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Research Article

Benchmarking of Cave Tourism Destinations in Greece

Eva Psatha [1]

[1] University of Thessaly, Department of Planning and Regional Development, Greece
✉ Correspondence: epsatha@uth.gr

Abstract: The current article presents the findings of a comparative evaluation of selected, already developed or developing cave tourism destinations in Greece, with the purpose of recognizing, highlighting, and disseminating good practices regarding the management and capitalization of caves. Cave tourism is a promising special form of tourism that attracts people with a variety of interests. This is because caves are both impressive sights and valuable sources of scientific knowledge, combining naturalistic, geological, archaeological, and environmental interest. Thus, show caves are valuable resources, potential tourist attractions, and axes of tourist development for their wider areas. The challenge of balancing the different needs entailed by conservation, on the one hand, and by exploitation, on the other, of an attraction of such ecological and cultural importance, dictates the need for research and exchange of knowledge, experience, and good practices. To locate and diffuse good practices, the method of benchmarking was selected. The design of the methodology according to benchmarking principles led to the selection of the destinations assessed, the definition of the evaluation criteria, and the way of gathering and comparing data. The research process highlighted specific features of the caves as determining factors for attractiveness and recognition, some of which are modifiable and can form suggestions for tourist capitalization. The interpretation of the findings results in policy recommendations for better management and successful promotion of cave destinations.

Keywords: Cave Tourism; Show Caves; Cave Destinations; Benchmarking; M-GAM; MyCaves Model; Greek Caves

Highlights:

- Caves can be important tourist attractions, leading local development in non-tourist areas.
- Benchmarking sheds light to overlooked aspects of tourist attractions.
- Tourist development of caves doesn't depend only on unchanging factors such as location and décor.

1. Introduction

The current paper focuses on the comparative evaluation of specific developed and potential cave tourism destinations in Greece, with the aim of highlighting - and by extension, diffusing - the best practices regarding the management of and capitalization on this unique geological resource.

Cave tourism is a promising special form of tourism attracting people with a variety of interests. This is because caves are of great geological, archaeological, and environmental interest altogether. Indeed, in addition to being an impressive sight, caves are also valuable sources of scientific knowledge, as they bear imprints from the geological history, the environmental and climatic evolution, and the early human civilizations (Kim et al., 2008). For this reason, cave tourism is closely related to popular nature tourism, but also to other special forms of tourism, such as geological and archaeological tourism (Antić et al., 2022; Antić & Tomić, 2019).

The importance of cave tourism is imprinted on its economic size. The income from show caves globally exceeds $2.3 billion annually, while the recipients of its direct and indirect effects are estimated at 100 million people (Tičar et al., 2018). Show caves are, therefore, a valuable resource, capable of becoming a major tourist attraction, and an axis of local development for their wider areas.

This fact doesn't mean that the tourist exploitation of caves is straightforward or without challenges, since caves are fragile ecological resources, requiring careful handling and sensitive planning for visitation. As with other sensitive eco-cultural resources, the opportunity for economic exploitation through tourism development conflicts with the need for protection, often leading to scientific and political debates about the intended limits, which are usually set based on sustainability (Chiarini et al., 2022; Jelinčić & Tišma, 2022).

Since any attempt at tourism development, especially in areas with heritage resources, must follow the principles of sustainability, it is necessary to adopt a soft utilization approach with respect to the carrying capacity and the conservation needs of the areas involved. The challenge of balancing the different (and sometimes opposite) requirements of conservation, on the one hand, and tourist exploitation, on the other, for attractions of such ecological and cultural importance as in the case of caves, dictates the need to exchange knowledge, experience, and good practices for cave management and promotion.

A central position among the tools provided for the assessment of applied policies, the highlighting of the most successful ones, and the transfer of best practices is the conduct of a comparative evaluation research based on the principles of benchmarking. Since the specific technique is not a single and predetermined methodology, but is rather adapted to the content, objectives, and limitations of the surrounding research, the building of the methodology is, essentially, included in the stages of the research process (Arrowsmith et al., 2004).

In this context, the article aims to investigate the preconditions for exploiting caves as tourism resources, underlining effective methods of management and promotion. To do so, a new benchmarking tool was designed and is also presented. The wider objectives of the article are to contribute to the promotion of caves, support the need for further exploration and conservation, disseminate knowledge for cave management, and improve awareness of the importance of caves and the role of proper cave management. This is important because cave tourism is expected to increase, both in developed and developing countries, and their management needs to be sustainable from the beginning, so that caves can be part of the cultural heritage while supporting sustainable local development (Chiarini et al., 2022).

Thus, after a brief presentation of the characteristics and advantages of the benchmarking method, the followed methodology is presented, including the criteria set for selecting the participant destinations, for evaluating the caves, and for gathering and comparing the data. The results of applying the new benchmarking tool are then presented, with the aim to locate and highlight the best practices for the management and promotion of cave destinations. The paper concludes with policy recommendations.

2. Literature Review

2.1 About Cave Tourism

According to the International Show Cave Association (ISCA), a show cave is "a naturally occurring void beneath the surface of the earth that has been made accessible to the public for tours". Chiarini et al. (2022) further elaborate on this definition by identifying three common characteristics of show caves: (a) the requirement to pay an admission fee, (b) the presence of infrastructure to facilitate access (such as pathways, stairs, and lights), and (c) the supervision of visits by guides. Even based on this definition, the existence and function of show caves are already placed in the 17th century in Central Europe. The systematic development of cave tourism, however, began in the 20th century when many caves were exploited for tourism, bringing new income to local communities, caving organizations, and businesses. Gradually, from an adventurous form of tourism for the few -mainly due to the lack of infrastructure towards and around the caves- many caves emerged as popular attractions for all. However, the allure of mass tourism has resulted in increased pressures on the sensitive geological formations, bringing to the fore the need for protection and sustainable management (Chiarini et al., 2022; Gillieson et al., 2022).

Nowadays, there are approximately 1200 show caves in the world attracting more than 70 million visitors annually (Chiarini et al., 2022). Given that in the year 2000 the number of visitors was estimated at 25 million (Cigna & Burri, 2000), the dynamic development of this special form of tourism is rather obvious. Following general tourism trends, cave tourism is most popular in Europe (48% of global visits), followed by Asia (36%) and North America (8%). The revenue from cave tourism exceeds $2.3 billion annually, while the recipients of the direct and indirect effects are estimated at 100 million (Tičar et al., 2018). In Greece, which is the case study of the article, the phenomenon of speleological tourism has not been sufficiently recorded, but the upward global trend is expected to be followed as well, as shown by the increase in the number of show caves. In Greece, there are 29 remarkable operating show caves and a series of smaller ones (Show Caves of Greece, n.d.).

Caves are fragile ecosystems, vulnerable to the changes caused by the presence of humans inside and around them. Particularly vulnerable are the endemic species (like some rare and protected species of bats), the water resources controlled through the karst formations of the caves, but also the geological and archaeological findings (e.g., fossils) which are of major importance (Gillieson, 2011). The management challenges of show caves have been the subject of many scientific publications around the world. To name a few, Crane & Fletcher (2016) compare the methods followed by selected show caves in Australia and China, while Lobo & Moretti (2009) assess the sustainability of the practices followed by show caves in Brazil. The role of show caves as tourist destinations is examined by Bočić et al. for Croatia (2006), Tomić et al. for Serbia (2019), and Garofano & Govoni for Italy (2012). In Slovenia, the country with probably the greatest tradition in show cave tourism, Tičar et al. (2018) investigate best management practices of show caves for balancing between mass tourism and geoheritage protection. An increasing number of authors also focus on the environmental issues over tourism exploitation (Ballestra & Bellopede, 2022; Mulec, 2014; Panno et al., 2019; Ruggieri et al., 2017). In the same spirit, Aydin & Yuceer (2020) point out the threats posed by the constructions made to serve visitors, including stairs, paths, wirings, railings, and parking spaces, without paying attention to the protection of the cave ecosystems. Particularly interesting is also the approach of Antić et al. (2020), which introduces the concept of geoethics in cave management, highlighting the need to apply geoethical values related to the conservation and protection of the caves when leveraged for touristic purposes.

Regarding the institutional framework for cave protection, this differs from country to country or even from region to region. In Greece, according to the legislation (Ministerial Decision no. 34593 of 1983), caves are included in the category of monuments and are considered part of the country's cultural heritage. They are under the authority and responsibility of the Ephorate of Paleoanthropology and Speleology of the Greek Ministry of Culture. Local governments are considered co-responsible for the protection of caves and often take over the management. Thus, almost all caves are managed either directly by the Ministry of Culture or by the local government. On an international level, the International Union for Conservation of Nature (IUCN) has issued guidelines on cave and karst protection (Gillieson et al., 2022), while the International Show Caves Association (ISCA) has proposed guidelines for show cave management (ISCA, 2014). However, these are simply recommendations and not binding legal documents.

Nevertheless, both the recent institutional texts and the multitude of scientific publications regarding the various management challenges of show caves reveal the growing international interest in a more systematic and unified approach to the management of these fascinating geological formations.

2.2 About benchmarking

A common characteristic among people, organizations, and places is the constant pursuit of improvement. However, the definition of improvement, to move from a vague desire to a determinable goal, presupposes the process of evaluation, and thus comparison, since interpreting any performance (such as the attractiveness of a destination) relies on comparing it either with a standard or with the corresponding performances of other entities. In this context, comparative evaluation is generally a means for an individual, organization, or destination to identify its shortcomings and/or advantages over others (or against its own past performances), to identify good practices that can be transferred, and to set achievable goals for performance improvement.

According to Vartiainen (2002), the key advantage of comparative evaluations is the collection of data from different alternatives to the same issue, as the analysis of the functioning of other entities facilitates the understanding of the socio-economic and administrative aspects of development, illuminating the positive and negative sides of the respective alternative approaches. The goal when implementing a comparative

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evaluation is not simply to determine the ranking position of the organization or destination in terms of performance, but to take advantage of the accumulated experience in the considered field, i.e., to learn from one's own and others' experiences (Arrowsmith, 2004; Vartiainen, 2002; Balthasar & Rieder, 2000).

The most reputable tool for comparative evaluations is probably benchmarking, which has been established as a means of continuous improvement and quality management, with the key advantage of its focus on real applied practices with proven effectiveness. As a solid methodology applied to businesses, benchmarking seems to have started informally during the era of industrial development and to have established itself under its current name (which etymologically refers to topographical landmarks) in the 1980s (Zairi and Ahmed, 1999). Although there isn't a single commonly accepted definition for the benchmarking method, the numerous definitions proposed converge on the elements of evaluation, performance improvement, learning from competitors, sharing knowledge and experience, and identifying best practices (Kunzmin et al., 1999).

The first documented application of benchmarking in the business world is attributed to XEROX, which initially used this method to compare the manufacturing costs of its products with those of competitors (Camp, 2006). Gradually, benchmarking has spread among organizations due to the need for efficiency improvement and the increase in global competition, which requires operating competitively in an expanding context. The implementation of benchmarking practices by public organizations is recognized as a tool for improving and strengthening public administration as well, since public organizations, like businesses, invest financial and human capital in the pursuit of quality, efficiency, and effectiveness of their services (Del Giorgio Solfa, 2017). Adebanjo et al. (2010) find that benchmarking is very popular among global organizations as a self-improvement method, but of less use for highlighting and transferring best practices. Hong et al. (2012), on the other hand, find an increase in the use of benchmarking among businesses, while Castro & Frazzon (2017) point to a large increase in the relevant scientific publications with applications of the benchmarking method in various contexts.

Another distinctive feature that emerges from the literature, and is particularly applicable to benchmarking of destinations, is the promotion of a collaborative culture, since the success of the method depends on the synergies established between the participating destinations (Ramabadran et al., 2004). The pursuit of synergies is decisive for the success of the method because if the participating entities are actively involved, the possibility of adopting changes to implement the best practices increases (Hyland & Becket, 2002).

In summary, the reasons for an organization or destination to implement a benchmarking process include increasing productivity, realistic goal setting, discovering new ideas, developing a culture of continuous learning, and adopting new strategies (Camp, 2006). From the previous, the literature mostly highlights the improvement of performance, learning, and competitiveness. Performance improvement is mainly achieved through understanding the strengths and weaknesses of the organization or destination, within the realistic framework defined by the comparison with competitors and focusing on actual needs. Improving culture and learning ability, on the other hand, result from sharing knowledge, experiences, and practices. Finally, the improvement of competitiveness is achieved when the organization proceeds to transfer and adopt the emerging best practices. To promote the correct application of the method, the European Foundation for Quality Management (EFQM) issued the European Benchmarking Code of Conduct, listing 10 principles for benchmarking techniques (EFQM, 2009).

In the ever-changing and ultra-competitive global tourism industry, tourist destinations face the need for continuous improvement and development. As pointed out by Robinson et al., to cope with these increased demands, destinations are turning to methods established in the business world, where knowledge of the market is considered, over time, as the most powerful tool (Robinson et al., 2021). As tourism destinations borrow means, tools, and principles from business management, the application of benchmarking for performance improvement is not a novelty.

Dzięgiel (2020) uses benchmarking to assess the geotouristic attractiveness of show caves in Poland, using visual, cognitive, functional, and investment criteria, according to a geotourism valorization evaluation. Tičar et al. (2018), on the other hand, using the M-GAM model for evaluating geological resources, present an interesting benchmarking of caves in Slovenia, emphasizing the need to adopt ecological practices for protection. The case of Slovenia was considered particularly interesting because, on one hand, the country is an emblematic cave destination due to the well-known and numerous karst caves (the term 'karst' itself comes from the homonymous area of Slovenia) and, on the other hand, due to the level of tourist exploitation of the caves, starting from the 19th century. Furthermore, the management of the country's caves is regulated through strict legislation for their protection, and they are all considered as natural monuments of national importance, which is also the case in Greece (Ministerial Decision 34593/1108/1983). Interestingly, after benchmarking the visitation and management of large and small caves in Slovenia based on the above model, the researchers concluded that natural beauty, aesthetics, and geological importance of the caves are not adequate determining factors for tourism development.

3. Methods

3.1 A benchmarking method for cave destinations

As made clear from the previous section, benchmarking refers to a research process in which different entities are evaluated in a comparative context. Although it is the most well-known and widespread method for comparative evaluation, both in terms of references and in terms of the number of applications, neither as a concept nor as a methodology is clearly established. Since it is a practical tool lacking a common background theory, it is rather developed through the experience of its applications. Thus, the organizations and researchers using it tend to adapt the method to their research needs (Rohlfer, 2004).

According to Vartiainen (2002), the common denominator of the numerous variations of the benchmarking method is set by the principles shared between comparative research and evaluation research, which are: (a) selection of the entities to be evaluated, (b) selection of the level of comparison, (c) understanding of the concepts, (d) analysis of the findings. These principles facilitate producing reliable and comparable results. The above principles for the methodology building could also be interpreted as the questions to be answered during the design and implementation of the method, and correspondingly can be set as: (a) Whom will we evaluate? (b) What are we going to compare? (c) How shall we make the comparison? (d) What are the reasons for the differences found?

In the case of destinations' benchmarking, the above principles can be adjusted as follows:

- Selection of the entities: This involves selecting the places as well as their representing agencies. In other words, will the data concern the destination, the administrative entity (e.g., the municipality), or a corresponding organization (e.g., a management body)? For reliable results, benchmarking should consider both elements of the internal environment and the interaction with the external environment.

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- Determining the level of comparison: To ensure that data collected from different destinations and under different conditions are truly comparable, differences and similarities should be successfully captured to produce 'variables' that will help interpret the differences in performances.
- Understanding of the concepts: This stage refers to achieving a common understanding of the underlying concepts by all bodies involved (mainly the interviewees), as they play an important role in the interpretation of the results.

A common distinction between different benchmarking methods is between benchmarking of results and benchmarking of processes. The first type focuses on comparing the performances of the evaluated entities (usually by calculating quantitative indicators), while the second focuses on comparing the applied production processes to interpret differences in efficiency. In the case of destination benchmarking, the first type is more appropriate. In the literature, much more detailed categorizations of benchmarking methods are also proposed, depending on various characteristics, either of the organization evaluated or of the scope of the evaluation itself. Kyro, for example, distinguishes organizational benchmarking from network benchmarking, and local from regional, national, and global. Based on the purpose, instead of the binary categorization in benchmarking of results and processes, Kyro has proposed the categories of performance, technology, processes, capabilities, and strategy (Kyro, 2003).

The application of the benchmarking method involves the selection – or formation – and the calculation of indicators to measure the performance in specific domains of the evaluated entities (in this case destinations). Although performance measurement has its own methodological challenges, defining the indicators is necessary for achieving comparability. It also makes it possible to identify best performances both horizontally (i.e., between destinations) and vertically (i.e., weak and strong domains within destinations). The method results in both the emerging new 'standards', which are usually the best performances, and the identification of the practices that enable these performances to be achieved.

Despite the variation of the method between different applications, its principles and central steps are roughly constant and can be described as: (a) collection of data, (b) calculation of indicators (when numerical indicators are used), (c) comparison, (d) identifying best practices, and, optionally, (e) sharing experiences and encouraging the implementation of best practices (Arrowsmith et al., 2004).

The first step concerns the design of the methodology, including the set of performance measures (usually in the form of numerical indicators) and the selection of the agencies that will participate in the evaluation. The second step regards collecting data from the participating agencies (e.g., destinations, as in the present case). This step can be based on secondary data or a survey through direct contact with stakeholders (usually using structured interviews). The third step is to process the collected data, calculate the indicators, and interpret the results, including identifying the causes of performance gaps that will lead to the emergence of best practices. The interpretation requires collaboration between the participating agencies or re-communicating with the best performing organizations. The last and optional step concerns sharing the knowledge gained, often in the form of policy recommendations for improvement, and their implementation by the agencies.

A key criterion for methodology building, especially for the step of formulating the indicators to be used, is the availability of data. For example, evaluating strategies is more difficult than evaluating performances because the corresponding information is more difficult to access. An equally important criterion is the ease of recording the data and/or calculating the indicators so that no highly specialized skills are required on the part of the representatives interviewed.

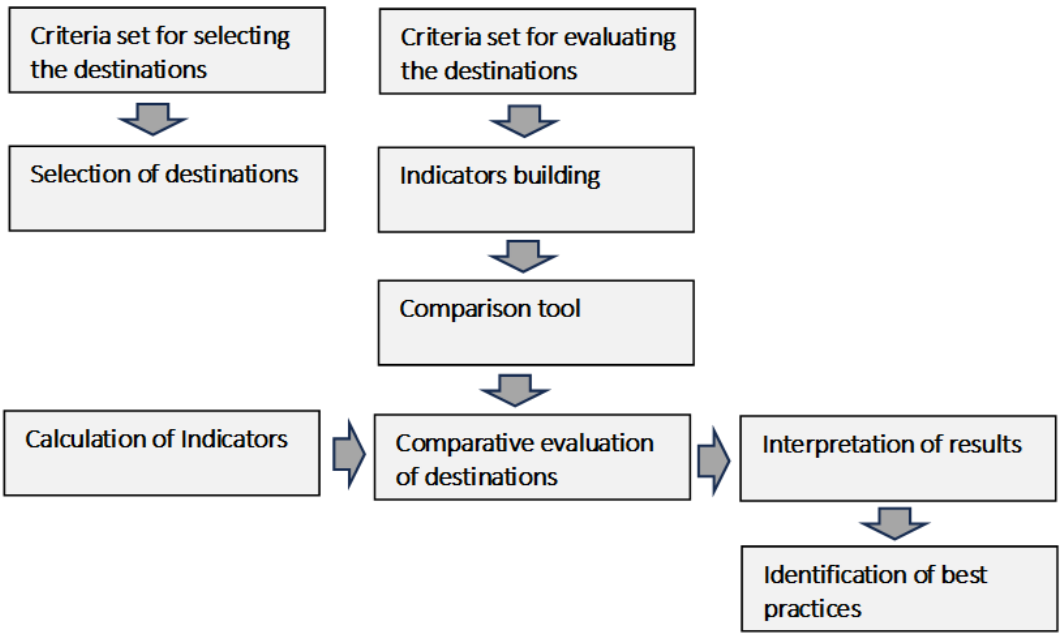

Figure 1. The method applied for benchmarking of cave destinations

Based on the above, the selected method is benchmarking of results, which compares and interprets the performance of selected destinations, following these steps:

1. Define the criteria for selecting the destinations to be assessed;
2. Identify the destinations, applying the criteria of step 1;
3. Define the criteria set for evaluating the destinations;
4. Determine indicators as proxies for evaluating determinants (quantification of the criteria from step 3);
5. Calculate indicators and compare the results;
6. Interpretate the results to reveal best practices.

A diagram illustrating the developed and used method is presented in Figure 1.

3.2 Criteria for selecting the cave destinations to be assessed

As mentioned previously, Greece boasts 29 operating show caves, which serve as established attractions or potential destinations for cave tourism. Table 1 illustrates that 13 of these caves are situated on the islands, while one is located in Attica. These areas are recognized as mature tourist destinations, a factor that amplifies cave visitation but complicates distinguishing between "visiting an attraction of a developed tourist destination" and "consciously visiting a cave destination". In essence, it is methodologically unsound to compare the performance of a show cave operating in a mature tourist destination with that of a cave situated in a non-touristic area. This is because the heightened tourism activity in established destinations is expected to skew the results, making it challenging to accurately identify best practices.

Due to these considerations, the benchmarking method was exclusively applied to the show caves of mainland Greece, with Attica excluded. The caves meeting this criterion are indicated in a darker color in Table 1, while their locations are presented in Figure 2.

Table 1. Operating show caves in Greece

No	Cave's name	Area of location
1	**Aggitis Cave**	**Drama**
2	Cave of Agia Sofia	Kithira
3	Agia Sofia Cave	Chania, Crete
4	**Cave Agios Andreas of Kastania**	**Lakonia**
5	Agio Gala Cave	Chios
6	**Agios Georgios Cave**	**Kilkis**
7	**Alepotrypa Cave at Diros**	**Lakonia**
8	**Alistrati Cave**	**Serres**
9	**Almopia Cave**	**Pella**
10	**Anemotrypa Cave**	**Ioannina**
11	Antiparos Cave	Antiparos
12	Melidoni Cave-Gerontospilios	Rethymmon, Crete
13	**Glyfada Cave at Diros**	**Lakonia**
14	Diktaion Cave	Lassithi, Crete
15	Drogarati Cave	Kefalonia
16	**Cave of the Dragon**	**Kastoria**
17	**Theopetra Cave**	**Trikala**
18	Ideon Cave	Rethymnon, Crete
19	**Kaparelli Cave**	**Argolida**
20	**Katarraktes Cave**	**Sidirokastro, Pella**
21	Peania Cave	Attica
22	**Limnes Cave**	**Achaia**
23	Melissani Cave	Kefalonia
24	Milatos Cave	Lassithi, Crete
25	Olimpi Cave	Chios
26	**Perama Cave**	**Ioannina**
27	**Petralona Cave**	**Chalkidiki**
28	Skotino Cave	Iraklion, Crete
29	Sfendoni Cave	Rethymnon, Crete

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Even after excluding the caves in the most touristic areas, the selected show caves do not exhibit the same degree of exploitation, recognition, or visitation. For instance, the caves of Diros, Perama, and Petralona are well-known established attractions, whereas others such as Almopia and Theopetra, although not lacking in sights and decorations, are newer attractions and are not yet equally well-known.

3.3 Criteria set and indicators for assessing the cave destinations

Having identified the cave destinations that will participate in the benchmarking process, the next step is to define the assessment criteria. The main factors for this process include common practices found in the literature and data availability. Data availability is not only a limiting factor but also an essential criterion for selecting indicators, as the benchmarking method aims to establish a tool that is easy to use, adequately approaches each of the examined sectors, lasts over time, and, above all, is repeatable at regular intervals, allowing continuous learning. Thus, the selected indicators should, as much as possible, be based on existing data regularly recorded by the managing authorities of the caves, without requiring primary field research in the destinations at every repetition of the process.

Through a review of the international literature to identify commonly applied areas of assessment for caves and/or cave tourism destinations, the Modified Geosite Assessment Model (M-GAM) was identified as prominent. M-GAM was proposed by Tomić & Bozić in 2014 and has since found numerous applications in the assessment of geological tourism resources. The initial model includes 27 criteria, classified into the following five domains: (1) Scientific and educational values, (2) Scenic and aesthetic values, (3) Protection values, (4) Functional values, and (5) Touristic values.

More recently, after the research presented here was conducted, Antić et al. (2022) adapted the M-GAM model specifically to caves, proofing the new model named SCAM (Show Cave Assessment Model). The difference from M-GAM lies in its incorporation of indicators from assessment models for cave management and vulnerability, resulting in a total of 15 speleological and 21 touristic values for assessment. The SCAM model is more comprehensive than the M-GAM but requires access to information regarding factors other than the caves, making it more difficult to be used periodically by cave managers themselves in the context of a benchmarking process. Interestingly, several of the touristic values proposed by SCAM are also contained in the MyCaves model presented below.

The M-GAM model, in its original form, employs a simple process of quantifying qualitative criteria through scores given by researchers and visitors (which also assumes an appropriately updated visitor survey). Grading the criteria has the advantage of providing a common rating scale for all indicators from the start, without introducing units of measurement, which would require the relatively complex process of normalizing the values.

Figure 2. Location of the eligible caves of Table 1.

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However, the benchmarking method does not require the calculation of a composite index per se, as it focuses on analyzing the domains to identify the good practices hidden behind the good performances. Although the M-GAM model served as inspiration for developing the criteria set for the present method, it was not applied as such but rather adapted to the case study. The adaptation of the criteria to the needs of benchmarking the Greek show caves was conducted based on the following principles:

- Ensuring the availability of the data required;
- Highlighting the peculiarities of the condition, operation, and management of each cave;
- Giving emphasis on the tourist perspective of the show caves.

Thus, the criteria set places more emphasis on the tourism dimension of the caves and their surroundings (or lack thereof) than the original model. Additionally, new domains and analysis questions were added to support the process of interpreting the results. Based on the above, a new model named MyCaves emerged, consisting of seven evaluation areas divided into 27 individual criteria/quality indicators, as shown in Table 2.

4. Results

Out of the 15 Greek show caves identified as eligible for the benchmarking survey, 10 ultimately responded and provided data. In the fall of 2021, a survey was conducted in the selected caves through structured interviews with the managers. The participating caves and their abbreviations are listed in Table 3, while the interview results are summarized in Table 4.

Table 2. The criteria set for benchmarking show caves, named MyCaves.

Domains of evaluation	**Criteria/Quality indicators**
1.General Features	1.1 Managing Authority
	1.2 Year of Discovery
	1.3 Year of opening to the public
2. Natural Features	2.1 Overall length of corridors
	2.2 Length of visitable corridors
	2.3 Decorations and Special characteristics
3. Operation	3.1 Opening hours
	3.2 Entry fee
	3.3 Staff (number and specialties)
	3.4 Annual budget
	3.5 Sources of funding
4. Maintenance and Protection	4.1 Current condition
	4.2 Special Protection framework
	4.3 Vulnerability
5.Surrounding Area	5.1 Part of an area of outstanding natural beauty or other special character
	5.2 Vicinity to popular tourist attractions
	5.3 Ease of access (through the local road network)
	5.4 Accessibility (through the highway network)
	5.5 Distance from large cities
6.Visitation	6.1 Number of visitors (average of 3 years)
	6.2 Main visitors' typology (students, groups, individually visiting)
	6.3 Amenities (café, gift-shop, information center)
7. Marketing and Promotion	7.1 Interpretation services
	7.2 Promotion activities
	7.3 Cooperation with tourist agencies
	7.4 Synergies with the community
	7.5 Site and Social media

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The aforementioned system of criteria resulted in the development of a questionnaire, which served as the basis for conducting structured interviews with representatives of the caves identified as eligible for benchmarking.

Table 3. Greek show caves evaluated with the benchmarking system MyCaves.

Name of Cave	**Regional Unit**	**Abbreviation**
Aggitis Cave	Drama	AGG
Cave Agios Andreas of Kastania	Lakonia	AgA
Agios Georgios Cave	Kilkis	AgG
Alistrati Cave	Serres	ALI
Anemotrypa Cave	Ioannina	ANE
Theopetra Cave	Trikala	THE
Katarraktes Cave	Pella	KAT
Limnes Cave	Achaia	LIM
Perama Cave	Ioannina	PER
Petralona Cave	Chalkidiki	PET

Table 4.a. Data on the criteria set of MyCaves collected from the Interviews (1-5 of selected caves)

Evaluation Criteria	**AGG**	**AgA**	**AgG**	**ALI**	**ANE**
1.General Features					
1.1 Managing Authority	M.E. [1]	M.E.	M.E.	S.A.	M.E.
1.2 Year of Discovery	1978	1958	1925	1974	1960
1.3 Year of opening to the public	2000	2002	1986	1998	2003
2. Natural Features					
2.1 Overall length of corridors (m.)	12.300	480	500	3.000	>500
2.2 Length of visitable corridors (m.)	500	480	300	1.000	350
2.3 Decorations and Special characteristics	Underground river, Wheel room	Number of chambers	Unique formations, Corals of stone	Stalactites, Stalagmites, Helictites, Shields, Stalactones, Pearl, Gour	River, Lakes, Bats, Shells, Colours
3. Operation					
3.1 Opening hours (h)	7 (winter), 9 (summer)	8	8	8 (winter), 9 (summer)	8 (to be expanded)
3.2 Entry fee (€)	2 to 7	3 to 7	2 to 5	3 to 8	3
3.3 Staff (number)	4	2	1	7	2
3.4 Annual budget (€)	≈130.000	50.000	-	240.000	350.000
3.5 Sources of funding	Own revenue	Municipality	Municipality	Own revenue	Municipality
4. Maintenance and Protection					
4.1 Current condition	Good	Excellent	Fair	Very good	Excellent
4.2 Special Protection framework	No	No	No	No	No
4.3 Vulnerability	High in pollutants	In anhydria	In large visitation numbers	Low	Low
5. Surrounding Area					
5.1 Part of an area of outstanding natural beauty or other special character	Yes (Area of Outstanding Natural Beauty)	No	Yes (Landmark)	Yes	Yes (Area of Outstanding Natural Beauty)
5.2 Vicinity to popular tourist attractions	Yes	No	Average	Yes	Yes

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5.3 Ease of access (local roads)	Good	Good	Good	Not good	Very good
5.4 Accessibility (highways network)	57 Km to A2	105 to E961	33 km to A1, 50 Km to A2	45 Km to A2	40 Km to A2, 50 Km to A5
5.5 Distance from large cities	61 km to Kavala, 170 km to Thessaloniki	220 km to Kalamata	160 km to Thessaloniki	135 km to Thessaloniki	56 km to Ioannina
6. Visitation					
6.1 Annual number of visitors	≈23.500	≈9.500	≈3.500	≈41.000	≈2.500
6.2 Main visitors' typology	Adults	General	Students	Adults/students	Adults
6.3 Amenities	Information Center	Café	No	Café, Gift-shop, Information Center	Café, Gift-shop, Information Center
7.Marketing and Promotion					
7.1 Interpretation services	Guided tours, Leaflets	Guided tours, Leaflets, Sign Boards	Guided tours, Leaflets, Sign Boards	Guided tours, Leaflets, Videos	Guided tours, Leaflets, Sign Boards
7.2 Promotion activities	Prints	Environmental Actions, Expos	No	Site, Social media, Video spots, Expos, Direct marketing	Prints, Expos, Video spots
7.3 Cooperation with tourist agencies	Of Bulgaria	Yes	No	Yes	n/a
7.4 Synergies with the community	With the local administration	Yes	With local schools	With local schools, and the local administration	With the local administration, and with the Environmental Education Center
7.5 Site and Social media	Directly assessed by the researchers.				

[1] Municipal Enterprise.

Table 4.b. Data on the criteria set of MyCaves collected from the Interviews (6-10 of selected caves)

Evaluation Criteria	**THE**	**KAT**	**LIM**	**PER**	**PET**
1.General Features					
1.1 Managing Authority	Ministry of Culture	Private Company	M.E.	LEPL	Ministry of Culture
1.2 Year of Discovery	1987	50's	1964	1956	1959
1.3 Year of opening to the public	2010	70's	1990	1961	70's
2.Natural Features					
2.1 Overall length of corridors (m.)	500	36	1980	-	1800
2.2 Length of visitable corridors (m.)	500	21	500	1.100	300
2.3 Decorations and Special characteristics	Arched entrance, Paleolithic findings	Decoration	Cascading Lakes	19 types of stalactites/stalagmites	Archaeological remains
3.Operation					
3.1 Opening hours (h)	Closed (temporarily)	10 (winter), 12 (summer)	8	8	8 (winter), 12 (summer)
3.2 Entry fee (€)	4	0,5	4.5 to 8	3.5 to 7	0 to 8
3.3 Staff (number)	No (temporarily)	1 -2	7	10	4
3.4 Annual budget (€)	-	-	-	600.000	-
3.5 Sources of funding	Ministry of Culture	Own revenue	Own revenue	Own revenue	Ministry of Culture
4.Maintenance and Protection					
4.1 Current condition	Fair	Excellent	Good	Excellent	Very good
4.2 Special Protection framework	A.S. [2]/P.Z.1[3]	No	No	A.S.	A.S.

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4.3 Vulnerability	Low	In large visitation numbers	Low	Low	In large visitation numbers
5.Surrounding Area					
5.1 Part of an area of outstanding natural beauty or other special character	Yes (Natura 2000)	Yes	Yes (Natura 2000)	Yes (Pamvotida Lake)	Yes (Area of Outstanding Natural Beauty)
5.2 Vicinity to popular tourist attractions	Yes	Yes	Yes	Yes	Yes
5.3 Ease of access (local roads)	Average	Very Good	Very Good	Excellent	Good
5.4 Accessibility (highways network)	75 km to A2, 92 km to A1	54 km to A2	49 km to A1	10 Km to A2	20 km to E16
5.5 Distance from large cities	77 km to Larissa	95 km to Thessaloniki	100 km to Patras	5 km to Ioannina	52 km to Thessaloniki
6.Visitation					
6.1 Annual number of visitors	≈9.000	≈13.000	≈50.000	≈90.000	≈65.000
6.2 Main visitors' typology	General	Adults/Families	General	General	Groups/Students
6.3 Amenities	Information Center	Amenities in the surrounding area	Café, Gift-shop, Information Center (under construction)	Café, Gift-shop, Information Center, tourist train	Café / Museum
7.Marketing and Promotion					
7.1 Interpretation services	Guided tours, Leaflets	Guided tours, Leaflets, Sign Boards	Guided tours, Leaflets, Sign Boards	Guided tours, Leaflets, Videos	Guided tours, Leaflets, Sign Boards
7.2 Promotion activities	No	Touristic Sites	Prints, Video spots, Expos	Social media, Video spots, Expos	No
7.3 Cooperation with tourist agencies	No	No	Yes	Yes	n/a
7.4 Synergies with the community	With schools	With a local collectivity	With local administration and environmental bodies	With local administration and volunteers	No
7.5 Site and Social media	Not part of the interviews, scored directly by the researchers				

[2] Archaeological Site
[3] Protection Zone of grade 1

After data mining from the structured interviews, the scoring of the indicators followed to achieve comparability. The 27 criteria of MyCaves were divided into two categories for rating. Category A incorporated purely qualitative criteria that cannot or do not make sense to be graded but potentially hold an interpretive character for visitation. Such criteria include the managing authority (1.1), the year of discovery (1.2), the year of opening (1.3), the overall length of corridors (2.1), the annual budget (3.4), the sources of funding (3.5), the special protection framework (4.2), and the typology of visitors (6.2). These eight indicators were named indicators 1-8. Category B, on the other hand, incorporated the remaining measurable criteria, which were named indicators 9-27. To score these indicators, the rating scale of 5-10 was used, with the addition of number 4 for the few cases where a performance requires special attention. Thus, the indicators of category B could receive one of the following numerical values: 4, 5, 6, 7, 8, 9, 10. The criteria for assigning scores to the measurable qualitative and quantitative indicators of MyCaves (Indicators 9-27) are presented in Table 5.

Table 5. Score setting for the quantifiable criteria of the MyCaves model (Indicators 9-27).

Indicator	**Scores**						
	4	**5**	**6**	**7**	**8**	**9**	**10**
9. Length of visitable corridors (m.)	<150	150-300	300-450	450-600	600-850	850-1000	<1000
10. Decorations and Special characteristics	Comparative score, depending on the rarity, given in consultation with the cave managers						
11. Opening hours (h)	< 8	8	9	10	11	12	>12
12. Entry fee (€)	<15	12-15	10-12	9-10	7-8	5-6	<5
13. Staff (number)	1	2	3	4	5	6	≥7
14. Current condition	Dangerous	Very bad	bad	Fair/ average	good	Very good	excellent

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15.Vulnerability	Comparative score, given after consulting with the cave managers						
16. Part outstanding natural beauty area	Degraded area	Average area	Well-known area	Area of naturalistic beauty	Natura or other natural habitat	Area of outstanding natural beauty	National park
17. Vicinity to popular tourist attractions	Composite score, in which the distance, importance, and ease of access of the nearest attractions were considered						
18. Ease of access (local roads)	Bad	Not good	Fair	Average	Good	Very good	Excellent
19. Accessibility (highways network)	>125 km to motoraway or national road	100-125 km to motorway or national road	75-100 km to motorway or 50-75 km to national road	50-75 km to motorway or 30-50 km to national road	30-50 km to motorway or 10-30 km to national road	10-30 km to motorway or <10 km to national road	< 10 km to motorway
20. Distance from large cities	>200 km to a metropolis or large city	200-250 km to a metropolis or 150-200 km to a large city	150-200 km to a metropolis or 100-150 km to a large city	100-150 km to a metropolis or 50-100 km to a large city	50-100 km to a metropolis or 10-50 km to a large city	≤50 km to a metropolis or ≤ 10 km to a large city	Inside a large city or metropolis
21. Annual number of visitors	Normalized value in the range 5-10						
22. Amenities	No amenities	Amenities in short distance	Only information center	Only gift-shop or café	2 of the following: gift-shop, café, information center	Café, gift-shop and information center	More amenities
23. Interpretation services	No interpretation	conventional media, no guided tours	Guided tours	Guided tours and conventional media	Guided tours and multimedia	Guided tours and other interactive media	VR, AR
24. Promotion activities	No promotion perspectives	No promotion activities yet	Basic promotion	Expos and other promotion activities	Targeted marketing actions	Social media and direct marketing actions	Marketing Plan
25. Cooperation with tourist agencies	No cooperation perspectives	No cooperation yet	Comparative score, depending on the number and pursuit of partnerships				
26. Synergies with the community	No perspectives for synergies	No synergies yet	Cooperation only with local administration	Synergies with schools and/or collectivities: depending on the number and impact of synergies			
27. Site and Social media	No site or social media	Old site, No social media	Basic use of Site, no social media	Site and social media: depending on the degree of use and updates			

The results of the scoring process summarize the benchmarking of the show caves and are presented in table 6. The last row contains the total scores, which correspond to the overall performances of caves.

Table 6.a. Results of benchmarking Greek show caves (1-5 of selected caves)

Evaluation Criteria	**AGG**	**AgA**	**AgG**	**ALI**	**ANE**
A. Informative data and/or Qualitative criteria					
1.Managing Authority	M.E. [1]	M.E.	M.E.	S.A.	M.E.
2.Year of Discovery	1978	1958	1925	1974	1960
3.Year of opening to the public	2000	2002	1986	1998	2003
4.Overall length of corridors (m.)	12.300	480	500	3.000	>500
5.Annual budget (€)	≈130.000	50.000	-	240.000	350.000
6.Sources of funding	Own revenue	Municipality	Municipality	Own revenue	Municipality
7.Special Protection framework	-	-	-	-	-

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8.Main visitors' typology	Adults	General	Students	Adults/students	Adults
B.Quantified criteria (scores)					
9. Length of visitable corridors	6	6	5	10	5
10. Decorations and Special characteristics	7	5	6	6	8
11. Opening hours	5	5	5	5	5
12. Entry fee	8	8	9	8	10
13. Staff (number and specialties)	8	5	4	10	5
14. Current condition	8	10	7	9	10
15.Vulnerability	8	8	8	9	9
16. Part outstanding natural beauty area	9	5	6	8	9
17. Vicinity to popular tourist attractions	8	5	6	8	9
18. Ease of access (local roads)	8	8	8	5	9
19. Accessibility (highways network)	7	5	8	8	8
20. Distance from large cities	7	5	9	7	7
21. Annual number of visitors	7	6	5	8	5
22. Amenities	8	7	5	9	9
23. Interpretation services	6	7	7	8	7
24. Promotion activities	6	7	5	9	7
25. Cooperation with tourist agencies	9	9	5	9	4
26. Synergies with the community	6	7	7	8	8
27. Site and Social media	7	7	6	10	7
Total Score	**138**	**125**	**121**	**154**	**141**

Table 6.b. Results of benchmarking Greek show caves (6-10 of selected caves)

Evaluation Criteria	**THE**	**KAT**	**LIM**	**PER**	**PET**
A.Informative data and/or Qualitative criteria					
1.Managing Authority	Ministry of Culture	Private Company	M.E.	LEPL	Ministry of Culture
2.Year of Discovery	1987	50's	1964	1956	1959
3.Year of opening to the public	2010	70's	1990	1961	70's
4.Overall length of corridors (m.)	500	36	1980	-	1800
5.Annual budget (€)	-	-	-	600.000	-
6.Sources of funding	Ministry of Culture	Own revenue	Own revenue	Own revenue	Ministry of Culture
7.Special Protection framework	A.S. [2]/P.Z.1[3]	-	-	A.S.	A.S.
8.Main visitors' typology	General	Adults/Families	General	General	Groups/Students
B.Quantified criteria (scores)					
9. Length of visitable corridors	6	4	6	10	5
10. Decorations and Special characteristics	7	7	9	9	9
11. Opening hours	5	9	5	5	7
12. Entry fee	10	10	8	8	8
13. Staff (number and specialties)	5	4	10	10	7

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14. Current condition	7	10	8	10	9
15.Vulnerability	5	8	9	5	8
16. Part outstanding natural beauty area	8	9	8	8	9
17. Vicinity to popular tourist attractions	10	10	9	9	10
18. Ease of access (local roads)	7	9	9	10	8
19. Accessibility (highways network)	7	7	8	9	8
20. Distance from large cities	7	8	7	9	9
21. Annual number of visitors	6	6	9	10	9
22. Amenities	6	9	8	10	8
23. Interpretation services	6	6	8	7	4
24. Promotion activities	5	8	7	8	4
25. Cooperation with tourist agencies	5	5	9	9	4
26. Synergies with the community	8	7	8	7	4
27. Site and Social media	7	4	10	9	6
Total Score	**127**	**140**	**155**	**162**	**136**

However, the summation of the total score serves less to record the overall performance of each cave and more to identify which caves accumulate the most favorable grades across evaluation domains, revealing good practices. It should also be noted that some scores do not represent performances per se, as they relate to intrinsic characteristics of the caves (e.g., geographical location, decoration, etc.). Nevertheless, these data are also evaluated, as the research aims not only to record performances but also to explore the conditions under which the potential for tourism development can be strengthened.

Thus, while all caves exhibit strengths and weaknesses, three caves—Alistrati, Limnon, and Perama—appear to stand out in terms of visitation and good practices, as they achieve the highest total score across all criteria. Additionally, the Anemotrypa, Agiti, and Petralona caves receive favorable ratings, as does the Katarraktes cave, albeit being a special case due to its surroundings, management, and proximity to waterfalls. The caves of Agios Andreas, Agios Georgios, and Theopetra garner slightly lower overall scores.

5. Discussion

Correlating the individual scores with visitation numbers and overall performance, while considering the informative and interpretative criteria of Table 6 (indicators 1-8), yields some enlightening findings.

Regarding the correlation of criteria with visitation, it appears that caves attracting more than 20,000 visitors typically possess the longest corridors and/or the most significant decoration and finds. Under this perspective, features playing the most significant role in visitation and recognition are intrinsic. This expectation stems from the fact that longer visiting routes and more impressive decoration offer a lengthier and richer experience. As visitable corridors usually constitute a small portion of a cave's overall area, caves could potentially increase their visitable space, thereby improving their tourism prospects.

Accessibility, both via the national road network and local roads, also significantly influences visitor numbers, as caves with higher visitation (over 20,000 per year) tend to have accessibility scores (indicators 18 and 19) of 8 or higher. Equally important are supporting amenities such as cafés, information centers, museums, and gift shops, all enhancing the visitor experience and correlating with higher visitation numbers and overall ratings.

Equally important are supporting amenities such as cafés, information centers, museums, and gift shops, all enhancing the visitor experience and correlating with higher visitation numbers and overall ratings.

A significant correlation exists between a cave's online presence (website and social media) and its overall score, as well as between cooperation with tourist agencies and visitor numbers, as expected.

While being part of or near an area of outstanding natural beauty is undoubtedly important, it did not emerge as a critical factor for visitation, as it is present in almost all cases. The same applies to entry fees, which are similar among the examined caves.

Performances in interpretation services (typically conventional) and cooperation with the local community (average in all cases) also showed little variation and did not emerge as crucial factors for cave visitation.

Most examined caves employ fragmented and conventional promotional methods, with none appearing to implement or have a marketing plan. Without targeted marketing, the existence of a primary visitor type (target group) does not ensure better visitation, as the most popular caves attract visitors of all types.

Similarly, proximity to a large urban center or popular tourist resorts does not guarantee visitation at present. However, this is expected to change with the implementation of appropriate marketing actions in the future.

Finally, the year of opening as a show cave strongly correlates with visitor numbers, as four of the five most visited show caves have been operating for more than 50 years. The Aggitis Cave, however, is an exception to this rule, suggesting that this factor influences but does not define tourism prospects. This finding is enlightening for caves explored but not yet opened to the public, as they have the potential to become tourist

attractions in the future. To achieve this, however, they must adopt marketing techniques and pursue cooperations to compete with older show caves that have gained recognition over time.

Upon examining the effectiveness of the MyCaves system, a deeper analysis of the interviews unveiled intriguing qualitative insights that elude quantification by systems like MyCaves and other variants of the M-GAM. Specifically, discussions with managers illuminated the varying degrees of concern regarding the vulnerability of caves and the potential repercussions of visitor presence, despite a general acknowledgment of their unique characteristics. Notably, while some caves prioritize continuous monitoring of microclimate parameters or express concerns about visitor behavior (particularly touching rocks), others assert the cave's resilience or adherence to regulations from the Ephorate of Paleoanthropology and Speleology, the supervisory authority. Furthermore, it's notable that personnel in most show caves lack specialization, with roles often extending beyond their primary duties. For instance, in caves with inadequate staff, electrical maintenance personnel and janitors may also serve as guides. Despite shortcomings in promotional efforts and collaborations, cave managers generally maintain a positive outlook from a tourism perspective.

However, despite the utility of periodic benchmarking with the MyCaves system in assessing current conditions and identifying promising opportunities, it falls short in fostering adoption within a strategy for sustainable tourist development of show caves. Although the overarching framework for cave protection in Greece appears effective, as evidenced by the absence of significant protection issues, there's a need for increased awareness among personnel involved in daily operations. This awareness should prioritize sustainability concerns and be effectively transmitted to visitors. To address this, establishing conference training sessions involving personnel from all operational show caves could facilitate continuous updates and the exchange of knowledge, experiences, and best practices.

6. Conclusions

The previous findings highlight interesting practices that caves can adopt to enhance their prospects for tourism development, provided they align with their carrying capacity and sustainable potential. These conclusions are not limited to the specific caves examined but can serve as the foundation for management policies for other caves in Europe and the Balkans—an area with the potential to become an outstanding cave tourism destination (Dollma, 2019; Marjanovic et al., 2021; Tomić et al., 2019).

Among the actions deemed most important for promoting show caves as tourism attractions is the improvement of accessibility where necessary and the expansion of visitable surfaces to enhance the visitor experience. Caves should also enhance their surroundings and develop amenities, including museums or information centers utilizing new technologies. Operating leisure amenities such as cafés and gift shops are essential, as they not only enrich the visiting experience but also generate revenue for the caves. Simultaneously, maintaining a strong online presence with modern, regularly updated profiles on social media and user-friendly websites is crucial. Establishing synergies with the local community, such as selling local products, can further enhance the cave's visibility and raise awareness of its significance as a resource worthy of protection and promotion.

Lastly, establishing branding and implementing marketing actions within an integrated communication strategy are essential for putting a cave on the tourist map and enhancing its attractiveness. In the competitive tourism market, marketing strategies and partnerships with tour operators can be pursued both individually and at a network level. Networking among different caves, even across neighboring countries, can facilitate their promotion as a unified geological resource in the growing cave tourism market. Such networking can highlight the unique characteristics of each cave individually and the collective strengths of the network while serving as a conduit for expertise exchange and sharing of best practices.

A prerequisite for all these efforts is the conduct of specialized studies to determine the carrying capacity and define the conditions under which each cave can function sustainably as a cave tourism destination.

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