Perspectives in Ecology and Conservation 16 (2018) 31–37

Perspectives in ecology and conservation

Supported by Boticário Group Foundation for Nature Protection

www.perspectecolconserv.com

Research Letters

As far as the eye can see: Scenic view of Cerrado National Parks

Ariane de Almeida Rodrigues[a,*], Mercedes Maria da Cunha Bustamante[b], Edson Eyji Sano[c]

[a] Programa de Pós-Graduação em Ciências Ambientais, Faculdade de Planaltina, Universidade de Brasília, Brasília, DF, Brazil
[b] Laboratório de Ecologia de Ecossistemas, Departamento de Ecologia, Instituto de Ciências Biológicas, Universidade de Brasília, Brasília, DF, Brazil
[c] Centro de Sensoriamento Remoto, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA, Brasília, DF, Brazil

ARTICLE INFO

Article history:
Received 28 June 2017
Accepted 17 November 2017
Available online 10 January 2018

Keywords:
Cultural ecosystem services
Savanna
Tourism
Protected areas
Buffer zone
Scenic beauty

ABSTRACT

Buffer zones around protected areas (PA) can minimize negative human impacts and stimulate the sustainable use of natural resources. To fulfill these goals, it is important to ensure the participation of local communities on resources management and to support local economies. Sustainable tourism activities have the potential to reconcile the apparent conflict between protection of nature and socioeconomic benefits, but it has not been fully developed in Brazilian PA network. The objective of this study is to address opportunities to expand and complement the touristic attractions in areas surrounding eight Cerrado National Parks opened for visitation, by taking advantage of their scenic views. The analysis was based on remote sensing derived landscape biophysical attributes, including three key categories related to visual and ecological qualities and six indicators. Results allowed the identification of profiles for the selected parks, relating their biophysical characteristics to their main touristic potential. Strong hilly topographies, in general, were associated with wide visual scale and high complexity while flat topographies favor water related recreational services. Although focused on National Parks located in the Brazilian Cerrado, the study area is representative of tropical ecosystems with relevant species richness and high land conversion pressure.

Introduction

South America contains one of the most comprehensive protected area (PA) networks in the world, with around 25% of its terrestrial area under protection (Deguignet et al., 2014). There is a trend, however, of increasing degradation inside and around PAs all over South and Central America (Leisher et al., 2013) that can lead to the isolation of those areas, impairing their capacity to conserve biodiversity. One of the strategies to minimize the negative impacts of land conversion is to create buffer zones and ecological corridors, that increase PAs connectivity and resilience (Hansen and DeFries, 2007; Lopoukhine et al., 2012). The buffer zone concept was initially conceived to restrict human activities in PAs borders and reduce external disturbances. Later, it incorporated concerns with the human groups affected by the conservation measures (Wells and Brandon, 1993). Nowadays, support from local people is considered a critical aspect to ensure long term conservation goals (Wells and Brandon, 1993). Nevertheless, it remains a challenge to promote the inclusion of different stakeholders in the decision making processes and to provide alternatives to sustain the livelihood of PA neighboring communities (Vivacqua and Vieira, 2005).

One of the economic activities that can be developed in the buffer zone, in accordance with nature protection, is ecotourism, derived from cultural ecosystem services (CES). Beyond the traditional goal of biodiversity conservation, PAs provide many ecosystem services (ES), including CES (Lopoukhine et al., 2012). CES are the intangible benefits that arises from the interaction between society and the environment (MEA, 2005). Cultural and social aspects are often neglected because immaterial and intangible dimensions are considered difficult to characterize and measure, since high levels of subjectivity are involved in their analyses (Chan et al., 2012). Even though the importance of CES to societies have increased as the economies grow (Guo et al., 2010), there are few publications about this theme in Latin America (Hernández-Morcillo et al., 2013).

Scenic view is a type of CES included in the group of aesthetic services (MEA, 2005). Scenic potential or scenic quality expresses the aptitude of the place to provide quality experiences in terms of visual appreciation of the natural scenery to the visitors. These

* Corresponding author.
E-mail address: arianerodrigues@gmail.com (A. de Almeida Rodrigues).

https://doi.org/10.1016/j.pecon.2017.11.004

Table 1
Concepts (visual scale, complexity and imageability) and indicators (viewshed area, terrain roughness, slope variability, Shannon Diversity Index, Shannon Evenness Index and drainage density) considered in the integration of visual and ecological aspects for landscape metrics analysis. The framework was proposed by Fry et al. (2009).

Concept	Definition	Dimension	Landscape attribute	Indicator	Estimation method	References
Visual scale	Related to openness, what increases visibility, associated to human landscape preferences	Visibility	Topography	Proportional viewshed area (in percentage)	Viewshed area inside the park, identified from observer points located on the peaks of the external 1 km buffer, divided by the park area.	Schirpke et al. (2016)
Complexity	Refers to the diversity and richness of landscape elements	Diversity of landforms	Topography	Terrain roughness (in meters)	Average standard deviation of the altitude.	Germino et al. (2001)
				Slope variability (in percentage)	Average difference between maximum and minimum slope.	Bishop and Hulse (1994)
		Diversity of land cover	Vegetation cover	Shannon Diversity Index (SDI) (dimensionless)	Equals minus the sum, across all patch types, of the proportional abundance of each patch type multiplied by that proportion, based on total landscape area.	Frank et al. (2013) De Vos et al. (2016)
				Shannon Evenness Index (SEI) (dimensionless)	The observed SDI divided by the maximum SDI for that number of patch types.	Lindemann-Matthies et al. (2010)
Imageability	Related to the key visual concepts of sense of place, iconographic and uniqueness of a landscape	Vividness	Water	Drainage density (in kilometers per square kilometers)	The total length of all the streams inside the parks limits, divided by the total area of the park	Wherrett (2000)

experiences come from the interaction between the observer and the landscape features. In this case, landscape refers to the perceived landscape, a space determined by the impression of the observer that involves all human senses, especially the vision (Alonso et al., 2004). Two sets of analytical variables are considered: the objective landscape characteristics and the subjective observer perceptions (Daniel, 2001). Objective approaches focus on environmental features and aesthetic theories while subjective approaches are based on direct or indirect measures of opinion to qualify scenic beauty, according to preferences of individuals or groups. Most of the studies combine elements from these two approaches (Daniel, 2001). There is also a tendency to join aesthetics with ecology, defining the scenic potential based on ecological integrity criteria (Daniel, 2001). This perspective enriches the multifunctionality of natural environments, in agreement with the Brazilian policy to create National Parks intended to protect both biodiversity and scenic beauty (as defined by the Federal Law no. 9985 of July 18, 2000).

Scenic view and other CES are also important sources of revenues. In Brazil, federal PAs received around 8 million visitors in 2015, contributing with the national economy with estimated $1.2 billion U.S. dollars (Souza, 2016). For every one U.S. dollar that the Brazilian government invested, about seven U.S. dollars returned to the economy, supporting 43,602 jobs. The numbers indicate that the benefits related to ecotourism exceed the geographical limits of PAs, contributing to improve local economies and create direct and indirect jobs in their neighboring areas (Souza, 2016). Tourism activities, however, are unevenly distributed among PAs.

The Brazilian savanna (Cerrado) is a biodiversity hotspot under threat from the rapid land cover change process, with as little as 3% of its area within strictly PAs (Françoso et al., 2015). The National Parks located within the Cerrado received approximately 0.6 million visitors in 2015 (Souza, 2016), which is only 7.5% of the total visitors received by all Brazilian federal PAs in the same year. Diverse factors, such as multiple attractions in the region, reputation, recreation facilities and population density have been demonstrated to affect the number of visitors in a park (Castro et al., 2015). Yet, the imbalance in the number of tourists among parks needs to be further investigated, as well as the unexplored potentials of development of each park (Souza, 2016).

This study aimed to identify opportunities to expand and complement the touristic attractions in areas surrounding eight Cerrado National Parks opened for visitation (ICMBIO, 2017), by exploring landscape biophysical aspects of their scenic view. National Parks correspond to areas with low anthropogenic impacts (Françoso et al., 2015), therefore, expected to provide increased levels of ecosystem services. Projects to improve ecotourism in the surroundings of the parks can create opportunities for the engagement of local population in sustainable activities.

The selected National Parks were: Brasilia, Cavernas do Peruaçu, Emas, Chapada dos Veadeiros, Chapada dos Guimarães, Grande Sertão Veredas, Serra da Canastra and Serra do Cipó. For each park, we obtained relevant information about their panoramic view based on objective landscape biophysical attributes. Using key categories of visual and ecological qualities suggested by Fry et al. (2009), we selected indicators related to visual scale, complexity and imageability.

Material and methods

The investigation was based on the spatial analysis of remote sensing data that were processed with the support of ArcGIS 10.4.1 geographical information system software, Patch Analyst 5.2 (Rempel et al., 2012) extension available for the ArcGIS software to estimate landscape metrics and Envi 5.0 image processing software. The analysis was centered in landscape structural characteristics, a common feature that integrates visual and ecological aspects of