

PUBLIC SUPPORT AS A KEY ELEMENT FOR FAUNA CONSERVATION IN MAQUINÉ AND REI DO MATO SHOW CAVES

O APOIO DO PÚBLICO COMO ELEMENTO-CHAVE PARA A CONSERVAÇÃO DA FAUNA DAS CAVERNAS TURÍSTICAS MAQUINÉ E REI DO MATO

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Abstract

Once the public support is a key element for the show cave maintenance, we aimed to understand environmental behavior and perception from visitors at Maquiné and Rei do Mato show caves to help on building more informative visits. We used data from questionnaires applied to show caves visitors. School excursions (44.3%) had a high contribution on bringing visitors and providing the first direct contact with caves. Regarding the way participants constructed a context about life in the caves and the need for their conservation, although bats (70.1%) and insects (40.6%) were properly referred as the main cave dwellers, obligate cave fauna was not mentioned (troglotic). The perception of the link among landscape and cave conservation (42.1%) and necessity of educational practices (29.6%) were prevalent. Based on the environmental behavior and acceptance of participants, the use of more instructive visits was suggested in order to provide a broader view of the environment for the cave tourists and then induce more interest by the preservation of those unique and endangered habitats. Moreover, pedagogical exercises provided inside the cave environment can lead visitors to appropriate from environmental education issues and therefore apply them in the practices developed in the caves of Brazil.

Key-Words: recreational caves; educational practices; outdoor activities.

Resumo

Uma vez que o apoio público é um elemento chave para a conservação das cavernas, buscamos compreender o comportamento e a percepção ambiental dos visitantes das cavernas Maquiné e Rei do Mato, no Brasil e fornecer dados que ajudem na construção de visitas mais informativas. Utilizamos dados qualitativos, extraídos de questionários aplicados aos visitantes. As excursões escolares (44,3%) tiveram uma elevada contribuição em trazer visitantes e fornecer o primeiro contato direto com as cavernas. Embora morcegos (70,1%) e insetos (40,6%) fossem propriamente referidos como os principais habitantes das cavernas, a ocorrência de fauna troglótica não foi mencionada. A percepção da ligação entre conservação de paisagem e das cavernas (42,1%) e necessidade de práticas educativas (29,6%) foram prevalentes. Com base no comportamento ambiental e aceitação dos participantes, foi sugerido o uso de visitas mais instrutivas, a fim de fornecer uma visão mais ampla do ambiente para os turistas das cavernas e, em seguida, induzir mais interesse pela preservação desses ambientes únicos e ameaçados. Além disso, os exercícios pedagógicos fornecidos dentro das cavernas podem levar os visitantes a se apropriarem das questões de educação ambiental e, portanto, aplicá-los nas práticas desenvolvidas nas cavernas do Brasil.

Palavras-Chave: cavernas recreativas; práticas educativas; atividades ao ar livre.

1. INTRODUCTION

Cave exploration as a job, hobby or recreational activity (caving) is a growing outdoor activity for people interested in exploring to produce knowledge, in adventure and leisure activities similar to visiting thematic parks, zoos, botanical gardens and museums or in having fun outdoor like

camping or hiking. Each cave provides a unique experience to visitors and excellent opportunities for learning (HAMILTON-SMITH, 2004; VAR 2004). Furthermore, caves are protected from the sun light, rain and storms and may provide protected and clean passages, suitable to be visited by a broad public (especially in show caves).

Nowadays, caves are important as social and economic tools because people sometimes must pay to visit show caves and this kind of activity support surrounding stores and may attract millions of people (VAN-BEYNEN; BIALKOWSKA-JELINSKA, 2012). There are different kinds of show caves around the world in which people must pay and enter walking, by boat, cable car, elevator or train. Some caves are used as snack bars, restaurants, cabins, aqua parks, medical therapy and motels that are located inside them or nearby (TIBOR, 1986; PAVLOVICH, 2003; VAR, 2004; CIGNA; FORTI, 2013). Most of the show caves operate with regular tours and educational programs and some of them offer adventure tours and have gift and craft shops, trading posts, or country stores (VAR, 2004).

In order to reduce risk of accident and mitigate environmental impacts from all these activities, several caving organizations recommend good education as the best solution (VAR 2004). A special protection for caves is required since it takes thousands of years to repair damages to formations and the fauna endemic to the cave can disappear forever. The pollution above the caves can easily seep and reach the water source, what may led to health problems due to contamination (GILLIESON, 2004). For this reason, preserving the surface area is as important as preserving the cave to protect water resources (VAR, 2004; CHEEPTAM et al., 2013). Restoring damaged caves is difficult because of the possibility of contamination during cleaning processes (Var, 2004). Furthermore, the narrow range distribution of obligate cave fauna makes re-colonization extremely difficult in most cases (FONG, 2011).

Show caves located close to urban centers or protected areas (usually with easy access) receive thousands of visitors along the year, with or without tourist guides (WOLF, 2005; FERNANDEZ-CORTES et al., 2011; FONG, 2011; CHEEPTAM et al., 2013). On the other hand, there are few studies about the likely impacts caused by tourism in cave environments and about the viewpoint of visitors regarding the risks of accidents and environmental importance of these systems (CIGNA; BURRI, 2000; VAN-BEYNEN; TOWNSEND, 2005; VAN BEYNEN, 2011; VAN-BEYNEN et al., 2012; VAN-BEYNEN; BIALKOWSKA-JELINSKA, 2012; TAYLOR et al., 2013).

Caves in Brazil have been exploited for tourism for over 60 years, some of them which are located close to urban centers and are altered with lighting installations, buildings, soil compaction (LINO, 2001; MARRA, 2001; LOBO, 2012; LOBO et al., 2013; LOBO; TRAVASSOS, 2013; LOBO et

al., 2015) and introduction of exotic microbiota (TAYLOR et al., 2013; SAIZ-JIMENEZ, 2015). There are governmental, academic and social incentives to disseminate tourism activities in cave environments in Brazil (LOBO; MORETTI, 2009; LOBO; TRAVASSOS, 2013; IEF, 2015; MAQUINETUR, 2015). However, the lack of professionals trained to conduct and coordinate tourism activities in a sustainable manner in cave environments is evident (LOBO; TRAVASSOS, 2013; SOUZA-SILVA et al., 2014). The efficient management of caves, considering economic, environmental and social elements is virtually non-existent in many parts of the world (VAN-BEYNEN et al., 2012; CHEEPTAM et al., 2013).

Outdoor environmental activities have a direct influence in the environmental behavior of the visitors because it provides experience and encourages individuals to cherish the nature (KUHLEMEIER et al., 1999; RICKINSON et al., 2009; DUERDEN; WITT, 2010). Show caves not only provides the opportunity to learn information about the physical habitat, but also can provide experiences with animals, increasing public engagement for wildlife conservation. Accessing the visitor opinion about environmental cave integrity may be a good tool to know the main ways to invest in cave management requirements. Thus, this study aimed to evaluate how visitors deal with issues related to show caves environments after direct experience and the implications of those perceptions for informative practices construction. Do the visitors have positive attitudes toward show caves? How do these visitors perceive the cave as fragile habitats? What are their concerns and expectations regarding the show caves use and conservation? We predicted that show visitors have a high connection with the environment and a low understanding of biodiversity, ecological dynamics and risk of a visitation without prior knowledge, what reinforces the need for frequent pedagogical practices to raise awareness of people and insert appropriate environmental education practices.

2. MATERIALS AND METHODS

2.1. Study site

The study was conducted in the Lapa Nova de Maquiné (MAQUINETUR, 2015) and Rei do Mato show caves (IEF, 2015), both located in Minas Gerais state, Brazil (Figure 1). Maquiné cave receives around 40,000 visitors and Rei do Mato around 22,500 along the year (PAN-CAVERNAS, 2014; IEF, 2015). None of these two show caves have religious appeal to visitors.

The Maquiné cave was discovered in 1825 by Joaquim Maria Maquiné. The cave was scientifically explored for the first time in 1834 by the Danish naturalist Dr. Peter Wilhelm Lund. The cave has seven explored halls, 650 m long and a vertical drop of 18 m. The cave was fitted with lighting and fixed pathways that enable visitors to observe the formations, but always accompanied by a guide (SOUZA, 2012; MAQUINETUR, 2015). The Management Plan and other studies in Maquiné cave so far have revealed 14 troglomorphic/troglobitic species including *Eukoenenia maquinensis*, one of the most troglomorphic Palpigradi of the world (Souza and Ferreira, 2010). Currently, the Maquiné cave and other 25 caves (non-tourist) are inserted in

a Natural Protected Area (Natural Monument Peter Lund).

Rei do Mato cave has 998m length and a vertical drop of 30 m and presents unusual features and very beautiful speleothems, especially in the Hall of rarities, where there are two symmetrical columns with about 12m height and 25cm in diameter (IEF, 2015). The cave was fitted with lighting and metal walkways that allow visitors to view the formations, also always accompanied by a guide (IEF, 2015). The management plan and other studies in the Rei do Mato cave, thus far, have revealed 4 troglomorphic/troglobitic species (IEF, 2015). Currently Rei do Mato cave and other 35 caves (non-tourist) are inserted in a Natural Protected Area (Natural Monument Rei do Mato).

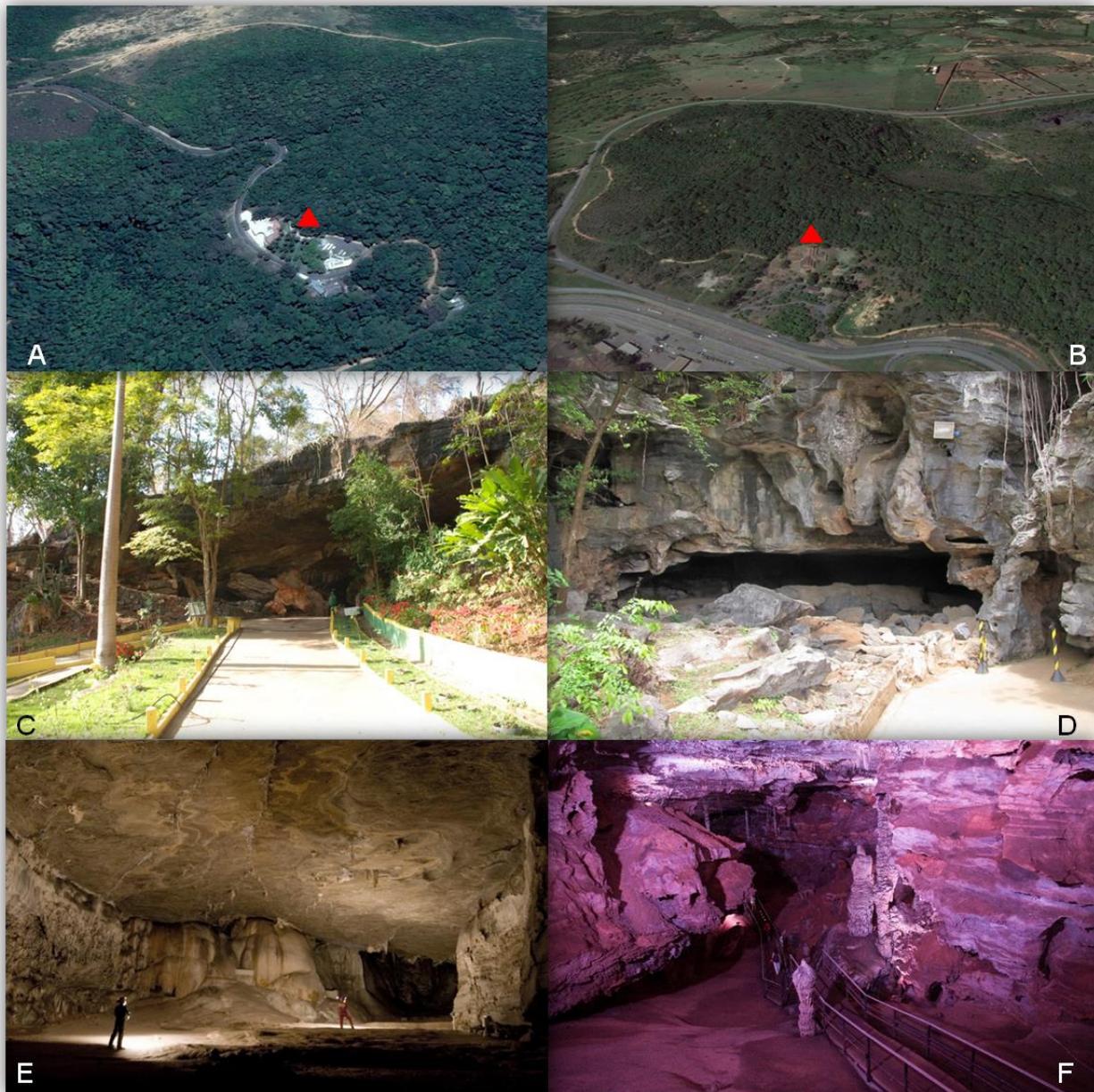


Figure 1. Lapa Nova de Maquiné (A, C, E) and Rei do Mato show caves (B, D, F) surroundings areas (A, B, C, D) and interior (E, F). Pictures: Vitor Moura (E) and Augusto Milagres (F).

2.2. Environmental perception survey

In order to obtain information regarding the reasons that led visitors to the Maquiné and Rei do Mato show caves, as well as observe how they construct a context regarding life in the caves and the need for their conservation, we used semi-structured printed questionnaire that were applied to show cave visitors in loco, right after the person has had direct experiences with the caves (Maquiné or Rei do Mato) (DONATO; DANTAS, 2009; NEWING, 2011; MACIEJEWSKI; KERLEY, 2014). Although in the questionnaire there were fields regarding data from the responders (gender, age, city/country etc.), nobody fulfilled such fields. Accordingly, we did not present those data or any analysis correlating perceptions and responder traits. The questions were: why did you come to see the cave? Have you ever visited non-tourist caves? What kind of life do you imagine can exist in caves? If any, what would they feed on? Do you believe that the preservation of the cave surroundings can help on preserving its interior? If so, what measures would you suggest preserving it?

The results about cave fauna composition and conservation needs, support the creation of an informative pamphlet to spread knowledge about cave life and to be used in environmental education programs.

2.3. Data processing

The answers built by respondents were grouped into distinct categories of key words, which were analyzed based on grounded theory methodology (GLASER; STRAUSS, 1967). The frequency for each answer was not mutually exclusive. We used descriptive information from the questionnaires as a starting point to build formal tools (pamphlet) that encourage individuals to care about show and pristine caves.

3. RESULTS

Overall, 281 questionnaires applied during week and weekends days from January to November 2000, were analyzed. Most of the participants (44.3%) have attended the show caves via school excursions, but curiosity also stood out (42.4%) as a reason (Figure 2A). Past experiences of participants visiting caves varied greatly. About 67.0% of visitors had visited only show caves, while 22.7% visited both tourist and non-tourist caves. Finally, 9.0% of the visitors had visited a cave for the first time (Figure 2B). The oldest show caves open to

visitors in Minas Gerais state and with speleological and paleontological appeal seem to be the preferred among participants. Among the main show caves occurring in this state (those adapted to large scale tourism - Maquiné, Rei do Mato and Lapinha), Maquiné was the most cited by the respondents as the most visited cave (Figure 2 C).

Regarding the living beings that inhabit caves, bats were the most cited animals (70.1%), with insects also represented (40.6%). Plants were also commonly cited (Figure 2 D), although troglobitic fauna was not mentioned by any visitor. Visitors characterized insects (25.7%) and plants (21.8%) as the main food items used by living beings in caves (Figure 2E). However, other items were also mentioned, even in small proportions, as other animals, fruits, blood and microbes. The conservation of caves is a concern for most visitors, since 90% of them considered that it is important to preserve such environments. Furthermore, they were aware of the need to preserve the external environment for the maintenance of life inside the caves, a concern shared by the majority (42.1%) (Figure 2 E and F and Table 1).

Table 1 Measures suggested by interviewed participants considered important for efficient conservation of the cave environment and its surroundings. At least, 17.6 % of respondents did not suggest anything.

Conservation actions	Responses (%)
Environmental education	29.6
Avoid depredation	23.8
Control visits	21.8
Protection of surroundings	15.7
Do not pollute the environment	13.4
Trash collection	12.6
Training of monitors	8.0
Financial incentives	5.4
Scientific research	5.4
Disclosure	4.6
Fines	3.8
Do not kill the animals	3.4
Investment and infrastructure	3.4

Visitors suggested integrated measures to conserve the cave environment and its surroundings. Environmental education practices (29.6%) were considered important for cave conservation, as well as training and information provided to visitors, but measurements towards restrained visits and depredation were also cited (Table 1). However, many visitors (17.6%) did not know what measures would be important for the conservation of the cave environment.

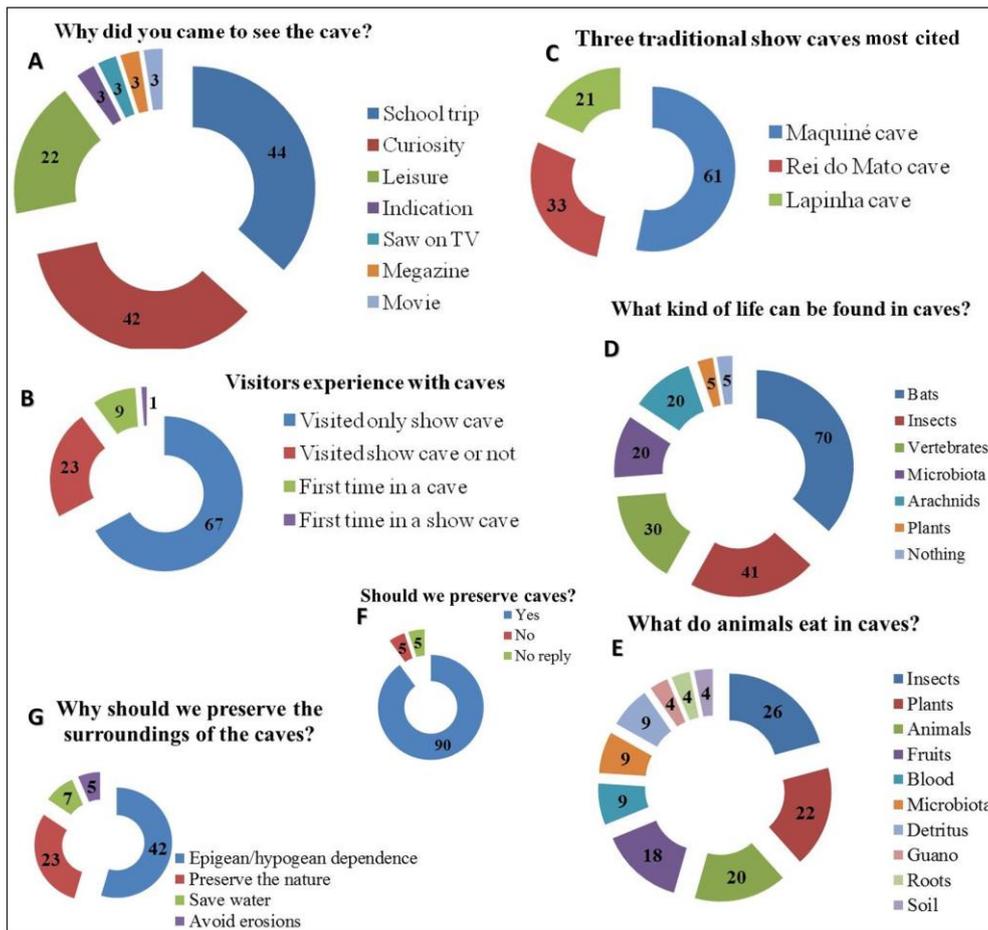


Figure 2. Frequency distribution (percentage) of the reasons that encouraged people to visit show caves in Minas Gerais state, Brazil (A), the favorite show caves (B and C) and sense about cave fauna (D and E) and environmental conservation (F and G).

Since, student were the most representative visitors, the informative pamphlet to spread knowledge about cave life was elaborated mainly focused in a young audience, what led us to use personages representing the Brazilian cave fauna with a playful aspect (Figure 3). We aimed to show the importance to aggregate values present in the local reality in order to intensify the learning and divulgate the cave life as a heritage.

4. DISCUSSION

The knowledge and popularity of a cave, the ease of access to internal areas, the travel distance to reach the cave, the legal permission for any visitor and the presence of agencies that promote organized visits are considered the main factors that contribute to a recreational visit (VAR, 2004; BOČIĆ et al., 2009; WILSON, 2012). However, environmental protection, visitor safety and profits are the main elements related to the development of caving and/or economic exploration programs. The optimization of such aspects ensures the balance and reduction of negative effects (CIGNA, 2011; RACHMAWATI; SUNKAR, 2013). Understanding the environmental

behavior and the preferences of the cave audience may be an important tool for managing and balancing the three important pillars in show cave use: environmental protection-safety-economic viability, once visit promote a positive impact on knowledge and concern and has the potential to influence future behavior.

In the present study, schools were important vehicles for the dissemination of tourism in Maquiné and Rei do Mato show caves, what also highlighted the importance of caves in teaching practices. However, in Brazil very few studies have assessed how caves should be treated in an educational manner, aiming to effectively inform and educate regarding the need for instructive visits and minimal impacts (DONATO; DANTAS, 2009; FERREIRA et al., 2014; CUSTÓDIO et al., 2014; SOUZA-SILVA et al., 2014). In such studies, the use of indoor and outdoor activities was suggested (use of booklets, field trips, multimedia, drawings etc.), however it is important to consider that an individual environmental attitude would be more improved in a natural environment than in a classroom (DUERDEN; WITT, 2010).

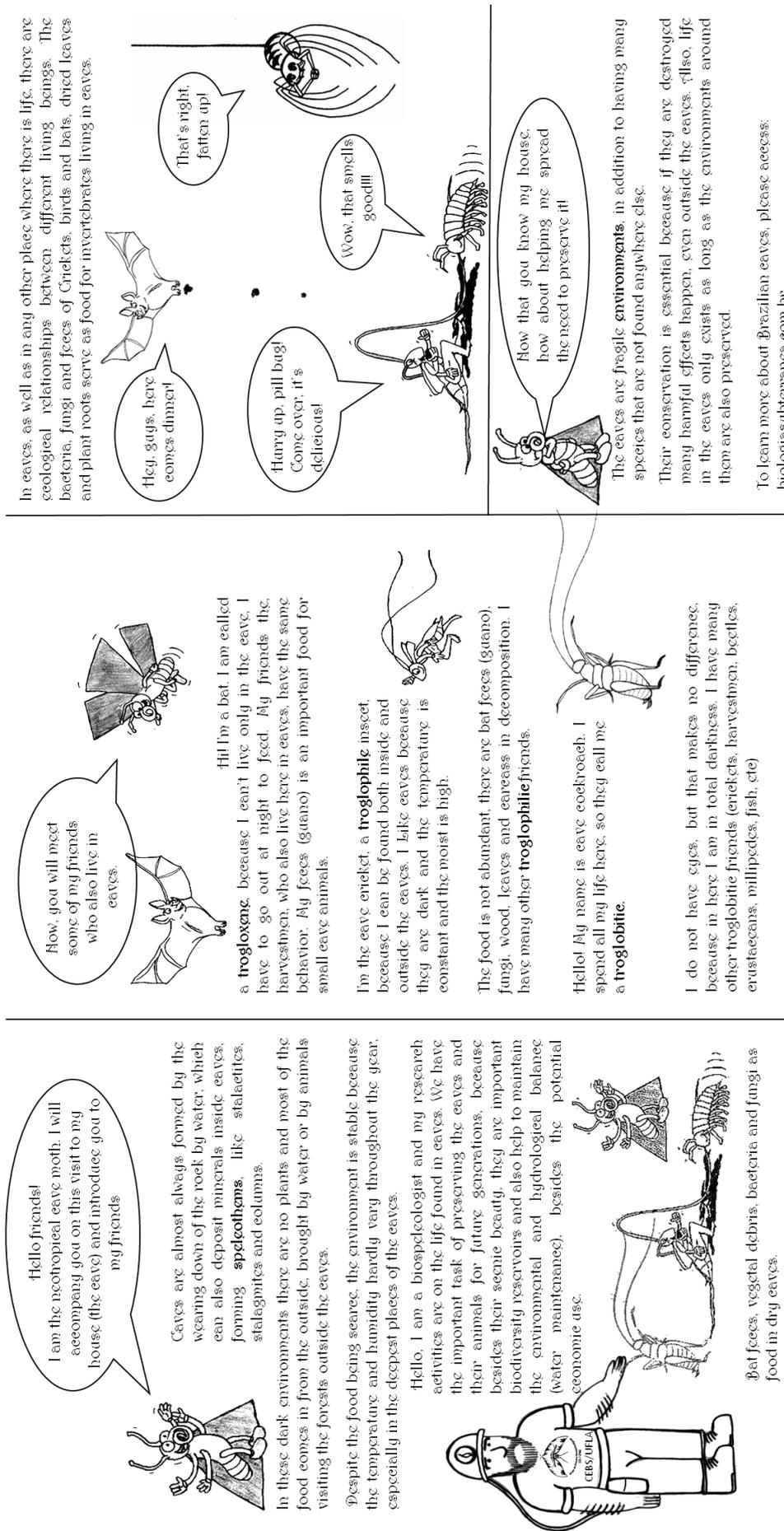


Figure 3. Educational tool suggested to be used in show caves as optional educational activity, using the common sense as anchor.

Participants mentioned animals that do not exist in Brazil, but that are common in caves along the world like bears, salamanders, or even imaginary beings like dragons, fairies or elves (Figure 2D Vertebrates). This reinforces the importance of the local and regional context on the perception of such environments and also the importance of bringing such regional components when intending to improve the visitor comprehension about caves. Therefore, it is important to mention that information on cave environments produced in regions very distant from the local reality may be ineffective in terms of disclosure and fixing knowledge. Learning is always located in some kind of social, cultural, economic or physical context and notions of such context draw attention to varying degrees of formality and also indoor/outdoor settings (RICKINSON et al., 2004).

A fact mentioned by participants is that the fauna needs to go out of the cave to look for food items. This opinion shows that many respondents only recognize animals that use caves as shelter (troglodens and troglophile), but they do not know about organisms specialized and restricted to the subterranean habitats, the troglotic ones (SKET, 2008; FONG, 2011; MACA, 2015). In Brazil, actions and vehicle of the disclosure of basic information about cave fauna for a broad audience is scarce. Furthermore, the small body size of most of the cave species (excepting, salamanders, cave fish and bats) hampers the interest and disclosure. According to Cardoso et al., (2011) the public tends to disregard invertebrate species as in need of protection because they do not recognize invertebrates or their roles in the ecosystem. However, better information and marketing can help to solve this kind of problems. Producing courses for disclosure as videos, workshops, posters, souvenirs related to cave animals or even visits to caves may help changing such point of view (DONATO; DANTAS, 2009, FERREIRA et al., 2014; CUSTÓDIO et al., 2014; SOUZA-SILVA et al., 2014). The need to share information regarding cave and their ecological and evolutionary importance as well as biotechnological potential of cave species is evident and essential both considering cultural and conservation aspects, although it is not easy assigning a popular appeal for them, since microorganisms, invertebrates and some vertebrates are not so welcome to the society (CARDOSO et al., 2011; HOFFMASTER et al., 2016). In general, bats are the most cited by the public as cave dwellers (SOUZA-SILVA et al., 2014). The public perception of bats has historically been largely negative, however people can be educated and inspired to save

bats through oriented events and exhibitions (HOFFMASTER et al., 2016).

The considerations about conservation needs and environmental education practices among participants reinforce the acceptance and importance of divulging the knowledge using popular perceptions about cave environment as an anchor to build an epistemological start point. The problem of the evidence of senses involves descriptive or "phenomenological" questions about aspects of our experience, what represents a source of evidence about the external world, normative questions on what previous experiences justify us believing and epistemic questions about the nature of these basic relations (CHISHOLM, 1988; KELLEY et al., 1988; MUNZ 1988).

The lack of professionals to apply and coordinate activities in a sustainable manner (economically, environmentally and socially) in cave environments is evident in Brazil (FERREIRA et al., 2008; FERREIRA et al., 2014; SOUZA-SILVA et al., 2014; BRUNN; SILVA, 2014). Studies related to the conservation of the cave physical environment are more frequent than those intending to preserve the biodiversity in show caves in Brazil (INIESTA et al., 2012; PELLEGRINI; FERREIRA, 2012; TAYLOR et al., 2013). Therefore, specific education efforts about biodiversity are needed to promote positive attitudes and practical conservation efforts in caves and karst areas under tourist or threatened use (KASTNING; KASTNING, 1999; VAN-BEYNEN et al., 2012; CIGNA; FORTI, 2013).

The effectiveness of educational programs regarding karst landscapes should be evaluated to select the most adequate approaches. Exhibitions, media campaigns or animated films with conservationist contents are used to stimulate positive attitudes and increase public commitment with conservation efforts, but the information is usually absorbed in an ephemeral form (NOVACEK, 2008; PILGRIM et al., 2008; ROBÉLIA; MURPHY, 2012). During transmitting formal knowledge, important factors such as interdisciplinary and informal knowledge should be fully exploited, since caves harbor many school themes like Biology, Zoology, Ecology, Evolution, Archeology, Paleontology, Hydrology, Mineralogy, Chemistry, among other (MORGADO et al., 1996; DONATO; DANTAS, 2009; CRNČEVIĆ et al., 2010; CUSTÓDIO et al., 2014; SOUZA-SILVA et al., 2014).

The development of teaching materials for training personnel that work in cave education and tourism (interpreter) may create a strong link

between the means of knowledge production and its dissemination, besides improving the quality of work offered by those professionals (FERREIRA et al., 2008; DONATO; DANTAS, 2009; CUSTÓDIO et al., 2014). Reception from an interpreter reassures clients that they are welcome and permits them to relax and become involved in the communication (LIPMAN; HODGSON, 1978).

The design of plans for show caves use are essential to mitigate impacts and provide information to help on the comprehension of the need to reduce depredations or alterations. The awareness can better educate the visitors by means of focused trainings and practices for the development of critical thinking about environmental issues. Moreover, activities involving human communities are useful for cave conservation (KASTNING; KASTNING, 1999).

5. FINAL CONSIDERATIONS

One of the most effective approaches to promote the sustainable use of karst landscapes and their caves is education. As presented in this study, schools in a karst region should offer some sort of educational activities related to the karst and its features. In this sense, show caves offer a rare opportunity to educate the general audience, mainly

because during visits technical information can be transmitted, thus providing a subtle inclusion of information and concepts, expanding the vision as well as providing the human interaction with the subterranean environment. The use of prior knowledge of visitors is, from the pedagogical point of view, a good way to begin the construction of formal knowledge about issues related to the karst. It is followed by the observation and, consequently, by the problematizations derived from it, and posteriorly by the production of hypotheses. This pedagogical exercise provided in the cave environment can lead visitors to appropriate from environmental education issues and therefore insert them in the practices developed in the caves of Brazil.

ACKNOWLEDGEMENTS

Thanks to Maquinetur and Rei do Mato show caves companies for the help in field work and Heros Lobo for provide suggestion on the manuscript. Rodrigo Lopes Ferreira is grateful to the National Council of Technological and Scientific Development (CNPq) (grant no 304682/2014-4) and Marconi Souza Silva was grateful to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes).

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Fluxo editorial:

Recebido em: 06.12.2018

Aprovado em: 10.02.2019



A revista *Espeleo-Tema* é uma publicação da Sociedade Brasileira de Espeleologia (SBE).
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