

DOI: <http://dx.doi.org/10.7784/rbtur.v11i2.1237>

## Systemic study of the landscape in the tourism enterprise “Ilha de Porto Belo” in Santa Catarina, Brazil, from a sustainability perspective

Estudo sistêmico da paisagem no empreendimento turístico “Ilha de  
Porto Belo” em Santa Catarina, Brasil, na perspectiva de sua  
sustentabilidade

Estudio sistémico del paisaje en el emprendimiento turístico “Isla de  
Porto Belo” en Santa Catarina, Brasil, desde el punto de vista de su  
sostenibilidad

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**Abstract:** This study **aims** to analyze the natural environmental of the island of Porto Belo, in Santa Catarina, and its relationship with the tourism complex in the island. We **expect** to make a methodological and empirical contribution to research on tourism sustainability, as the findings suggest a relationship between the ecosystem and the processes related to the attractions of the destination. This is a descriptive study, using both qualitative and quantitative **methodology**, based on a systemic approach. The technical procedures were divided into three stages: literature, documentary, and field survey; mapping and crossing; summary and results. The Geographic Information System (GIS) was the instrument used in the identification, sizing and systemic analysis of landscape units of the island. The **originality** of this study lies in ranking the natural and social environment systems from the mapping of the stability of landscape units, as well as in the identification of spaces and infrastructures that can be requalified in order to improve the services on the island. This **result** and the discussion of its contribution

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Paper received in: 05/10/2016. Paper approved in: 17/03/2017.



to the sustainable management of leisure and recreation activities on the island are original contributions to the state-of-the art to tourism research Brazil.

**Keywords:** *Tourism. Sustainability. Geographic Information Systems (GIS). Landscape Units. Ilha de Porto Belo-SC.*

**Resumo:** O estudo teve como **objetivo** analisar os aspectos naturais da Ilha de Porto Belo em Santa Catarina, bem como sua relação com os atrativos do complexo turístico nela implantado. A **justificativa** aponta para a expectativa de uma contribuição metodológica e empírica, com a revelação das relações entre os recursos ecossistêmicos e os processos relacionados aos atrativos deste destino, sob o paradigma da sustentabilidade do turismo. No tocante à **metodologia**, a pesquisa foi do tipo descritiva, de caráter quali-quantitativo e amparada no método sistêmico de abordagem. Os procedimentos técnicos foram distribuídos em três etapas: levantamento de dados bibliográficos, documentais e de campo; mapeamento e cruzamento; síntese e resultado. O Sistema de Informação Geográfica (SIG) foi a ferramenta utilizada na identificação, dimensionamento e análise sistêmica das unidades da paisagem na ilha. A **originalidade** dos resultados consiste na hierarquização do sistema natural e social do ambiente a partir do mapeamento da estabilidade das unidades da paisagem, bem como na indicação dos espaços e infraestruturas que podem ser requalificadas para aprimorar os serviços na ilha. Este **resultado** agregado à discussão sobre o seu efeito prático para a gestão sustentável dos espaços de lazer e das atividades de recreação na Ilha, mostra-se original e contributivo, diante do estado da arte da produção científica do turismo no país.

**Palavras-chave:** Turismo. Sustentabilidade. Sistemas de Informações Geográficas (SIG). Unidades da Paisagem. Ilha de Porto Belo-SC.

**Resumen:** El **objetivo** del estudio fue analizar los aspectos naturales de la isla de Porto Belo en Santa Catarina, así como su relación con el complejo de los atractivos turísticos implantados en ella. La **justificación** apunta a la expectativa de un aporte metodológico y empírico para la revelación de las relaciones entre los recursos de los ecosistemas y los procesos relacionados con los atractivos de este destino, bajo el paradigma de la sostenibilidad del turismo. En cuanto a la **metodología**, la investigación fue descriptiva, con el enfoque cualitativo y cuantitativo y apoyada en el método sistémico de explicación. Los procedimientos técnicos se dividieron en tres etapas: recolección de datos bibliográficos, documentales y de campo; cartografía del campo y cruce de los datos; síntesis y resultado. El Sistema de Información Geográfica (GIS) fue la herramienta utilizada en la identificación, dimensión y análisis sistémico de las unidades de paisaje de la isla. La **originalidad** de los resultados se encuentra en la jerarquía del sistema natural y social del ambiente, hecha desde el mapeo de la estabilidad de las unidades de paisaje; así como en la indicación de los espacios de ocio y de las infraestructuras, que pueden ser recalificados para mejorar los servicios en la isla. Este **resultado**, agregado a la discusión de su efecto útil para la gestión sostenible de los espacios de ocio y las actividades recreativas de la isla, parece ser original y contributivo delante de la situación de la producción científica del turismo en el país.

**Palabras clave:** Turismo. Sostenibilidad. Sistemas de Informaciones Geográficas (SIG). Unidades de Paisaje. Isla de Porto Belo-SC.

## 1 INTRODUCTION

In the State of Santa Catarina (SC), Brazil, the coastal trail attracts an increasing flow of tourists due to the beach scenery and the concentration of tourism services.

With a coastline of 561.4 kilometers,

Santa Catarina is a national and regional destination for summer vacation. It presents suitable conditions for localities to develop their potential through initiatives aimed at the implementation and consolidation of tourism activities. In recent decades, tourism development on the North Coast, driven by

Balneário Camboriú, has shown a dynamism that produced changes and impacts on the neighboring resorts, e.g. Porto Belo.

Coastal tourism is based on a unique combination of land and sea resources, such as water, beaches, land and marine biodiversity, in addition to a rich cultural and historical heritage, good food, and basic tourism infrastructure.

On the other hand, coastal areas are sensitive environments that face various anthropogenic pressures due to the variety of economic and tourist activities. They require planning to ensure the sustainability of their ecosystem goods and services (Alister, 1982; Santos, Melo & Brito, 2013). In particular, the vulnerability of the islands stems from their characteristics such as a small area, which is a social, economic, and environmental limiting factor (Carvalho; Decol; Gil; Lanzer, 2016).

According to Ruschmann (2009), nature is the only component of the tourism product that cannot be enlarged and it is the building block of the very existence, attractiveness, and highlight of tourism. In this sense, more planning is needed to minimize the negative impacts of economic development. Silva and Cândido (2016) consider that tourism is an economic activity with potential for local development, being necessary to think about the environmental, social, economic, and cultural impacts in order to comply with the principles of sustainability.

Regarding the object of this study, in the high season of 1996-1997, the tourism infrastructures were inaugurated in João da Cunha Island. Known as Island of Porto Belo,

it is located off the coast of the municipality of the same name. The tourism complex motivated the creation of a multidisciplinary team made up of professors and academics of the degree course and the master program in tourism and hospitality of the University of Vale do Itajaí, SC, Brazil, to study the visits to the island, assess the environmental impacts and define its load capacity.

Therefore, as referred by Ruschmann, Rosa and Weidgenant (2010, p. 813), the Porto Belo enterprise was based on sustainable tourism, preserving nature, coordinating the construction of facilities and controlling the tourism flow. In the same line of thought, Oliveira et al. (2016), state that in tourism and hospitality, sustainability must be the goal of the management team, incorporating natural elements relating to the place wherein the enterprise is located, providing greater durability, and lower cost, often being a decisive factor in the choice for a certain resort.

Since then, throughout the following seasons the studies were replicated contributing to further theoretical knowledge and providing tourism managers in the island with useful information. More recently, this line of academic research has broadened the approach. Hence, this study aims to analyze the natural aspects and their relationship with the tourism-recreational attraction in the Island of Porto Belo, drawing on the systemic study of the landscape units. To that end, the work identifies, sizes, and analyzes from a systemic perspective the landscape units of the island through a geographic information system (GIS) in order to understand the tourism and environmental

processes, allowing for the identification of the spaces, infrastructure, and services which may be enhanced, thus consolidating tourism sustainability.

The research has bias, particularly methodological, supported by the systemic approach. It emphasizes the design and the application of qualitative and quantitative procedures, whose results are the mapping of the stability of the landscape units. Therefore, the discussion is on the practical implications of the generation and availability of this information to the sustainable management of recreation spaces and activities in the island.

This study falls within the scope of a wider research project entitled: **"The Island of Porto Belo, SC as a Management Model for Tourism- Recreation Use for Environmental Sustainability of Island Destinations in Brazil"** approved and funded by the **National Council for Scientific and Technological Development - CPNq**, through the Public Call MCTI/CNPq No. 14/2013.

Next, we present the theoretical framework, the methodology, the results and discussion, and we conclude the paper with final considerations.

## 2 THEORETICAL FRAMEWORK

### 2.1 Environmental sustainability of coastal tourism

Tourism planning consists of organizing the human action on the territory and it entails the regulation of construction of structures and facilities, in order to avoid the negative effects that destroy the resources or

reduce their attractiveness (Ruschmann, 2009). Thus, it is possible to manage tourism development reducing the negative impacts and enhancing the positive ones (Cooper, 2001). According to Costa and Miranda (2016), tourism planning is important to minimize the damages caused to destinations.

From this perspective, despite the trivialization and general appropriation by many public and private agents of society, the paradigm of sustainability is still the universal theoretical and empirical framework for the relationship between the systemic analysis method and the object of this study. The small Island of Porto Belo has been experiencing, for almost 20 years, a successful tourism-recreational use of its natural spaces

Buckley (2012) considers that sustainability is as important as it is difficult to achieve, for both tourism and any other economic sector. Torres-Delgado and Palomeque (2012) reflect on the inaccurate nature of sustainability, which favors the rhetorical use and the multiple interpretations, which lead to different applications and purposes. Jovicic (2014) considers that the widespread use of the term "sustainable tourism" generates controversy as to its interpretation and practical implementation of the concept. In addition, the satisfaction of all stakeholders is a key issue, but difficult to reach. In the same way, Ruhanen (2008) refers the difference between theory and practice, easily turned into propaganda despite the challenge of its practical process, which in the observation of Bramwell (2015) makes sustainable tourism

object of criticism regarding its application and effectiveness.

In this sense, Jiménez and Nechar (2014) observe that it is not an easy task to combine all the elements of a tourism operation within a sustainable framework. To that end, it is necessary that the concepts and methodologies of sustainability are clear.

Despite the limitations, sustainability is widely considered as a required feature of contemporary tourism and it should be taken into account as a key factor in any initiative affecting tourism (Torres-Delgado & Palomeque, 2012). However, the fact that it is possible to develop small-scale tourism and at the same time viable to the destination, as in the case of the object of this study, the Island of Porto Belo, in the State of Santa Catarina, Brazil, is backed by the main global governance body of tourism, which is the World Tourism Organization (UNWTO). The activities of the UNWTO since the 1990s, and especially as of the 2000s, have resulted in the dissemination of important reference documents, with empirical basis for the sustainability of tourism.

Thus, we can point out the guidelines of sustainable development for tourism destinations (UNWTO, 2004), focused on the use of indicators as a tool to assist destination and company managers in the planning and management of tourism. From a total of 18 types of destinations, just for beach destinations, there are approximately 50 sustainability indicators. Along the same line, the Global Sustainable Council Tourism Criteria for Destinations (GSTC, 2008), a world council that creates and administers

global sustainability standards, has established 41 criteria, and their respective indicators, divided into four main topics related to culture, environment, economy, and management of the destination.

Both the UNWTO and the GSTC refer that given the differences and specificities of each destination, there must be an adjustment and selection of the criteria/indicators to be effectively used for the planning and management of tourism from a sustainability perspective. Anyway, this is a concern that dates back to 1990, when Butler (1991), presented sustainability indicators for the tourism sector.

Despite this institutional effort toward a sustainable management and its implementation in some tourism destinations, Buckley (2012) considers that tourism, as any other economic sector as a whole, is far from being completely sustainable. Except for some particular companies, tourism activities are mainly focused on economic aspects, while the environmental and social aspects just comply with legal and political requirements or follow marketing and public relations strategies.

Within the scope of governance, the United Nations Environment Programme (UNEP) together with the UNWTO published guidelines for Governments or public agents to adopt effective approaches and to draw strategies and policies toward a more sustainable tourism (WTO, 2005). Regarding the relationship between sustainability and tourism standards and quality systems currently in America has been the focus of other UNWTO publication (WTO, 2010).

Another document by this organization (WTO, 2013a), examines the situation of tourism in small island developing states and offers guidelines to tourism agents regarding a sustainable management of tourism to the benefit of their people.

Coastal tourism management was the object of another recent study by the UNWTO (WTO, 2013b). The document identifies and evaluates the political instruments that influence tourism sustainability in these areas seeking, among other objectives, the conservation of biodiversity and the well-being of local communities. Finally, there are also global standards (WTO, 2007; 2011) on purely managerial aspects, professionalism, and quality at the destination, in organizations and in the tourism product. Other international organizations, academic institutions, Governments and private companies, according to Blancas et al. (2010), have been trying to define indicators systems in order to assess the effectiveness of sustainable tourism in different destinations. While global organizations set goals in terms of sustainable tourism development, other entities put forward projects to this end. In this sense, Williams and Ponsford (2009) verify that regulatory agencies deal with many factors when they put forward guidelines for best practices in environmental management. For example, the uncertainty of how these guidelines will be received by tourism suppliers and their customers; Governments' reluctance on imposing new regulations on tourism companies that may discourage these from keeping generating tax revenues; the adoption of sustainable

practices is slow due to the lack of leadership and shared responsibilities among tourism agents. However, Rosa and Silva (2017) emphasize that sustainability, particularly in the environmental dimension, is a relevant and current topic, as referred by studies both in the organizational, and in the economic and political spheres.

According to Pearce (2016), in order to ensure that tourism destinations are sustainable and competitive, we have to identify, both in practice and in scientific research, the variety of management models for tourism destinations. In this way, it is essential to recognize this diversity, since no model is complete, and each has its strengths and limitations.

## **2.2 The qualification of destinations and the systemic approach to landscape**

Tourists while consumers can have a significant power in the design of “green” products, leading tourism operators to satisfy an emerging environmental awareness. The long-term balance between the proper use or overuse of environmental resources of a destination and the maintenance of their attractiveness to the demand is a key issue (Williams & Ponsford, 2009).

Tourism must maintain a high level of Satisfaction and ensure a meaningful experience for tourists who want to find clean environments, attractive natural resources, and welcoming people in the destinations, among other motivations (WTO, 2003). Therefore, the concern with the quality of the destination is essential for tourism success, as visitors' emotions are inextricably related to

satisfaction and overcoming of their expectations (Ruschmann, Rosa & Weidgenant, 2008). According to Boullón (2002), the image of a tourism destination must take into account the activity program and the quality of the attraction, natural or urban. This image is a key aspect for the success of a tourism destination (Sancho, 2001).

From a marketing perspective of tourism development sustainability, according to Moraes (2012, p. 284), only the destinations capable of offering comparative advantages stand out. These advantages are the unique features of destinations that, in the case of the Island of Porto Belo, are the remarkable level of natural integrity of the territory. Its competitive advantages consist of the way that the original features are used in order to offer a unique tourism experience to visitors. For PNUMA and OMT (2006), much of the tourism sector is dependent on intact and clean environments, natural resources, cultural and historical authentic traditions, and welcoming people in the destinations, which is what visitors seek.

Therefore, planning for the qualification of tourist resorts in natural environments should consider the infrastructure, equipment and services offered to the tourist (Ribeiro & Stigliano, 2010). It is important to understand the environment and the processes occurring in tourism spaces from a systemic perspective, to the extent that the image of these environments is conditioned by the relationship between nature and society.

Systemic approach is linked to the notion of various elements in permanent

interaction, whose behavior is not linear (Bertalanffy, 2009). We are forced to deal with complex, with 'wholes' or 'systems' in all fields of knowledge. Capra (1992) corroborates the importance of systemic perspective in various scientific fields, stating that the linear models are not sufficient.

The interpretation of environmental behavior from a systemic view admits that the whole is not the sum of its parts, but it is made up of complex processes involving both the understanding of the organization (structure), and the operation (process) of the object of study (Drack & Bertalanffy, 2008).

Based on the systemic approach, the comprehension of the environment can come from the landscape, as a key concept, an instrument of integration of natural and social aspects. The landscape can be defined as a spatial unit perceived or felt, resulting from the heterogeneous combination of biotic, abiotic, and socio-economic elements in different space-temporal scales. It is a study of the structure, function, and dynamics of heterogeneous areas composed of interactive ecosystems (Forman & Gordon, 1986). According to Odum and Barrett (2011) the landscape encompasses people and nature serving as a fundamental tool for integrated studies.

In this study, the landscape is envisaged as a key concept to an integrated understanding of environment that is configured in a complex system. In other words, the landscape does not exist by itself, but it is an abstraction for the study of the environment, made up of the combination of natural and built elements.

According to Tres, Reis and Schindwein (2011), the landscape is the result of the human presence by interfering in the environment, creating new situations and demanding ever more natural resources, which generates, in general, negative impacts. Expressed as a complex unit encompassing interdependent and interactive elements, the landscape is the result of the interaction of human society with its living space, natural and built.

The landscape unit was adopted as an environmental unit that goes beyond the purely formal aspects, seeking to understand its function, structure, and process. Hence, it appropriates of the categories "form, function, structure, and process," proposed by Santos (1992), for the analysis of the space, which we consider that can be used also in the study of landscape. Thus, according to this author, the space is an objective reality in a permanent process of transformation, and to study it one must apprehend its relationship with the productive social processes, over time. In turn, the landscape is the cumulative result of these times at the local and regional level, being formed by past and present events. Oliveira (1999) corroborates this idea, and states that the landscape is the result of natural processes and human actions. It is the materialization of human actions and/or natural processes occurring in a certain area over time. Yázigí (2003) associates the landscape to the passage of time on a particular site.

Figueiró (1997) defines landscape as something dynamic and complex, in addition to its physiognomy (form, appearance) it is a

creation of modernity in the nineteenth century. For Bertrand (1972, p. 2), the elements that constitute the landscape take part in a common dynamics, which does not correspond to the specific evolution of each element:

The landscape is not the simple addition of disparate geographic elements. It is, in a certain portion of space, the result of a dynamic combination, thus unstable, of physical, biological, and human elements that, reacting dialectically over each other, make the landscape a unique and inseparable set, in perpetual evolution. (Ibid).

Therefore, the delimitation of landscape is not an end in itself, but a process of approximation to reality. It does not happen by overlapping elements, but by their relationships, interconnections, being understood as an instrument for the study of the environment.

Landscape units can be understood as systems that maintain uniformity in relation to its formal and functional composition, as well as of its organization (structure and process) and dynamic (Bertalanffy, 2009). The study of landscape units has become an important tool for the management of nature for the benefit of society (Odum & Barrett, 2011), serving as spatial unit for systemic analysis. Geographic information systems emerge as a tool that allows the accurate, automate crossing of physical and social data, generating thematic maps that facilitate the understanding of complex processes and structures.

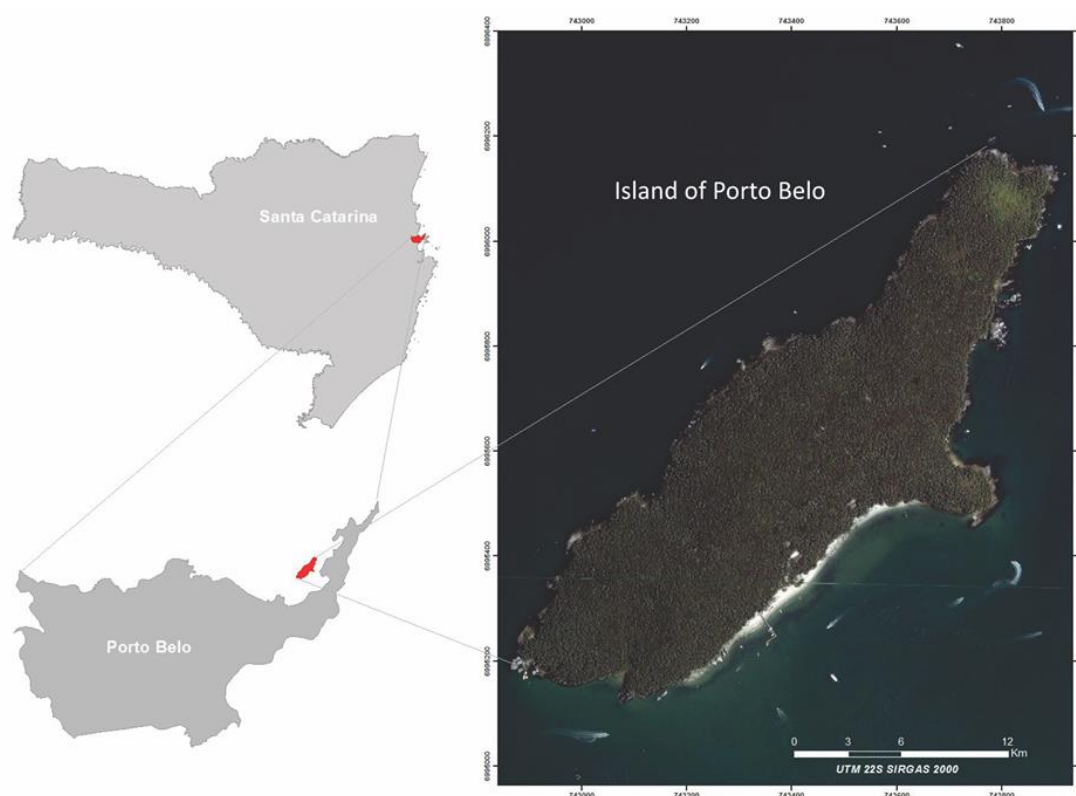


### 3 METHODOLOGY

The destination of Island of Porto Belo (IPB) is part of the municipality of Porto Belo

on the north-central coast of Santa Catarina, with geographic coordinates of 27° 08' 13''S latitude and 48° 32' 17''W longitude (Figure 1).

**Figure 1** – Geographic location of the Island of Porto Belo in north-central coast of Santa Catarina



**Source:** The authors

The IPB is located 25 kilometers away from the city of Balneário Camboriú and 64 kilometers from the state capital. It has an area of 40 hectares, covered with secondary Atlantic forest and it is only 900 meters from mainland. The architectural design of the complex at the disposal of the visitors was developed bearing in mind the concept of sustainable tourism. The tourism facilities are in harmony with the natural environment and the tourist flow is controlled aiming the protection and valuation of the extraordinary nature of the island.

In this study, the methodological procedures included literature and documentary survey, besides fieldwork. Research was divided into three stages: (1) Data survey; (2) mapping and crossing; (3) summary and results.

The first stage consisted in collecting secondary and primary data through documentary and field survey, respectively. The secondary data used to characterize the natural systems were provided by the company *Socioambiental Consultores Associados* (EIA, 2008), including the

characterization of the geomorphology, hypsometry, intermittent watercourses and vegetation cover. The characterization of the social system was carried out in the field using observation for obtaining primary data. The sizing of the landscape units was conducted through geodetic survey with the DGPS system (RTK - Real Time Kinematic) TRIMBLE R6 model.

The geodetic survey registered 508 points, was carried out in two field trips on April 16 and 23, 2014, including the

demarcation of the bathing area, beaches, circulation areas, walkways, trails, piers, zip line, lookouts, and buildings. The survey of the area of the beaches was conducted at times of neap tides in the ebb period, and therefore, with the greatest possible extent of beach (Figure 2). The areas were calculated using the *Calculate Geometry* tool in ArcGIS 10.0.

The variables used to characterize the landscape units for systemic analysis are described in Table 1.

**Table 1** – Methodological framework used

<b>NATURAL SYSTEM Variables</b>	<b>ANALYTICAL CATEGORIES</b>	<b>SOCIAL SYSTEM Variables</b>
Geomorphology Hypsometry Intermittent watercourses Vegetal cover	<b>FORM</b>	<b>Natural attractions:</b> such as beaches, rocky coasts, rupestrian inscriptions, among others <b>Built attractions:</b> restaurant; kiosks, among others <b>Infrastructure:</b> walkways, bathrooms, etc Tourism Relationship matrix natural x social
Environmental protection Relationship matrix natural x social stable/transition/ unstable	<b>FUNCTION</b>  <b>STRUCTURE</b>  <b>PROCESS</b>	stable/transition/unstable

**Source:** Adapted from Santana (1998) and Vieira (1999)

The second stage consisted of mapping and crossing the variables that compose the natural and social system, using ArcGIS 10.0 software. The stability of the landscape units was classified into stable/transition or unstable from the interpretation of their environmental performance and their adaptation to the principles of sustainable tourism. In the natural system, we considered the natural susceptibility to gravitational mass movements and in the social system the dimension of built infrastructure and the frequency of use by tourists.

In accordance with Crepani et al.’s (2001) methodology, adapted by Tres, Reis and Schlindwein (2011) the variables used to characterize the landscape units were standardized through a hierarchy. The variables with the value 1 (one) were classified as stable and adequate to sustainable tourism; the variables with value 2 (two) were classified as transition; and those with value 3 (three) were classified as unstable. These are landscape units with environmental instability, little used by tourists or without a qualified physical space.

The class of social system stability was defined through empirical knowledge of the area and the analysis of the frequency of use of tourist equipment and was based on the study by Lessa (2006). The attractions with high or intense flow were considered unstable for tourism sustainability, as well as the ones little used by tourists, because of their low tourist attractiveness. The frequency of use of spaces not cited by Lane (2006) was defined from observation during field activities on the island (Table 2).

Table 3 shows the classification of the variables used to describe the stability of landscape units of natural and social systems.

The systemic analysis was carried out through the crossing of variables and ranking of the stability of landscape units by arithmetic mean, done separately for the natural and social systems, and the integration of scenarios through the array of relationship indicated in Table 4.

**Table 2 –** Frequency of use of tourism-recreational spaces of IPB complex

Unstable areas - least used areas by tourists/ need appreciation of space	Transitional areas – medium circulation areas for tourists	Stable areas – most frequented areas by tourists
Beaches	Tropical kiosk	Pathways
Playground	Museum	Nautical kiosk
Gift shop	Ecological trail	Juice kiosk
Stage for activities	Central Restaurant	Bathroom 1
Kitchen	Natural kiosk	Bathroom 2
Lookout	Storage – chairs	Information kiosk
Pier	Restaurant “4 rodas”	Office
	Tattoo Kiosk	Sewage Treatment Station
	Beach circulation areas	Ambulatory
	Bathing and boating areas	Pier and rupestrian inscriptions
	Machine room	
	Zipline	

Source: The authors

**Table 3 –** Stability classes of variables describing the landscape units

Stability	Stable = 1	Transition = 2	Unstable = 3
Natural Variables			

Vegetation	Advanced Stage of Recovery	Intermediate Stage of Recovery	Initial Stage of Recovery /Bamboo
Geology	Crystalline Basement (Granite / Gneiss, Rocky Coast)	Wind Deposit /Beach	Coluvio-Aluvional Deposit
Declivity	0-17°	17-45°	>45°
APP	Without APP	-----	With APP
Hipsometry	0-5m	5.1-15m	> 15m
<b>Social Variables</b>			
Area of the structure	Natural attractions, linear elements (trails) e <50m <sup>2</sup>	50.1-160m <sup>2</sup>	>160m <sup>2</sup>
Frequency of users	Adequate flow of tourists	Moderate flow of tourists	High or very low flow of tourists

Source: The authors

**Table 4** – Relationship matrix to define the stability of landscape units

		<b>Natural</b>		
		Stable	Transition	Unstable
<b>Social</b>	Stable			
	Transition			
	Unstable			

Source: The authors

The third and last stage of research is presented following, consisting of summary and results obtained.

#### 4 RESULTS AND DISCUSSION

To characterize the natural system, we prepared thematic maps of vegetation cover, geomorphology, hydrography, permanent preservation areas, and declivity, which are included in the original Research Technical report.

The vegetation in advanced stage of recovery is prevalent on the island of Porto

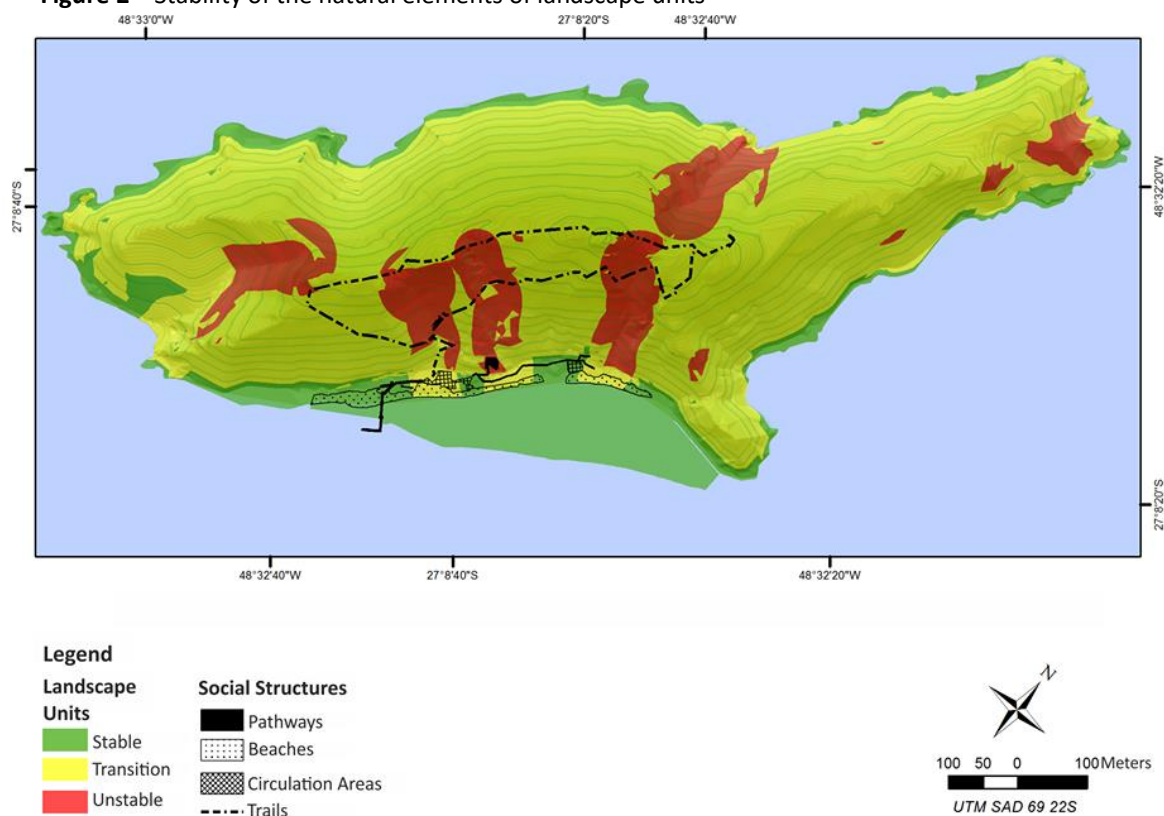
Belo, giving it a lush natural landscape, enhancing its tourist attractiveness. Concerning the geomorphological formation, the crystalline basement predominates. Its stability to gravitational mass movements is greater compared to colluvium-alluvial deposits, present in small areas spread over the island, along the watercourses. The springs and the banks of these water bodies are Areas of Permanent Preservation (APP), according to the Forest Code, Federal Law No. 12,651/2012. The declivities exceeding 100% are also included in these APPs.

However, due to construction for tourism, not all of these areas are being preserved.

The ranking of stability classes of landscape elements resulted initially in thematic maps of natural and social systems, Figures 3 and 4 respectively. The stability map of natural systems (Figure 2) shows that much of the island was considered as transitional area, a result of its sharp topography. However, most of these spaces are not accessible to tourists.

The natural landscapes near the coastline, accessible to the tourist, were considered stable landscape units. There are few landscape units classified as unstable and they correspond to Areas of Permanent Preservation affected by surface drainage channels. These indicate areas susceptible to gravitational mass movements. In some places, they correspond to areas near the museum and to portions of the trail that leads to the lookout and to the archaeological site.

**Figure 2** – Stability of the natural elements of landscape units



**Source:** The authors

The stability of the social system based on the size of the buildings and in the frequency of tourists in every attraction/in-fra-structure of the island (Lessa, 2006) is presented in Figure 3. In the social system, much of the landscape was classified as

stable. The circulation, boating and bathing areas, beaches, and trails have been classified as transition. In addition, the buildings of the nautical kiosk, ambulatory, bathrooms at the second beach and the kiosks - snacks, juices, drinks, and information - have been classified

as transition. The unstable landscape units are the lookout, the pier, the engine room, gift shop, the stage for activities, the playground, the museum, the central restaurant, and the second beach restaurant.

**Figure 3** – Stability of the social elements of landscape units



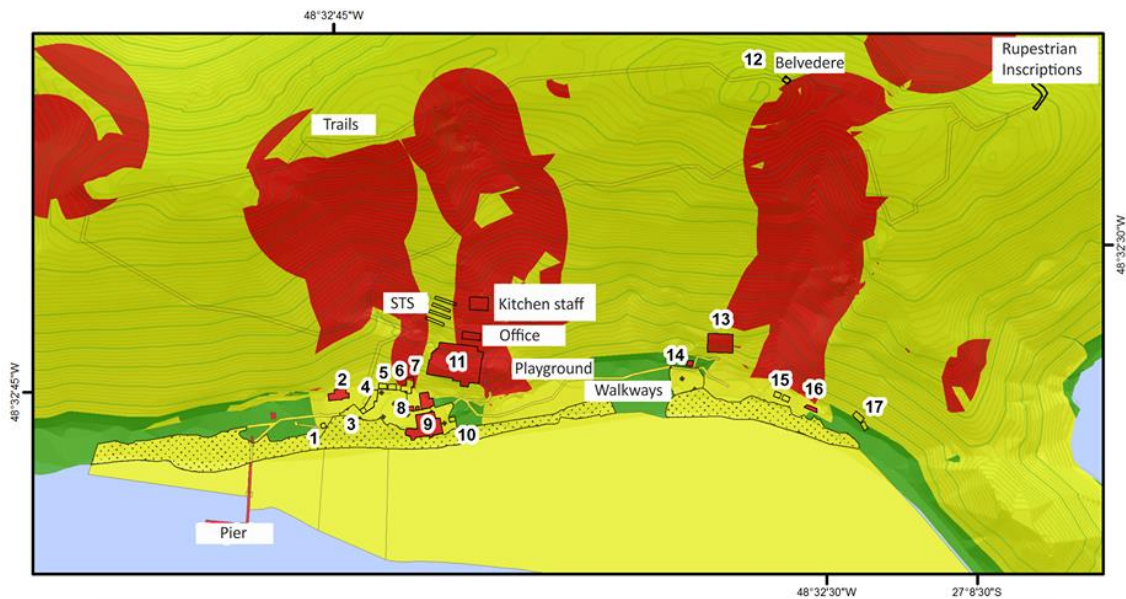
**Source:** The authors

In the integration of the natural and social system scenarios, by crossing them in the relationship matrix (Figure 4), the unstable landscape units increased. However, in the spaces wherein tourists access there was little change in stability. The following landscape units were considered as unstable with the integration of scenarios: the museum, playground, arrivals pier, engine room, central restaurant, second

beach restaurant, lookout, portions of the trail, gift shop, and the stage.

Based on the systemic analysis we carried out the study on the stability of the landscape in relation to the sustainability of tourism in the island of Porto Belo, having identified the stability of landscape units as stable, transition, or unstable.

**Figure 4** – Stability of the landscape units of the area of access of the Island of Porto Belo, SC



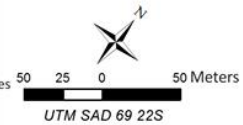
**Legend**

**Landscape Units**

- Stable
- Transition
- Unstable

- Beaches
- Circulation Areas

- |                       |                        |                           |
|-----------------------|------------------------|---------------------------|
| 1 – Nautical Kiosk    | 7- Central Bathrooms   | 13 – Restaurant           |
| 2 – Machine Room      | 8 – Gift Shop          | 14 – Bathrooms            |
| 3 – Information Kiosk | 9 – Central Restaurant | 15 – Lockers              |
| 4 – Ambulatory        | 10 – Tattoo Kiosk      | 16 – Stage for Activities |
| 5 – Juice Kiosk       | 11 – Museum            | 17 – Food Kiosk           |
| 6 – Drink Kiosk       | 12 – Lookout           |                           |



**Source:** The author

It is worth mentioning that the beach areas deserve attention, even though they were classified as transitional landscape unit. The beach area measured in this analysis was obtained in geodetic measurement on field during period of low tide in syzygy. Referred by Lane (2006) and verified in the field, in the hours of high tide the beach area decreases a lot.

As the strip of sand in the beach environment is a natural vector that cannot be controlled, it is clear the need to create relaxation spaces for tourists during high tide, which usually occur around lunchtime and in the evening. An alternative would be to encourage the use of infrastructures little used proposing a revival of these spaces. As an example, the external area of the museum, a building already consolidated,

could be revitalized, providing a resting area for tourists. The engine room could also be relocated to another space, emptying the area, near the sea and the nautical kiosk, for circulation and permanence of tourists.

In addition, the playground lies in environmentally unstable area and we suggest its relocation to a flatter and more accessible area. The arrival and departure pier features a high flow of tourists. Its expansion would offer greater comfort at arrival and departure times. The lookout of the trail could also be renewed in order to make it more spacious and attractive to tourists, promoting the guided trail service offered by the complex.

The stage for activities appears as unstable due to the low frequency of use. It is used only for groups in just two daily

activities. However, its renewal could make the space more enjoyable so that it could be used as a space of relaxation during the periods of high tide. In turn, the gift shop, located in the central and prime area, has an attractive structure. Due to low frequency of use, we suggest exploring this issue by surveying tourists in loco, to investigate their expectations vis-à-vis gift shopping in the tourism complex.

The central and the second beach restaurants are classified as unstable landscape units due to their wide areas. However, both are consolidated buildings and have a good frequency of use, and act as the Island's key attractions. In addition, the central restaurant has a permeable structure and it is highly integrated with the natural space, without using cuts or landfills in its construction structure. This suggests that the criterion of area used in this methodology cannot describe properly the appropriateness of the infrastructure for the sustainability of tourism. Therefore, it is understood that there is a need to explore in greater depth the criteria of analysis of the social environment.

## 5 FINAL CONSIDERATIONS

By classifying the landscape units and by sizing tourist-recreational facilities in the Island of Porto Belo, focusing on the analysis of information and discussion of the results based on the systemic theory, this study aims to contribute to two main dimensions. One is a practical contribution intended to guide and improve the tourist-recreational use of IPB; and another, eminently methodological

by which the category "landscape" is incorporated in the formulation of a spatial planning necessary for tourism sustainability, especially in its environmental dimension. In this sense, the results obtained in the study of Santos and Rejowski (2013) on articles published in 20 Brazilian scientific journals of tourism between 1990 and 2012, revealed that the words landscape units and geographic information system, representative of the present study, were not found among the recurrent keywords in this universe. Although we do not have equivalent data from a more recent period, it is clear that this approach focused on the tourism and sustainability of destinations is rare among researchers in Brazil.

In this way, the classification of landscape units (stable/ transition/ unstable) allowed an understanding of its organization (structure) and of its operation (process). The former, obtained from the intersection of the natural and social aspects, and the latter through the adequacy of the dimension of the tourist-recreational equipment with regard to protection of natural aspects. This was based on the application of the relationship matrix of natural and social scenarios for determination of stability of landscape units generating the rating: adequate = stable; restricted = transition; and inadequate = unstable.

This methodology can easily incorporate new variables for analysis, thus a suggestion for future studies would be to incorporate in the social system analysis the field results regarding the tourist's perception about the space. Another possibility that can be explored is to include a



weighted average for the crossing of variables, exploring in a more effective way the weight of each landscape element regarding the goods and services offered in the tourist-recreational complex. It is also suggested for further studies that the definition of the weights be made through multi-criteria decision analysis, the AHP-Analytic Hierarchy Process (Costa, 2002). The AHP is a comprehensive and rational procedure that assists the decision-making process that allows analyzing various alternatives and comparing them quickly through a criteria hierarchy weighted by preference weights. Finally, it is recommended that questions about the perception of space applied to tourists and island managers be used to change preferences, or human judgments, into numerical values, thus creating a more precise model of decision-making.

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