vegetation or stabilizer of mangroves, plus playing an important role in maintaining the coastline in face of impacts from the sea and erosion. These answers provoke a consideration of the context that leads beach goers to treat the *restinga* as a "nuisance." What prevents harmonious coexistence between human populations and the environment? One answer may be related to recent interventions on the beaches of Ubatuba and Itaguaçu that sought to restore altered areas of *restinga*. These interventions, which were decisions made by the Federal Public Ministry, removed banks, trees and other structures that impeded the natural development of the *restinga* with the aim of restoring the ecosystem. According to a newspaper article, "A Notícia" (Prefeitura..., 2016), many changes that had been made to the environment were originally promoted by the residents, and their withdrawal during the restoration process resulted in some dissatisfaction and disapproval on their part. It seems likely that these actions contributed to the negative representations of the *restinga* found in this study.

A strong influence of the level of schooling was found, with emphasis on undergraduate training ($\chi^2 = 64.46$, $gl = 40$, $p = 0.008$), age of 40-60 years ($\chi^2 = 489$ ($X^2 = 152.46$, $gl = 90$, $p < 0.0001$)) frequency of visits with an average time of at least 1

week ($\chi^2 = 152.46$, $gl = 90$, $p < 0.0001$) and knowledge of the ecological function of the *restinga*. The opposite was found for interviewee category ($\chi^2 = 44.65$, $gl = 54$, $p = 0.8$) and profession ($\chi^2 = 311.49$, $gl = 310$, $p = 0.46$). These findings show that

although people know the meaning of *restinga*, they do not know its ecological functions, such as preventing the advancement of the sea towards streets and buildings, and serious erosion on the coast.

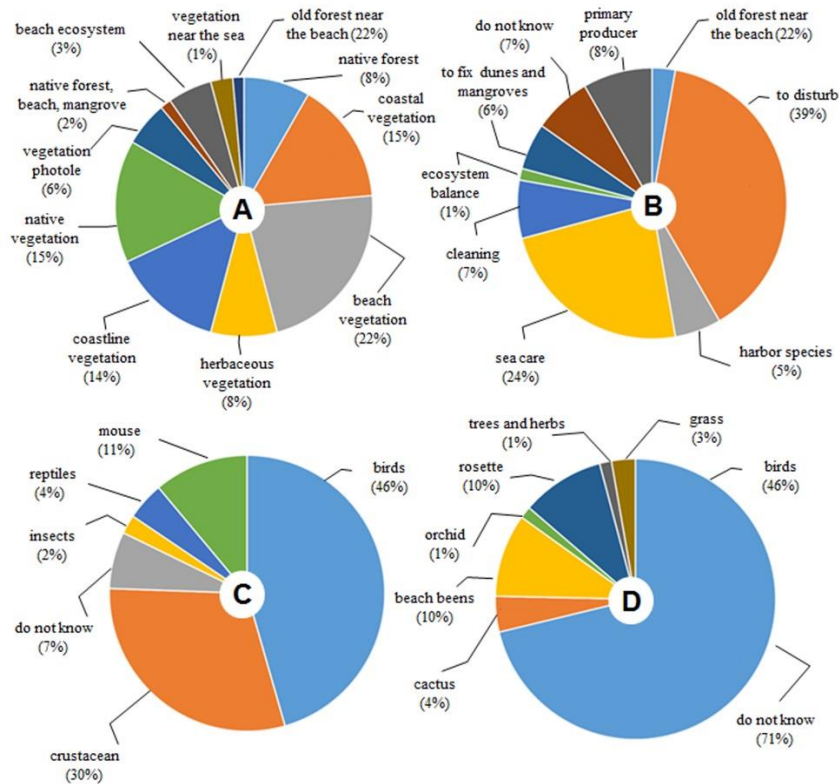


Figure 3. Distribution of respondents' answers to questions evaluating the environmental landscape of *restinga* of the beaches of Ubatuba and Itaguaçu, São Francisco do Sul, Santa Catarina, Brazil. Caption: A: definition of *restinga*; B: ecological function of the *restinga*; C: knowledge about the fauna existing in the *restinga* environment; and D: knowledge about the flora of the *restinga* environment.

From a statistical point of view, with the exception of people with a higher level of schooling ($\chi^2 = 59.59$, $gl = 32$, $p = 0.002$), *restinga* biodiversity is practically unknown, even when considering the category of respondents ($\chi^2 = 49.34$, $gl = 48$, $p = 0.41$). Regarding the fauna that inhabits the *restinga* environment, the most commonly cited group was birds (46%), followed by crustaceans (30%). Among birds, the citation of owls indicates a certain familiarity of the community with the environment of *restinga*, since the buraqueira owl is considered a flagship species of the *restinga* fauna. The mention of the presence of rats in the *restinga* (11%) is indicative of the degradation of this environment (Figure 3C), which is linked to the presence of trash, animals that transmit diseases that affect human

health and the abandonment of the site. The connection between the presence of rats and the *restinga* may be another factor that has helped to construct negative representations of the *restinga* and that it brings "nuisance" (Figure 3B). Again, the local context must be known to understand the origin of social representations.

Regarding knowledge of *restinga* vegetation, 71% of respondents did not know any species of vegetation in this environment, which further reinforces the population's lack of knowledge about this environment and its biodiversity. Only 20% of the responses indicated the presence of plants such as the rosette (*Acicarpha bonariensis* - Calyceraceae) and beach bean (*Canavalia rosea* - Fabaceae) (Figure 3D).

According to the Brazilian psychologist Spink (1993), representations are not only reproductions, but appropriations that generate new signs and symbolic elements and are reinterpreted by different social groups depending on the information they have access to, including scientific results transmitted by the media, schooling or even by word of mouth that often modifies the original information. Spink (1993) showed the importance of the media and science in the construction of representations, a fact that, compared to the results of the research in question, indicates the need for greater investment in education and sharing of information with the population directly involved with an ecosystem in order to instill a greater appreciation of the importance of the maintenance of ecological balance to the quality of life of this same population.

The ideal, and most chosen coastal landscape, was Brava/Itajaí Beach, with 45% of the responses. The least chosen landscape was the Italian beach, with 1% of the responses (Figure 4A). The answers given by the interviewees differed statistically, with the choice of the ideal *restinga* landscape being significant for people with a higher level of schooling ($\chi^2 = 47.97$, $gl = 24$, $p = 0.002$), age of 40-60 ($\chi^2 = 272.16$, $gl = 228$, $p = 0.02$), profession, with emphasis on fishermen and retirees ($\chi^2 = 244.92$, $gl = 186$, $p = 0.002$), and visit frequency ($\chi^2 = 115.37$, $gl = 54$, $p < 0.0001$), but did not differ among the categories of respondents ($\chi^2 = 21.96$, $gl = 36$, $p = 0.9$). It is important to emphasize that the photograph that represents Brava Beach is highlighted by a strip of beach with a boardwalk and wooden structures that prevent access to the *restinga*.

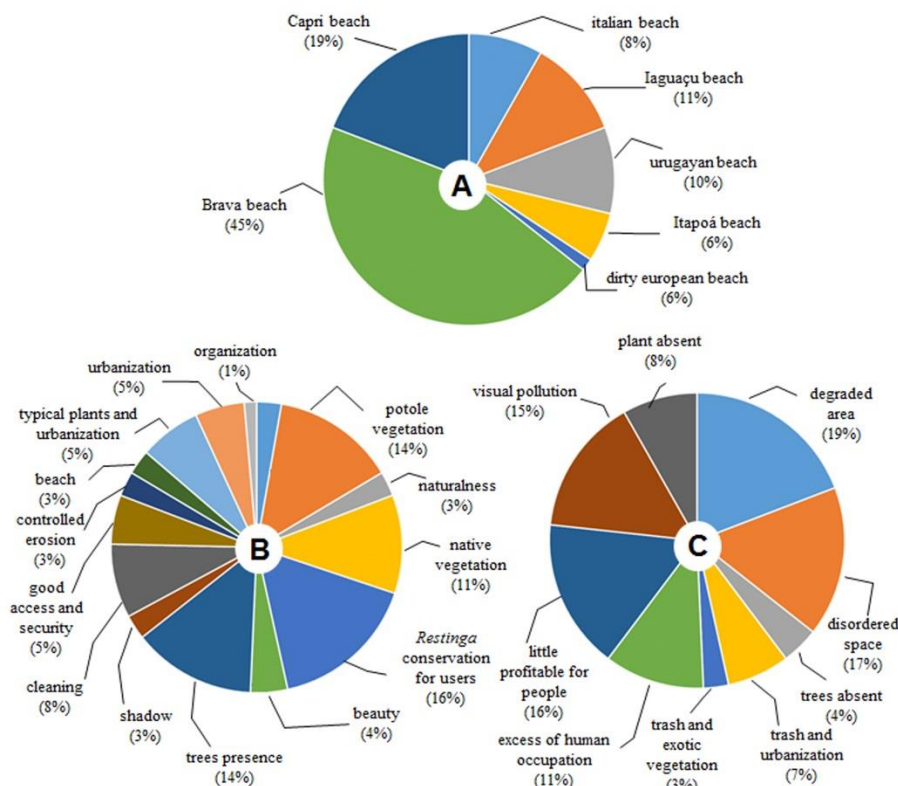


Figure 4. Distribution of the respondents' answers to questions evaluating the environmental landscape of *restinga* of the beaches of Ubatuba and Itaguapé, São Francisco do Sul, Santa Catarina, Brazil. Caption: A: ideal coastal landscape; B: positive attributes leading to the choice of the ideal coastal landscape; C: negative attributes that prevented the choice of other coastal landscapes as ideal.

The conception that justified the choice of this landscape is tied to the idea of a preserved ecosystem that does not exclude the community from the environment. On the other hand, the landscape of the Italian beach was identified as polluted, due to the presence of garbage, and used little by the

community, giving it an air of abandonment. Again, the trash situation is related to what one wants removed without, however, a critical view of who is polluting these places.

The identification of positive or negative attributes of the *restinga* landscape did not differ

statistically among the categories of respondents ($\chi^2 = 47.73$, $gl = 48$, $p = 0.48$). The most cited positive attributes for choosing coastal landscapes were conservation of the *restinga* with structure for the visitors (16%), followed by the presence of native plants and trees, both with 14% of the responses (Figure 4B). Among the negative attributes that culminated in the disapproval of other landscapes portrayed by the photographs, the most cited were signs of beach degradation, with 19% of responses, followed by disorderly occupation (17%), little use by people (16%), visual pollution (15%), excess human occupation (11%) and lack of vegetation (8%) (Figure 4C).

According to Dearden (1981), Fines was one of the first scholars to undertake systematic studies of visual evaluation of landscapes using photographic representations. The use of photographs allows the description of preferences for the real landscapes they represent (Gonzales-Bernaldez, 1981). In addition, Lucas (1990) argues that there is some difficulty in comparing the quality of landscapes, since the analysis occurs through observation and individual judgment. From this perspective, Jordana (1992) assumes that the task of valuing a landscape is not easy, since it is a consequence of the relationship between visual space and the observer. Cosgrove (2004) points out that landscapes have symbolic meanings because they are products of the appropriation and transformation of the environment by man, and the researcher has the task of exercising "imaginative ability" and reflecting on the uses and meanings that are been attributed to landscapes.

In order to evaluate a landscape it is necessary to combine plastic and emotional factors with the representations that society has about that landscape. This establishes a triad-interpretation involving the intrinsic quality of the landscape, the aesthetic response that the landscape produces in a person and, finally, the assignment of a value (Escribano et al., 1989). Jordana (1992) states that the relationship becomes behavioral on the part of the observer when it triggers a perceptual response, the elements of the landscape producing a sensitive response and the triggering stimuli of this response can be interpreted. He also states that landscape perception, based on stimuli received from the environment, is a creative act, conditioned to emotional, affective and sensory factors inherent to the individual, as well as educational and cultural factors. This observation by Jordana (1992) is in keeping with Moscovici's (2003) statements that

representations are social products and, therefore, constructed historically, from experiences and social relationships of the different groups that make up the society. Cauquelin (2007) corroborates Moscovici's view when he mentions that culture conditions the perception of reality, and that the same is true with the landscape; there is a feeling of satisfaction conferred upon it when observing a painting or image of nature, "it is adequacy cultural model to the singular content that is presented here"(p.119). This means that observers believe they "see" what they expect from a natural landscape. Following this view, it can be affirmed that the visual evaluation of an image of a landscape reflects the representation of one's own culture, the pleasure and the satisfaction of the landscape comes, therefore, from that cultural bond, which provides satisfaction in the contemplation of a landscape of which it is a part, or it can generate deception in the case of observing a modified landscape.

As Menezes (2002) teaches us, landscapes themselves are "dynamic" and also socially constructed, as is the landscape of the *restinga* of the beaches of Ubatuba and Itaguaçu in São Francisco do Sul, SC. In addition to the utopian thought that the processes of restoration of natural landscapes will be able to create a condition identical to its original state, the main factor to be considered in a proposal of ecological restoration is human assistance to nature by means of techniques that help aid its resilience and continuity of ecosystem services (Reis, 2003) and its sociocultural and aesthetic functions.

From this perspective, environmental management deals with an action taken by a public power aiming to apply national environmental policy, under the assumption that natural landscapes are a collective patrimony and must be seen through the prism of the collective "own", taking into account the different social segments that influence, directly or indirectly, the conservation of that good (Moraes, 1997). Environmental management implies the participation of different types of managers and the development of a new management proposal, as foreseen by the Brazilian Cultural Landscape Scenario, which proposes a shared management that may involve initiatives of public power, civil society and private partnership (Ordinance 127, of 04/30/2009 - IPHAN). Applying this assumption to the *restinga* environment discussed here, it is possible to say that actions should be directed towards a common purpose, be it the recovery and conservation of the coastal landscape of the *restinga*

and its biodiversity, or the preservation of the cultural and aesthetic values associated with it (Ollagnon, 1997). Another problem facing environmental managers is what strategies to adopt for the preservation of this landscape (Ribeiro, 2007).

The environmental patrimony of the *restinga* constitutes landscapes that integrate humankind and the ecosystem, considering the transformations and the meanings that are imbricated in them (Worster, 2003). One must consider that it is remarkable that a landscape is not immutable, but in constant transformation (Menezes, 2002). It is necessary to remember that the processes of preservation can not be sacralized, independent of the contingencies of sociocultural life (Menezes, 2002). There are imbricated relationships between nature, time and cultures.

Thus, in harmony with the other members of society, the managers of the environmental quality of a space must become actors in this process, having the important role of coordinating management and conservation of the *restinga* environment and all other natural or cultural components linked to it. Management actions should be linked to the daily activities of each segment of society, thereby getting them to commit as co-responsible entities, through raising awareness and education about heritage, with the integral conservation of the coastal landscape and its attributes. Nonetheless, the creation of such a system aimed at the collective management of the environmental heritage of the *restinga* must be mediated by deep social changes that permeate the bias of people's awareness, which implies the implementation of educational actions, for both the medium and long term, applicable to all social segments.

In this sense, the social psychologist Jodelet (1993) defends the importance of knowledge of social representations for the definition of efficient public policies, because only then it becomes possible to establish a feeling of belonging, which thereby facilitates the effective participation of individuals. Jodelet (1993) provides reasons to believe that by knowing the representations that society possesses about the *restinga*, we can collaborate in the development of education actions and public policies aimed at the preservation of this patrimony.

Conclusion

The present study showed more comprehensive conceptions about *restinga* landscape

and its ecological and cultural importance are positively related to people living in the surrounding environment or those with higher education. The relations of belonging of fixed dwellers and fishermen seem to be important links between landscape and conservation, although the landscape that integrates nature and improvements that benefit people is most pleases people in general. Processes of recognition of people's perceptions about landscapes are fundamental to initiate actions that cause any change in these spaces.

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