



## **Visitation patterns in Brazilian tourist caves: what do the visitors themselves think?**

*Padrões de visitação nas cavernas turísticas brasileiras: o que pensam os próprios visitantes?*

**Heros Augusto Santos Lobo<sup>1</sup>**  
**Glauber Eduardo de Oliveira Santos<sup>2</sup>**

**ABSTRACT:** Caves are very specific natural attractions, which differ in terms of spatial confinement, lack of direct light and even the general idea of outdoor nature. They are usually associated with ecotourism and adventure tourism, which asks for smaller groups of visitors, both for safety reasons and due to the logistics of these touristic activities. In this context, a research was carried out in the scope of the social carrying capacity, with the aim of evaluating the effect that the number of concurrent visitors on a tour route can have on each visitor's satisfaction with the visit made. To investigate this aspect, a research was conducted by interviewing 682 visitors from three different Brazilian show caves, located in Iporanga-SP, Bonito-MS, and Lagoa Santa-MG, Brazil. The results show that the visitation volumes, including the number of people per group, total number of groups, and the waiting time to start the visitation, do not have relevant effects on the quality of the

---

1 Department of Geosciences and Environment, Unesp, São Paulo, Brazil. Department of Geography, UFMS, Mato Grosso do Sul, Brazil. Department of Environmental management in forestry systems, UFLA, Lavras, Brazil. Department of Tourism, UAM, São Paulo, Brazil. Department of Geography, Tourism and Humanities, UFSCar, São Carlos, Brazil. E-mail: heroslobo@ufscar.br

2 Department of Tourism Economics. USP, São Paulo, Brazil. Department of Business, USP, São Paulo, Brazil. Department of Economics, Universitat de les Illes Balears, Palma, Spain. Department of Tourism, USP, São Paulo, Brazil. Department of Arts, Sciences and Humanities, USP, São Paulo, Brazil. E-mail: glauber.santos@usp.br

experience. Visitors were equally satisfied with the experience at the various observed levels of visitation. Based on the results and conclusions, new hypotheses and questions were raised, also considering possible changes in the crowd perception due to new practices of social distancing and travel behavior.

**Keywords:** Show caves; Social Carrying Capacity; Cave tourism; Satisfaction; Ecotourism.

**RESUMO:** Cavernas são atrativos naturais muito específicos, que se diferenciam em função do confinamento espacial, ausência de luz direta e mesmo da ideia geral de natureza ao ar livre. Geralmente estão associadas a roteiros de ecoturismo e turismo de aventura, os quais preconizam grupos menores de visitantes, por questões de segurança e pela própria lógica de concepção das atividades. Neste contexto, realizou-se uma pesquisa no âmbito da capacidade de carga social, com o objetivo de avaliar o efeito que a quantidade de visitantes concomitantes em um roteiro pode ter sobre a satisfação de cada visitante com a visita realizada. Para investigar este aspecto, a pesquisa de campo entrevistou 682 visitantes de três diferentes cavernas turísticas brasileiras, localizadas em Iporanga-SP, Bonito-MS e Lagoa Santa-MG. Os resultados demonstram que os volumes de visitação, incluindo as quantidades de pessoas por grupo, de grupos entre si e o tempo de espera para entrada nas cavernas turísticas não têm efeito relevante sobre a qualidade da experiência. Os visitantes pesquisados se mostraram igualmente satisfeitos com a experiência nos vários níveis de visitação observados. Nas conclusões, hipóteses e questões foram levantadas, considerando também eventuais mudanças na percepção de lotação em função das práticas contemporâneas de distanciamento social e comportamento de viagem.

**Palavras-chave:** Cavernas Turísticas; Capacidade de Carga Social; Espeleoturismo; Satisfação; Ecoturismo.

## 1 INTRODUCTION

Caves are distinctive tourist attractions from the point of view of environmental fragility, due to characteristics such as spatial confinement, absence of direct sunlight, air circulation restrictions and wildlife specialization (WILLIAMS, 2008; LOBO; BOGGIANI, 2013; GALLÃO; BICHUETTE, 2018). In some destinations, caves are the main attractions (CIGNA; FORTI, 2013), whereas in others, they act as secondary elements of tourist attractiveness. In Brazil, most touristic caves as visitation spots have been associated with ecotourism, which has also been called speleotourism in several destinations (LOBO, 2014). Besides the link to ecotourism, touristic activities linked to religion, spiritualism, scientific research, environmental studies and even geotourism, in more recent times, make up the range of the various motivations associated with cave visitations (LOBO; TRAVASSOS, 2013). These types of touristic activities undertaken in Brazilian caves can be classified as alternative activities – in Gabrielli’s (2017) conception – both due to the scale of visitation as well as the average behavior of visitors in touristic caves possessing formal and institutionalized management. From the viewpoint of different types of motivation, visitors are usually ecotourists, although most partake in such motivation only sporadically, also going on trips and visits with other motivations, on different occasions and destinations (FENNELL, 2020). As ecotourists, they fit into the profiles described by Panosso Netto & Gaeta (2010) and Han (2021) – seeking the simplicity of unspoiled nature, among other factors.

In addition to the alternative profile of visitors, which already points to a less predatory behavior (GABRIELLI, 2017), speleotourism is based on international recommendations and national standards which encourage more sustainable and less harmful practices to the environment. Globally, general guidelines for the planning and management around touristic caves have been published by the International Show Caves Association (ISCA), in partnership with the International Union for the Conservation of Nature (IUCN) and the International Union of Speology (UIS). The guidelines address aspects ranging from access infrastructure to visitation limits and also environmental interpretation (ISCA; IUCN; UIS, 2014). In Brazil, the touristic usage of caves is subject to the development of a Speological Management Plan (CONAMA, 2004), which defines each cave’s planning, management and monitoring requirements based on socioenvironmental research. Furthermore, the existence of specific Brazilian norms for routes and guides for speleotouristic adventure activities (ABETA, 2022) is also highlighted.

Caves can provide visitors primarily with recreational and educational opportunities and experiences. For the rest of society, cave visitation can generate positive economic impacts such as revenue, employment and taxes, as well as possible behavioral changes favorable to environmental conservation (LOBO, 2015). Therefore, the potential contribution of cave visitation to social welfare is considerable. However, the act of effective visitation depends not only on the willingness of the management, but also on the free choice of the potential visitor. It is important to remember that cave visitation represents a tourism and leisure activity to visitors, not

an obligation. Therefore, it is to be expected that demand will behave in a way that meets its own wants and needs (SANTOS; KADOTA, 2012), which includes selfish and altruistic traits, without necessarily displaying the behavior planned for and desired by the area's management. Thus, if the visitation experience is not overall positive, part of the potential social benefits may be lost. To the visitor, the poor quality of the experience will represent a loss, a waste of resources dedicated to touristic expenditure as well as the negative value of the experience itself (SANTOS, 2022). To society in general, experiences of this nature lead to dissatisfaction and, consequently, behaviors such as low intentions of returning and negative word-of-mouth (RIBEIRO; COSTA; FREIRE, 2021), which finally results in a decrease in visitor flow and loss of the potential positive impacts of the activity. Therefore, visitor satisfaction is a central issue to be considered by visitation management.

Previous studies in this field have brought up themes such as overcrowding perception (DOORNE, 2000; MANNING; HALLO, 2010; SANTANA-JIMÉNEZ; HERNÁNDEZ, 2010), satisfaction levels regarding spatial concentration patterns for each cave (MASUTTI; LOBO, 2019), as well as overall satisfaction with the experience (ALEGRE; GARAU, 2010; CAMPO-MARTÍNEZ; GARAU-VADELL, 2010). These aspects are researched within the scope of social carrying capacity, one of the strands of tourism carrying capacity studies (BUTLER, 2019). In general terms, it refers to the limit of number of visitors in a given area beyond which the visitor's level of satisfaction with the experience decreases, that is: tolerance for crowding (CIFUENTES-ARIAS, 1992). In this sense, this article's approach is conceptually aligned with the methodological proposal of Lobo *et al.* (2013), in which it is postulated that the tourism carrying capacity should take into account, as a starting point, the current patterns of visitation – or the desired patterns, in the case of new routes – to verify its adequacy.

Based on this context, a study was conducted to investigate the relationship between the volume of crowding practiced in groups of visitors and visitor satisfaction with the experience. For this purpose, questionnaires were conducted with visitors in order to assess their personal perception and levels of enjoyment from the experience. The analyses sought to evaluate the relationship between variables in order to understand whether visitors to Brazilian caves are satisfied with the amount of people they meet on the tours.

The research was carried out in touristic caves located in the Alto Ribeira State and Tourist Park (PETAR), in Apiaí-SP and Iporanga-SP, in the Gruta do Lago Azul Natural Monument (MONAGLA), in Bonito-MS, and in the Sumidouro State Park (PESU), in Lagoa Santa-MG.

## 2 CHARACTERIZATION OF THE RESEARCH AREA

The research took into account the need to study different speleotourism caves, in order to avoid biases due to the specific characteristics of each area. Thus, places that offer adventure tours as well as places offering contemplative tours were equally considered (Fig. 1).

FIGURE 1 – RESEARCH LOCATIONS



SOURCE: Google Maps (2022), prepared by the authors.

The first site constitutes a group of touristic caves located in PETAR, a Conservation Unit which protects a significant share of the Atlantic Forest as well as hundreds of caves, being part of a World Natural Heritage Site (UNESCO, 1999) and of an Atlantic Forest Biosphere Reserve (FUNDAÇÃO FLORESTAL; EKOS BRASIL, 2010). The study focused on the caves located in the region of Bairro da Serra (Iporanga-SP), as they are the most visited. The caves Água Suja, Alambari de Baixo, Cafezal, Couto, Morro Preto, Santana, and Ouro Grosso were selected. For reference purposes, PETAR received in 2019 approximately 40 thousand visitors, according to information provided by management. The visits are distributed among the Park's various tourist caves, especially Santana, which alone accounts for half of the total number of visitors. In general, the speleotourism routes in PETAR are characterized

by the sense of adventure, due to traits such as the relative natural difficulty of access, enclosed stretches in some caves, underground waterway hikes, and the use of headlamps on helmets (FUNDAÇÃO FLORESTAL; EKOS BRASIL, 2010).

The Lago Azul cave in Bonito-MS is protected by a Conservation Unit under the Natural Monument category, as well as by being listed as a National Cultural Heritage Site (UFMS, 2002). The municipality is one of the most famous ecotourism and sustainable tourism destinations in Brazil (GRECHI *et al.*, 2019). The attraction is one of the most notorious in the region, along with the clear water rivers, which are sought after for flotation tours. The visitation tour takes place in a large chamber almost entirely flooded by sunlight. The tour is made through a set of stairs and platforms, which makes it a visual and contemplative type of tour rather than adventurous. The use of helmets is mandatory, although there are no stretches with roofs low enough to present risk to visitors (UFMS, 2002). According to management data, the Lago Azul cave welcomes approximately 60 thousand annual visitors, with a significant share being foreigners.

Lastly, the Lapinha cave is one of the main touristic attractions of the Sumidouro State Park (PESU), in the municipality of Lagoa Santa-MG. The region is famous not only for being the cradle of Brazilian paleontology, due to the findings of Danish paleontologist Peter W. Lund, but also for being the “cradle of Luzia”, the oldest dated human fossil ever found in Brazil (BERBERT-BORN, 2000). Its main difference in comparison with the other caves is the presence of artificial electrical lighting installed inside, offering a clearer view of its confined ducts and chambers. The use of helmets is mandatory during the visitation to the cave, which receives approximately 30 thousand visitors annually (GHEOSFERA CONSULTORIA AMBIENTAL, 2010). Figure 2 depicts some of the caves surveyed.

FIGURE 2 – PHOTOGRAPHY OF THE SURVEYED CAVES



SOURCE: Original photography of Heros A. S. Lobo (2022).

Caption: A) Tourists in the meeting chamber in the Santana cave (Petar-SP); B) Tourists straying from the guided path in the Água Suja cave (Petar-SP); C) Overview of the main chamber of the Lago Azul cave (Monagla-MS); and D) Entrance staircase to the Lapinha cave (Pesu-MG).

The touristic caves surveyed in these destinations have a few common traits, such as strict visitation control, as well as being located in Full-Time Protection Conservation Units, with the possibility of indirect use of the natural resources, which includes tourist visitation (BRASIL, 2000). The visitation itineraries are previously defined and there are established visitation limits, both per group of visitors as well as the daily total limit. In the Lago Azul cave, the daily limit of visitors is reached often, which does not occur in the other caves surveyed, which are mainly visited only on weekends, holidays and during school breaks. All visits are guided, both by tour guides (in the Lago Azul cave) and by environmental supervisors (in the other caves). A summary of the quantitative parameters of visitation to these caves is shown in Table 1.

TABLE 1 – INTERVAL BETWEEN VISITS AND VISITATION LIMITS IN THE SURVEYED CAVES

Cave name	Time interval between group visitations (minutes)	Maximum number of visitors per group
PETAR caves	30	16 + 1 guide
Lago Azul	20	15 + 1 guide
Lapinha	30	20 + 1 guide

SOURCE: UFMS (2002); Fundação Florestal; Ekos Brasil (2010); Gheosfera Consultoria Ambiental (2010).

The data presented in Table 1 indicate low density in the simultaneous number of visitors per day, both due to the time interval between groups of visitors and the number of people per group. However, different groups may meet inside the caves, either due to overlapping of the sections in the visitation route – an occurrence observed on field – or by the inadequate time management during environmental explanations by some of the guides (BURGOS-DELGADO; SERANTES-PAZOS, 2013). Another aspect that sets the caves apart in comparison to other nature tours and that guided the research was the relative spatial confinement and its possible effect on the visitor's perception of crowding. Although they are natural environments, caves have often tight walls and ceilings, which differentiates them from most other natural locations visited by tourists. Furthermore, even when compared to constructed environments such as buildings, caves can potentially cause an amplified sense of constraint associated with varying degrees of claustrophobia and nyctophobia (ANTIC *et al.*, 2022), as well as the culturally constructed imagery often linked to the supernatural (COLEBATCH, 2004).

### 3 METHODOLOGY

Investigating the relationships between visitor density and satisfaction with the cave visitation experience constitutes a descriptive purpose. This study sought to describe different aspects of these relationships. The investigation culminated in an explanatory objective of testing the hypothesis of a negative association between densification and satisfaction, established with the support of a literature review and the current discourse among some stakeholders of the cave areas. This hypothesis establishes that higher levels of densification are associated with lower levels of satisfaction. Therefore, for the present purposes, this work is descriptive and explanatory.

This research adopts the quantitative method to describe and verify the relationships of interest. As for the data collection method, this work applied questionnaires (surveys) to visitors of the selected caves. The surveys were conducted in different periods of time from 2015 through 2018. The survey collection tool was

initially tested at PETAR and then adjusted for the final implementation. Data were recorded using tablet devices, in which participants entered their own answers, without researcher interference. The application of the surveys occurred immediately after a visit to one of the caves, in the nearby visitor centers and their surroundings. All surveys were carried out in periods of high touristic demand in the destinations, in order to analyze the satisfaction of the visitors under great density conditions. The total number of respondents per collection campaign and application is described in Table 2.

TABLE 2 – OVERVIEW OF THE SURVEYS APPLIED PER TIME PERIOD AND DESTINATION

Application site	Time period	Time period description	Total of respondents
PETAR caves	Oct 9–Oct 11, 2015	Nossa Senhora de Aparecida national holiday	58
	Jan 22–Jan 24, 2016	São Paulo city anniversary holiday	120
	Feb 5–Feb 7, 2016	Carnaval holiday	100
	May 26–May 29, 2016	Corpus Christi holiday	93
Lago Azul cave	Apr 12 and Apr 16, 2017	Easter holiday	144
Lapinha cave	Feb 8 and Feb 14, 2018	Carnaval holiday	167
Total of valid answered questionnaires			682

SOURCE: the authors (2022).

In this study, the visitation conditions were described by four variables, namely:

- Research site (PETAR, Lapinha cave or Lago Azul cave);
- Waiting time to start the visitation route, measured in minutes;
- Size of the groups of visitors, measured in number of people;
- Number of encounters with other visitor groups along the visitation route.

Descriptive statistics provide a first approach to the problem, revealing the unconditional probabilities of satisfaction. These results are easy to understand and represent the relationships observed in practice. However, the unconditional probabilities do not indicate causal effects, as they combine the impacts of different correlated explanatory variables. Furthermore, given the ordinal nature of the satisfaction variable in this study, the descriptive statistics represent the relationships through a set of estimates, not offering effectively synthetic measurements of the possible effects of the explanatory variables.

Thus, the effects of the explanatory variables on satisfaction were estimated through an ordinal logistic model (GREENE; HENSHER, 2010). Models of this type consider that the observed value of an ordinal variable ( $y$ ) is the result of the censoring process of a latent variable ( $y^*$ ). In this sense, the satisfaction rating indicated by the respondents can be understood as the ordinal classification of a continuous degree of satisfaction. Latent satisfaction can be modeled as a linear function of the order:

$$y_j^* = \beta x_j + u_j$$

In this case,  $x$  is an explanatory variable vector,  $\beta$  is a parameter vector,  $u$  is the estimation error, and  $j$  identifies the respondent. The observed value of the ordinal variable is equal to  $i$  (e.g., very good, good, regular, etc.) if the value of the latent variable is between the lower ( $\kappa_{i-1}$ ) and upper ( $\kappa_i$ ) limits of this category:

$$\kappa_{i-1} < y_j^* < \kappa_i \Rightarrow y_j = i$$

Hence, the probability of observation of outcome  $i$  is equal to the probability that  $y^*$  is between the limits of the category. Assuming that  $u$  follows a Gumbel distribution, then we have:

$$Pr(y_j = i) = Pr(\kappa_{i-1} < \beta x_j + u_j < \kappa_i) = \frac{1}{1 + e^{-\kappa_i + \beta x_j}} - \frac{1}{1 + e^{-\kappa_{i-1} + \beta x_j}}$$

In this work, the vector  $x$  is composed of the four explanatory variables described:

$$y_j^* = \beta_0 + \beta_1 L_j + \beta_2 A_j + \beta_3 T_j + \beta_4 P_j + \beta_5 G_j + u_j$$

For this equation,  $L$  is a dummy variable that identifies the observations made at Lapinha cave and  $A$  is a dummy variable that identifies the observations made at Lago Azul cave. The observations from the PETAR survey constitute the reference group.  $T$  is the waiting time (in minutes),  $P$  is the number of people in the visitation group, and  $G$  is the number of groups found on the route. Besides the general model composed of these variables, a detailed model was estimated including interactions between the local variable of the survey and the other three. In this manner, we considered the possibility of variation in the effects of waiting time, group size and number of encounters with other groups, according to survey location.

$$y_j^* = \theta_0 + \theta_1 T_j + \theta_2 P_j + \theta_3 G_j + \theta_4 L_j T_j + \theta_5 L_j P_j + \theta_6 L_j G_j + \theta_7 A_j T_j + \theta_8 A_j P_j + \theta_9 A_j G_j + u_j$$

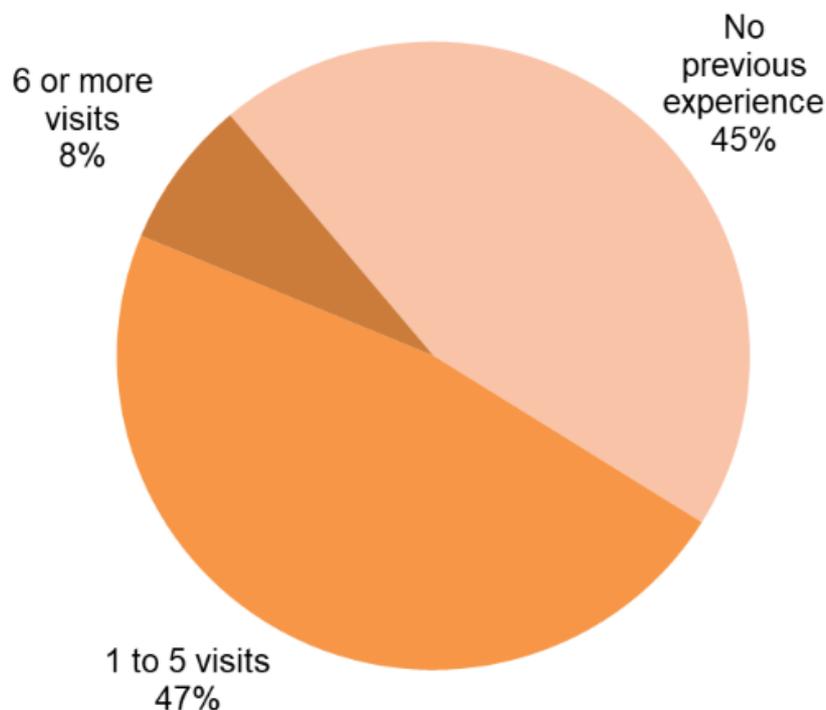
The results of the estimations of the two models, both overall and in-depth, as well as the descriptive statistics of the relationships between crowding and satisfaction with the visitation experience are presented in the next section of this paper.

#### 4 RESULTS AND DISCUSSION

The surveyed sample was comprised of a majority of women (56%). Adults between 20 and 59 years of age predominated the sample (92%), with only 5% of the respondents being under 20 years old, and 2.2% being over 60 years old. As for the education levels, 40% of the respondents had a post-graduate degree, 37% had finished higher education, 18% had completed high school, and the remaining 6% had either completed or dripped out of middle school, or no formal education.

A small share of the respondents (8%) had previously visited show caves six times or more (Figure 3). Almost half (45%) had never visited a cave prior to the survey. This, it is understood that the main demographic is composed of tourists who sporadically visit caves. This indicates that most visitors are predominantly ecotourists, as identified in other studies in natural areas (SANCHO-PIVOTO *et al.*, 2018; Deng; Li, 2019; GU *et al.*, 2018). Strictly speaking, it can be inferred that their interest in caves is sporadic, a fact proven by previous research in the same destinations (MASUTTI *et al.*, 2017; GIUSTI *et al.*, 2019; MASUTTI; LOBO, 2019), which would allow them to be classified as “occasional speleotourists”, as an already defined nomenclature for geotourists (BOLEY; NICKERSON, 2013).

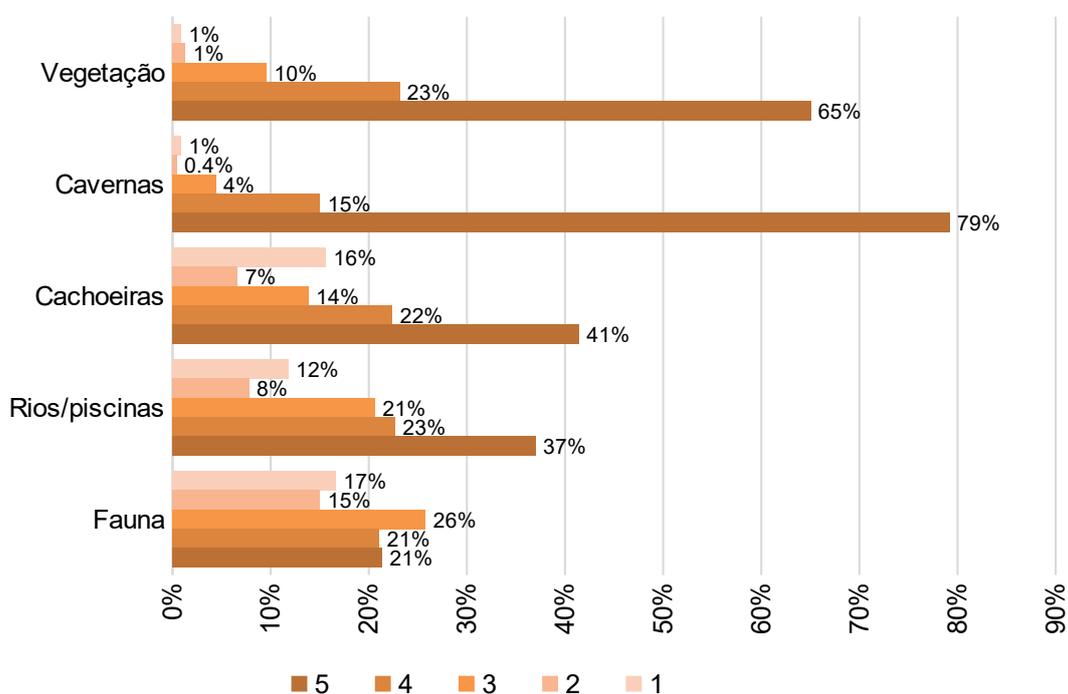
FIGURE 3 – VISITORS DISTRIBUTED BY NUMBER OF PREVIOUS CAVE VISITING EXPERIENCES



SOURCE: the authors (2022).

To the respondents, caves make up the most important natural attribute that contributed to the decision to visit the surveyed Conservation Unit (Figure 4). Most visitors (79%) rated them in the highest level of importance on the five-point scale used in the survey. Another natural element considered important for this decision was vegetation. Rivers, waterfalls, natural pools and fauna were indicated as very important by a smaller share of the respondents.

FIGURE 4 – LEVEL OF INFLUENCE OF DIFFERENT NATURAL ATTRIBUTES ON THE DECISION TO VISIT THE CONSERVATION UNIT

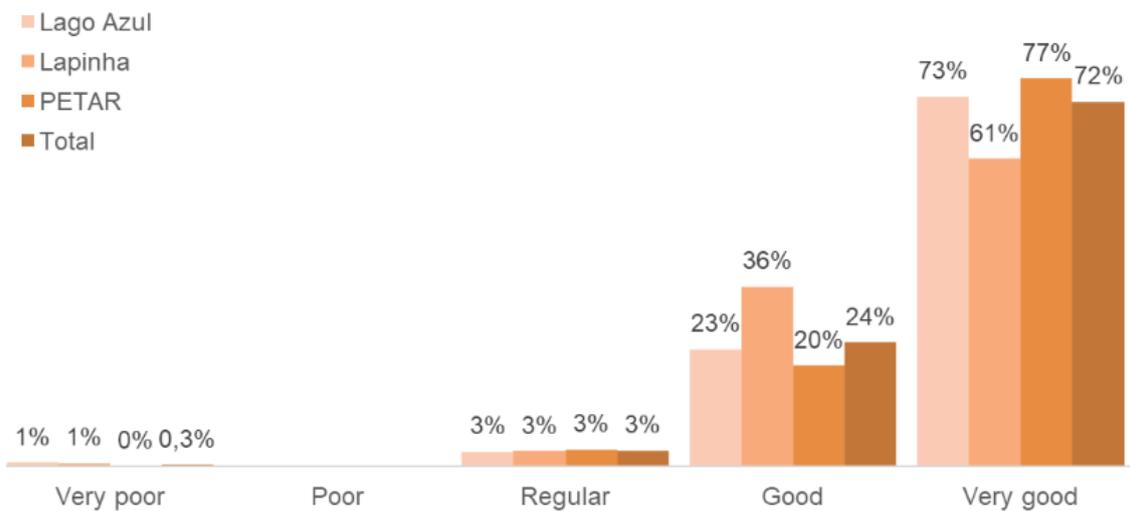


SOURCE: the authors (2022).

Caption (Y axis): Vegetation; Caves; Waterfalls; Rivers/natural pools; Fauna.

Overall, the surveyed visitors to the studied caves were satisfied with their experience. From the total number, 72% of visitors classified the experience as very good, as shown in Figure 5. Only 3% expressed that the visit was regular and 0.3% had a negative experience. The percentage of respondents with very positive opinions is slightly higher in the PETAR caves (77%) and lower in the Lapinha cave (61%).

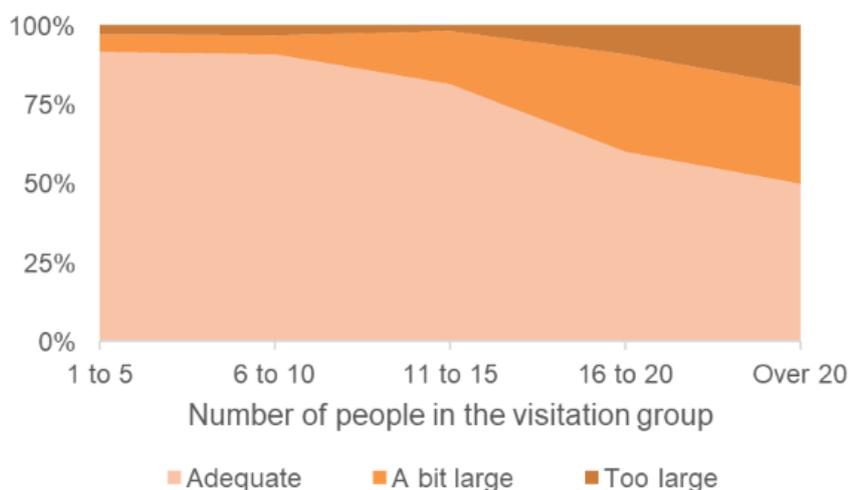
FIGURE 5 – VISITORS’ GENERAL LEVELS OF SATISFACTION



SOURCE: the authors (2022).

The size of the visitation groups elicits differing opinions from visitors. Larger groups tend to be effectively perceived as too large, indicating visitors’ sensitivity to this issue. The excessive size starts to become noticeable when the group exceeds 10 people (Figure 6). About 91% of visitors consider groups of up to 10 people adequate. For groups of 11 to 15 people, this number drops to 81%. The percentage of visitors who consider the size of the group adequate continues to decrease as the number of people in the group increases, until it reaches 50% for groups with over 20 people.

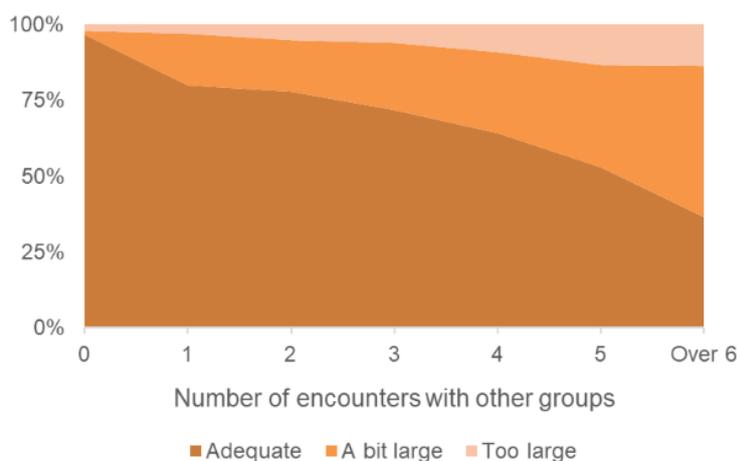
FIGURE 6 – OPINION ON GROUP SIZE BY EFFECTIVE GROUP SIZE



SOURCE: the authors (2022).

Visitors also showed sensitivity to the number of encounters with other groups along the route (Figure 7). Around 20% of the visitors who encountered only one other group during the visit indicated that this number was already large. As the number of encounters increases, the percentage of those who see the encounters as excessive increases. Almost half of the visitors who encountered 5 other groups said that the number of encounters was excessive. This percentage increases to 63% among those who met 6 groups or more.

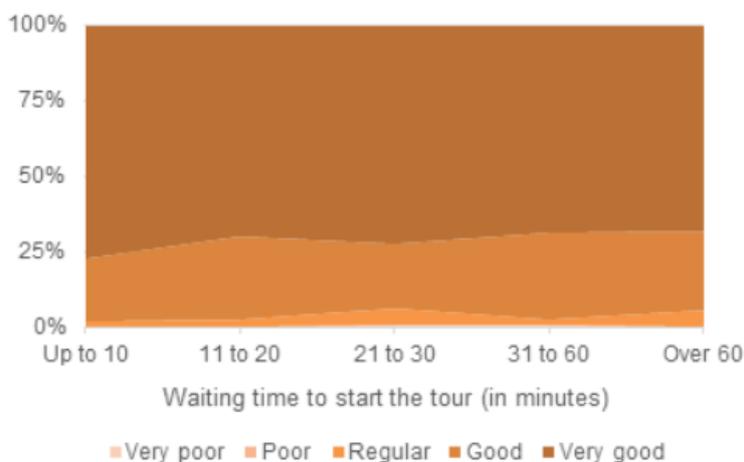
FIGURE 7 – OPINION ON THE NUMBER OF OTHER GROUPS ENCOUNTERED BY EFFECTIVE NUMBER OF GROUPS ENCOUNTERED



SOURCE: the authors (2022).

Visitors' overall satisfaction with the experience does not seem to be associated with the waiting time to start the tour. The overall opinion is essentially constant regarding the waiting time (Figure 8).

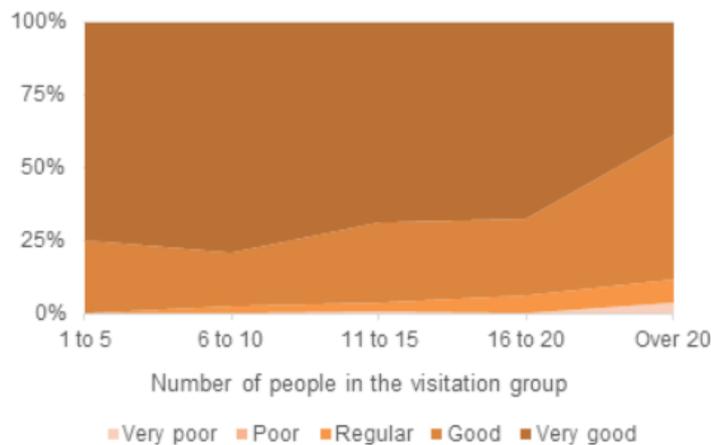
FIGURE 8 – OVERALL SATISFACTION BY WAITING TIME



SOURCE: the authors (2022).

Visitors' overall satisfaction seems to be sensitive to the size of the visiting group, although it results in only marginally negative opinions (Figure 9). In groups of up to 5 people, 75% saw the visiting experience as very good. This percentage drops to 68% in groups of 11 to 20 people, and to 38% in groups of 21 or more people.

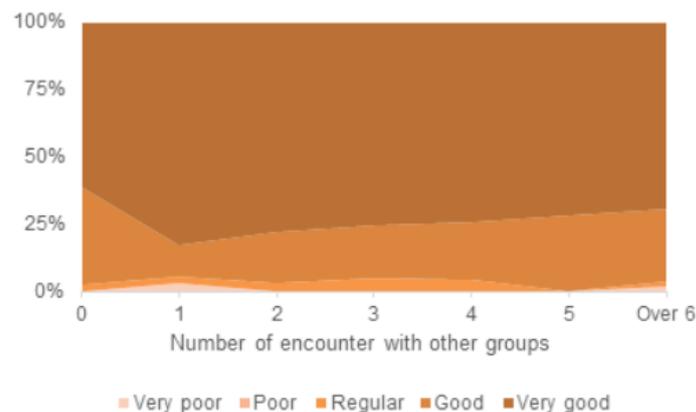
FIGURE 9 – OVERALL SATISFACTION BY SIZE OF THE VISITING GROUP



SOURCE: the authors (2022).

Regarding the number of encounters with other visitor groups along the route, the general satisfaction seems to be slightly sensitive (Figure 10). However, this factor does not seem to affect visitors who did not encounter any other groups. Starting with 1 group encountered, the percentage of visitors who consider the visitation experience very good decreases slightly. Among visitors who met one group along the way, 83% consider the experience very good. This percentage drops to 69% among those who encountered more than 5 groups.

FIGURE 10 – OVERALL SATISFACTION BY NUMBER OF ENCOUNTERS WITH OTHER GROUPS



SOURCE: the authors (2022).

The two ordinal logistic models estimated proved significant at the 0.001 level. However, the explanatory power of both models was considerably low. The general model showed a pseudo-R<sup>2</sup> regression coefficient of 0.026, while for the model detailed by the research site, this value was 0.029. The estimated coefficients are presented in Table 3. The standard errors of the estimates are presented in parentheses. It is important to note that the two statistical models were also estimated with logarithmic transformations of the three quantitative variables, since they all present markedly positive asymmetry. However, none of the conclusions suffered any qualitative change, reinforcing the validity and solidity of the results discussed.

TABLE 3 – ESTIMATES OF THE EXPLANATORY MODEL OF OVERALL SATISFACTION

Variable			Overall model	In-depth model			
				Overall	Location-specific		
					PETAR caves	Lago Azul	Lago Azul
Location (reference: PETAR caves)	Lapinha		-0.484* (0.248)	-0.078 (0.592)			
	Lago Azul		-0.054 (0.249)	-0.229 (0.702)			
Waiting time			-0.002 (0.002)		-0.002 (0.002)	0.003 (0.009)	-0.007 (0.012)
Group size			-0.051*** (0.018)		-0.035 (0.030)	-0.080*** (0.029)	-0.019 (0.041)
Number of encounters			0.001 (0.017)		0.000 (0.017)	0.082 (0.128)	-0.004 (0.065)
Constants	Very poor	→ Regular	-6.645 (0.746)	-6.535 (0.774)			
	Regular	→ Good	-4.162 (0.313)	-4.051 (0.377)			
	Good	→ Very good	-1.740 (0.236)	-1.618 (0.317)			

SOURCE: the authors (2022).

The level of satisfaction of visitors to the three research sites was essentially the same. In the overall model, visitors to PETAR had a higher level of satisfaction than visitors to Lapinha. However, the difference is only marginally significant ( $p=0.051$ ). Moreover, this difference showed up in the in-depth model ( $p=0.896$ ), suggesting that PETAR’s higher levels of satisfaction in the general model was due to the undifferentiated effects of the other explanatory variables. No other differences between the satisfaction levels between pairs of research sites were found.

The waiting time to start the visitation route to the caves did not show any effect on visitor satisfaction. The coefficient of this explanatory variable in the overall model

proved to be non-significant ( $p=0.224$ ). Non-significance was also observed at each of the research sites in the in-depth model. Furthermore, the coefficients in the in-depth model are not different from each other ( $p>0.1$ ), reinforcing the hypothesis that the lack of impact of this variable is not specific to a particular site.

The effect of group size on visitor satisfaction was negative in the overall model ( $p=0.005$ ). Therefore, the larger the number of people in the group, the lower the visitors' average satisfaction. This aspect can be explained both by the possible expectation of greater isolation that usually surrounds the idea of ecotourism (FENNELL, 2020), as well as by the distortion generated by the spatial confinement within caves, which can generate greater crowd perception, even in small groups (MASUTTI; LOBO, 2019). However, the data showed that such an effect is relatively small in absolute terms. To cause a decrease in satisfaction from good to regular, 48 additional people are required to be in the visiting group, while from very good to good, 115 additional people are required<sup>3</sup>. Therefore, although it has a significant effect on satisfaction, the magnitude of this effect is too small for any practical purpose. Furthermore, the detailed model showed that group size only affected the satisfaction of visitors of Lago Azul ( $p=0.005$ ). At the other two research sites, the estimated effect is non-significant ( $p>0.1$ ). Thus, although this variable has some effect on cave visitor satisfaction, the occurrence of this impact depends on site-specific aspects. Moreover, even in the Lago Azul cave, the magnitude of the effect is quite small. It would be necessary to add 31 people to the group for the level of satisfaction to decrease from good to regular.

Additionally, the number of encounters with other groups of visitors along the route had no effect on satisfaction. All estimated coefficients, in both models, did not show any statistical significance ( $p>0.1$ ). This result allows us to discuss two central aspects. The first aspect regarding the adequacy of the volumes and visitation intervals currently practiced in the three destinations. It is worth noting that the social carrying capacity is not being exceeded, contrary to the conclusions of some previous works (e.g. GIATTI; ROCHA, 2001; LOBO; MORETTI, 2008), which referred to less organized contexts of visitation to these destinations in the past. The second aspect is the socialization promoted by such encounters. In this sense, although the effect of encounters between groups is not positive, the fact that it is not negative allows us to hypothesize that the chance encounter with other groups can generate a sense of satisfaction, either by similarity of tastes, or by allowing the visitor to feel belonging to a larger group of people with common interests (BAUMEISTER; LEARY 1995; CASHMAN, 2021), among other possible factors. Cultural differences between different groups should also be considered in this hypothesis, as already evidenced in different approaches in the research of Sayan *et al.* (2013), Ma *et al.* (2018) and Zaman & Aktan (2021).

Lastly, it may be worth considering the variability between visitors. Although the number of visitors has no effect on average satisfaction, this does not mean

---

<sup>3</sup>  $[-4.162 - (-6.645)]/0.051 = 48$ .  $[-1,74 - (-4,162)]/0.051 = 115$ .

that all visitors think the same way. In fact, a share of visitors have less positive experiences when they encounter other people or groups on the route. The data collected are not sufficient to provide good estimates of the size of this share of visitors. However, knowing that it exists allows us to outline another recommendation for the management of these spaces. Offering exclusive visitation experiences which ensure that the visitor will not encounter other people in the cave may be a solution to cater to this public that deviates from the average. Of course, ensuring that no other people will be encountered requires restricting visitation. For example, instead of one group every half hour, only one group per hour could be allowed, provided that one hour is enough time to guarantee the group's exclusive access to the cave. This type of experience can be offered at specific times or on specific days, or by prior arrangement. Therefore, this kind of service also requires a different managerial approach. The additional costs of this type of experience, whether by extending the wait for other visitors or by needing a different managerial approach, can eventually be covered by special visitation fees. This recommendation has support in revenue management literature (SCHWARTZ et al., 2012; GUILLET; MOHAMMED, 2015). Hence, it is recommended to consider implementing a revenue management system for caves based on different degrees of sharing the space with other people and groups.

## 5 CONCLUSION

The results obtained in this research allowed us to conclude that visitors are satisfied and positively evaluate the studied caves in terms of crowding. The visitation system that restricts the number of visitors per group enhances the visiting experience, since most visitors considered the level of crowding experienced as adequate. The results also indicate that if the visitation limits of each route are respected, an increase in the number of visitors does not harm the visitation experience. Considering that these limits were established in view of environmental studies that consider the decrease in environmental impacts, both the negative consequences for the environment and for visitors' experience are being considered and avoided.

Based on the results obtained, the final statement proposed by this work goes against the assumptions that guided the initial development of the research. If the starting point took into account a possible dissatisfaction with the levels of visitation crowding being practiced, the ending point evidenced levels of satisfaction with all the patterns tested. Hence, the question is: would this not be an indication that it is possible to increase the size of the groups? Or even to decrease the interval between them? Of course, such a revision should undergo the scrutiny of specialists in environmental studies. But it is clear that this is a feasible possibility, considering that: a) the studied caves operate with annual volumes well below their total possible limit; b) the demands are concentrated on holidays, so that on these dates, there is often a lack of openings for visitors to join the routes; and c) the eventual encounter between groups did not negatively affect the visiting experience, which paves the way for other research hypotheses.

Lastly, although the research was conducted before the SARS-COVID-19 pandemic, a revision of visitation limits may be necessary for the near future, considering both the perspectives of post-pandemic tourism (COELHO; MAYER, 2020) and the trends pointing to an increased interest in nature itineraries in the coming years (EDELMAN; PANROTAS, 2018; DENG; LI, 2019; FENNELL, 2020), under the logic of “isolation tourism” (CAMPOS, 2020). Given that social distancing was one of the most discussed and recommended measures for controlling the spread of COVID-19, could this be a new era of concern for perceived crowding?

### SPECIAL THANKS

To the CNPq for funding the research (processes 455100/2014-4 and 433372/2018-4). To the São Paulo State Forest Foundation/COTEC, to the IMASUL-MS and to the Sumidouro State Park-MG, for providing research licenses and permits.

### REFERENCES

ALEGRE, J.; GARAU, J. Tourist satisfaction and dissatisfaction. *Annals of Tourism Research*, v.37, n.1, p.52-73, 2010.

ANTIĆ, A., VUJIČIĆ, M.D., DRAGOVIĆ, N.; CIMBALJEVIĆ, M.; STANKOV, U.; TOMIĆ, N. Show cave visitors: an analytical scale for visitor motivation and travel constraints. *Geoheritage* v.14, n.53, 2022.

ASSOCIAÇÃO BRASILEIRA DAS EMPRESAS DE ECOTURISMO E TURISMO DE AVENTURA (ABETA). *Espeleoturismo*. Disponível em: <https://abeta.tur.br/pt/atividades/espeleoturismo/>. Acesso em: 23 jun. 2022.

BAUMEISTER, R.F.; LEARY, M.R. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, v.117, n.3, p. 497–529, 1995.

BERBERT-BORN, M. **Carste de Lagoa Santa**. In: SCHOBENHAUS, C.; CAMPOS, D.A.; QUEIROZ, E.T.; WINGE, M.; BERBERT-BORN, M. (Edit.) *Sítios Geológicos e Paleontológicos do Brasil*. Brasília: CPRM, 2000. Disponível em: <http://sigep.cprm.gov.br/sitio015/sitio015.pdf>. Acesso em: 14.jun.2021.

BOLEY, B.; NICKERSON, N. Profiling geotourists: an a priori segmentation identifying and defining sustainable travelers using the Geotourist Tendency Scale (GTS). *Journal of Sustainable Tourism*, v.21, n.2, p.314-330, 2013.

BRASIL. Lei nº 9985 de 18 de julho de 2000. **Sistema Nacional de Unidades de**

**Conservação.** Brasília: Presidência da República, 2000. Disponível em: [http://www.planalto.gov.br/ccivil\\_03/leis/l9985.htm](http://www.planalto.gov.br/ccivil_03/leis/l9985.htm). Acesso em: 28 mai. 2021.

BUTLER, R.W. Tourism carrying capacity research: a perspective article. **Tourism Review**, v.75, n.1, p.207-211, 2019.

BURGOS-DELGADO, A.; SERANTES-PAZOS, A. Interpretação do patrimônio, turismo e gestão de áreas protegidas: algumas aproximações. **Turismo & Sociedade**, v.6, n.2, p. 300-323, 2013.

CAMPO-MARTÍNEZ, S.; GARAU-VADELL, J. B. The generation of tourism destination satisfaction. **Tourism Economics**, v.16, n.3, p.461-475, 2010.

CAMPOS, M. **Turismo de isolamento é a nova tendência de viagem. Mas para onde fugir?** S.l.: UOL, 2020. Disponível em: <https://www.uol.com.br/nossa/noticias/redacao/2020/08/28/turismo-de-isolamento-e-nova-tendencia-entre-viajantes-durante-a-pandemia.htm>. Acesso em: 28 mai. 2021.

CASHMAN, D. **Fans and fams: experience and belonging aboard a cruise ship music festival.** In.: ES, N.; REIJNDERS, S.; BOLDERMAN, L.; WAYS DORF, A. (Eds.). *Locating Imagination in Popular Culture: Place, Tourism and Belonging.* New York: Routledge, 2021.p.230-244. Disponível em: <https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9781003045359-18/fans-fams-david-cashman>. Acesso em: 28 mai. 2021.

CIFUENTES-ARIAS, M. **Determinación de capacidad de carga turística en áreas protegidas.** Turrialba: CATIE, 1992. 28 p.

CIGNA, A.A.; FORTI, P. Caves: the most important geoturistic feature in the world. **Tourism and Karst Areas**, v.6, n.1, p.9-26, 2013.

COELHO, M.F., MAYER, V. Gestão de serviços pós-COVID: o que se pode aprender com o setor de turismo e viagens? **Revista Eletrônica Gestão & Sociedade**, v.14, p. 3699-3707, 2020.

COLEBATCH, H. G. Caves and coves of myth and mystery. **Quadrant**, v.48, n.6, p. 72-74, 2004.

CONSELHO NACIONAL DO MEIO AMBIENTE (CONAMA). **Resolução CONAMA 347/2004.** Dispõe sobre a proteção do patrimônio espeleológico. Brasília: CONAMA, 2004. Disponível em: [https://www.icmbio.gov.br/cecav/images/stories/downloads/Legislacao/Res\\_CONAMA\\_347\\_2004.pdf](https://www.icmbio.gov.br/cecav/images/stories/downloads/Legislacao/Res_CONAMA_347_2004.pdf). Acesso em 23 jun. 2022.

DENG, J.; LI, J. Segmentation of Nature-Based Tourists in a Rural Area (2008–2009): A Single-Item Approach. **Sustainability**, v.11, p.2052, 2019.

DOORNE, S. Caves, culture and crowds: carrying capacity meets consumer sovereignty. **Journal of Sustainable Tourism**, v.8, n.2, p.116-130, 2000.

EDELMAN; PANROTAS. **10 tendências para viagens e turismo na América Latina em 2018**. Disponível em: <https://edelman.com.br/propriedades/viagens-e-turismo-latam/>. Acesso em: 10.mai.2018.

FENNELL, D.A. **Ecotourism**. London: Routledge, 2020. 398 p.

FUNDAÇÃO PARA A CONSERVAÇÃO FLORESTAL DO ESTADO DE SÃO PAULO (FUNDAÇÃO FLORESTAL) / SECRETARIA DO MEIO AMBIENTE; INSTITUTO EKOS BRASIL (Coords.) **Plano de manejo espeleológico do Parque Estadual Turístico do Alto Ribeira**. São Paulo: Fundação Florestal, 2010. 765 p.

GABRIELLI, C.P. Turismo responsável: caminhos possíveis? **Revista de Turismo Contemporâneo**, v.5, n.1, p.81-97, 2017.

GALLÃO, J. E.; BICHUETTE, M.E. Brazilian obligatory subterranean fauna and threats to the hypogean environment. **ZooKeys**, v.746, p.1-23, 2018.

GHEOSFERA CONSULTORIA AMBIENTAL. **Plano de manejo do Parque Estadual do Sumidouro**. Belo Horizonte: [s.n.], 2010. 76 p., il.

GIATTI, L.L.; ROCHA, A.A. Impactos Ambientais do Turismo na Região do PETAR – Parque Estadual Turístico do Alto Ribeira – São Paulo – Brasil. In: **Proceedings of 13th. International Congress of Speleology**. Brasília: UIS/SBE, 2001. p.711-715.

GIUSTI, M.M.; TRAVASSOS, L.E.P.; LOBO, H.A.S. Percepção de lotação e grau de satisfação dos visitantes da Gruta da Lapinha (Parque Estadual do Sumidouro, MG, Brasil). **Caderno de Geografia**, v.29, p.1139-1160, 2019.

GOOGLE MAPS. **Localização das áreas de pesquisa**. Disponível em: <https://www.google.com.br/maps/@-22.0226102,-53.2850863,6z/data=!3m1!4b1!4m2!6m1!1s1MjtMmrZevNimdikzPJQo-kZUlrtd8aw>. Acesso em: 23 jun. 2022.

GRECHI, D.C.; LOBO, H.A.S.; MARTINS, P.C.S. Interação e inovação na trajetória do Sistema Turístico de Bonito, MS: um modelo para os destinos da RILA? **Interações**, v. 20, p.125-140, 2019.

GREENE, W.H.; HENSHER, D.A. **Modeling Ordered Choices: a primer**. Cambridge: Cambridge University Press, 2010. 278 p.

GU, X.P.; LEWIS, B.J.; NIU, L.J.; YU, D.P.; ZHOU, L.; ZHOU, W.M.; GONG, Z.; TAI, Z.; DAI, L.M. Segmentation by domestic visitor motivation: Changbai Mountain Biosphere Reserve, China. **Journal of Mountain Science**, v.15, p.1711-1727, 2018.

GUILLET, B.D.; MOHAMMED, I. Revenue management research in hospitality and tourism: A critical review of current literature and suggestions for future research, **International Journal of Contemporary Hospitality Management**, v.27, n.4, p. 526-560, 2015.

HAN, H. Consumer behavior and environmental sustainability in tourism and Hospitality: a review of theories, concepts, and latest research, **Journal of Sustainable Tourism**, v.29, n.7, p.1021-1042, 2021.

INTERNATIONAL SHOW CAVES ASSOCIATION. INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE. INTERNATIONAL UNION OF SPELEOLOGY. **Recommended international guidelines for the development and management of show caves**. s.l.: ISCA/IUCN/UIS, 2014. 18 p.

LOBO, H.A.S. **Fundamentos Básicos do Espeleoturismo**. 1. ed. Dourados: UEMS, 2014. 146p.

LOBO, H.A.S. Caracterização e tendências de gestão dos impactos negativos e positivos do espeleoturismo. **Revista Brasileira de Pesquisa em Turismo**, v. 9, p. 321-341, 2015.

LOBO, H.A.S.; BOGGIANI, P.C. Cavernas como patrimônio geológico. **Boletim Paranaense de Geociências**, v.70, p.190-199, 2013.

LOBO, H. A. S.; MORETTI, E. C. Ecoturismo: as práticas da natureza e a natureza das práticas em Bonito, MS. **Revista Brasileira de Pesquisa em Turismo**. v.2, n.1, p.43-71, mar. 2008.

LOBO, H. A. S.; TRAVASSOS, L. E. P. Cave tourism in Brazil: General aspects and trends from the beginning of the 21st century. **Australasian Cave and Karst Management Association**, p. 6-14, 2013.

LOBO, H.A.S.; TRAJANO, E.; MARINHO, M.A.; BICHUETTE, M.E.; SCALEANTE, J.A.B.; SCALEANTE, O.A.F.; ROCHA, B.N.; LATERZA, F.V. Projection of tourist scenarios onto fragility maps: Framework for determination of provisional tourist carrying capacity in a Brazilian show cave. **Tourism Management**, v.35, p.234-243, 2013.

MA, A.T.H.; CHOW, A.S.Y.; CHEUNG, L.T.O.; LEE, K.M.Y.; LIU, S. Impacts of Tourists' Sociodemographic Characteristics on the Travel Motivation and Satisfaction: The Case of Protected Areas in South China. **Sustainability**, v.10, p. 3388, 2018.

MANNING, R.E.; HALLO, J.C. The Denaly Park road experience: indicators and standards of quality. **Park Science**, v.27, n.2, p.33-41, 2010.

MASUTTI, R.F.; LOBO, H.A.S. Análise descritiva do perfil e satisfação dos visitantes da gruta do Lago Azul (Bonito, MS). **Entre-Lugar**, v.9, p.86-105, 2019.

MASUTTI, R.F.; LOBO, H.A.S.; SANTOS, G.E.O.; TRAVASSOS, L.E.P.; ALVES, J.V.I.; PIRES, A.P.; GIUSTI, M.M. Percepção de lotação e nível de satisfação dos visitantes como contribuições para a capacidade de carga turística das cavernas do PETAR (Iporanga, SP): resultados preliminares. In: 34° Congresso Brasileiro de Espeleologia, 2017, Ouro Preto. **Anais do 34° CBE**. Campinas: SBE, 2017. v. 1. p. 643-647.

PANOSSO NETTO, A.; GAETA, C. **Turismo de experiência**. São Paulo: Senac, 2010. 360p.

RIBEIRO, T.L.S.; COSTA, B.K.; FREIRE, O. B. L. Cocriação de valor no turismo – validação e replicação de escala em relação à intenção de recomendação boca-a-boca. **Revista Brasileira de Pesquisa em Turismo**, v.5, n.2, e-1924, 2021.

SANCHO-PIVOTO, A.; ALVES, A.F.; ROCHA, M.C.R. Ecoturismo em áreas protegidas: um olhar sobre o perfil de visitantes do Parque Estadual do Ibitipoca, Minas Gerais, Brasil. **Geografias**, v.26, n.2, 2018.

SANTANA-JIMÉNEZ, Y.; HERNÁNDEZ, J.M. Estimating the effect of overcrowding on tourist attraction: the case of Canary Islands. **Tourism Management**, v.32, n.2, p.415-425, 2010.

SCHWARTZ, Z.; STEWART, W.; BACKLUND, E.A. Visitation at capacity-constrained tourism destinations: exploring revenue management at a national park. **Tourism Management**, v.33, n.3, p.500-508, 2012.

SANTOS, G.E.O.; Modelo teórico microeconômico do consumo de turismo. **Revista de Turismo Contemporâneo**, v. 10, n. 2, p.211-234, 2022.

SANTOS, G.E.O.; KADOTA, D.K. **Economia do turismo**. São Paulo: Aleph, 2012. 470 p.

SAYAN, S.; KRYMKOWSKI, D.H.; MANNING, R.E.; VALLIERE, W.A.; ROVELSTAD, E.L. Cultural influence on crowding norms in outdoor recreation: a comparative analysis of visitors to national parks in Turkey and the United States. **Environmental Management**, v.52, p.493-502, 2013.

UNIVERSIDADE FEDERAL DE MATO GROSSO DO SUL (UFMS). **Estudo de impacto ambiental da visitação turística do Monumento Natural Gruta do Lago Azul – Bonito, MS**. Campo Grande: UFMS, 2002. 153 f.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA A EDUCAÇÃO, A CIÊNCIA E A

CULTURA (UNESCO). **Atlantic forest south-east reserves**. Paris: Unesco, 1999. Disponível em: <http://whc.unesco.org/en/list/893>. Acesso em: 15 fev. 2018.

WILLIAMS, P.W. **World heritage caves and karst**. Gland: IUCN, 2008. 57p.

ZAMAN, U.; AKTAN, M. Examining residents' cultural intelligence, place image and foreign tourist attractiveness: A mediated-moderation model of support for tourism development in Cappadocia (Turkey). **Journal of Hospitality and Tourism Management**, v.46, p.393-404, 2021.

**TS**

