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ECO-FRIENDLY AND NICHE ADVENTURE TOURISM: CAVING EXPERIENCES AS A FACTOR OF TOURISM DESTINATION DEVELOPMENT

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Ekologiczna i niszowa turystyka przygodowa: eksploracja jaskiń jako czynnik rozwoju destynacji turystycznej

Streszczenie

Rozwój turystyki stworzył możliwość rozwoju specjalnych form turystyki dostosowanych do konkretnych zainteresowań turystów, które jednocześnie promują zrównoważony rozwój turystyki wiejskiej i przyczyniają się do dobrobytu ekonomicznego destynacji turystycznej. W artykule zbadano hipotezę, że doświadczenia speleologiczne, gdy są zgodne z ekologicznymi i niszowymi zasadami turystyki przygodowej, mogą znacznie zwiększyć zrównoważony rozwój turystyczny destynacji, w szczególności wykorzystując Grotte di Castellana jako model i eksplorując potencjał jaskiń Sokobanja. Badanie zidentyfikowało trzy kluczowe czynniki motywacyjne dla turystów odwiedzających Grotte di Castellana: mityczne ścieżki, przygodę z celem oraz poznanie jaskini, które podkreślają różne sposoby, w jakie turyści nawiązują relację ze środowiskiem jaskiniowym. Dodatkowo, analiza obejmuje ocenę efektywnej infrastruktury turystycznej w Grotte di Castellana jako punktu odniesienia dla rozwoju turystyki jaskiniowej w Sokobani. Na tej podstawie przedstawiono rekomendacje mające na celu poprawę zrównoważonego rozwoju i atrakcyjności zasobów speleologicznych Sokobani poprzez inicjatywy z zakresu turystyki ekologicznej. Przyszłe badania po-

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winy koncentrować się na tworzeniu i monitorowaniu strategii rozwoju, aby zapobiec dalszemu niewłaściwemu zarządzaniu zasobami speleologicznymi Sokobani. Zarówno samo badanie, jak i jego wyniki, powinny zachęcić lokalne władze oraz zarządzających destynacją turystyczną Sokobani do postrzegania turystyki jaskiniowej jako potencjału rozwojowego.

Słowa kluczowe: turystyka jaskiniowa, motywacje, ekologiczna zrównoważoność, turystyka przygodowa, Grotte di Castellana.

Abstract

The development of tourism has created an opportunity to enhance special forms of tourism tailored to specific interests of tourists, which also promote the sustainability of rural tourism and contribute to the economic prosperity of the tourist destination. The paper investigates the hypothesis that caving experiences, when aligned with eco-friendly and niche adventure tourism principles, can significantly enhance the sustainable tourism development of destinations, specifically using Grotte di Castellana as a model and exploring the potential of Sokobanja's caves. The study identifies three key motivational factors for tourists visiting Grotte di Castellana: Mythic Trails, Purposeful Adventure, and Cave Insights, which highlight the various ways tourists connect with cave environments. Additionally, the research evaluates the effective tourism infrastructure at Grotte di Castellana as a benchmark for developing caving tourism in Sokobanja and offers recommendations to improve the sustainability and appeal of Sokobanja's speleological resources through eco-friendly tourism initiatives. Future research should focus on creating and monitoring development strategies in order to prevent further inadequate management of Sokobanja's speleological resources. The research and the study itself should encourage the local government and the management of the Sokobanja tourist destination to look at show cave tourism as a potential for development.

Keywords: cave tourism, motivation, ecological sustainability, adventure tourism, Grotte di Castellana.

Introduction

Ecological and personalized adventure tourism is increasingly being recognized as a significant factor in the development of tourist destinations (Chiarini et al., 2022). This market niche not only meets the growing demand for sustainable travel options, but also enhances the appeal of destinations by offering unique and individualized experiences (Buckley et al., 2025). Among its various forms, speleological tourism—or cave tourism—emerges as a distinctive blend of adventure and ecotourism, involving the exploration of natural cave systems for recreation, education, and scientific interest (Houge Mackenzie & Kerr, 2013). It typically takes place in sensitive underground environments, requiring responsible visitor behavior and sustainable management practices. As such, cave tourism aligns with the principles of sustainability by promoting environmental education, conservation, and community-based benefits, while offering immersive and often physically engaging experiences in natural settings. There

is a growing need for tourism offerings that allow modern tourists to connect with nature while also engaging in meaningful and adventurous travel. Research on adventure tourism is expanding, with scholars focusing on four broad areas: risk, motivation, experience, and product development (Deb et al., 2023). According to Bojović et al. (2024), there is significant demand potential for these types of experiences, with an estimated 60 million adventure-oriented tourists active on the international market. Within this spectrum, speleological tourism caters to a specific segment of environmentally conscious and experience-driven travelers seeking both intellectual enrichment and emotional engagement with the natural world.

Outdoor adventure tourism, including caving, has the potential to promote sustainable practices and well-being by fostering connections with nature, which can in turn lead to environmentally responsible attitudes and behaviors (Yeh et al., 2025; Arsić et al., 2025). Abdurakhmanova and Ahrorov (2025) emphasize that ecotourism should achieve outcomes such as nature conservation, sustainability education, and local community benefits. Speleological tourism, when developed according to these principles, can serve as a model for integrating environmental stewardship with adventure-based experiences. The incorporation of environmentally friendly practices and customized activities attracts eco-aware tourists and supports long-term, sustainable economic development (Apollo et al., 2023). This form of tourism, however, must be carefully managed to avoid overuse and environmental degradation. Instead, it should remain small-scale, environmentally responsible, and tailored to the unique characteristics of cave environments (Piano et al., 2022). By focusing on ecological sustainability and personalized experience design, destinations can tap into a growing market of environmentally conscious travelers (Vujko et al., 2025). This approach enhances not only the sustainability of tourism development but also the competitive appeal of the destination. Bojović et al., (2024) argue that adventure tourism can support sustainability goals when embedded within socio-ecological systems and tailored to achieve specific outcomes in conservation and development. Adventure tourism globally is valued at \$263 billion and is the fastest-growing sector in tourism, often involving longer, more immersive stays in remote locations by skilled travelers in search of authentic nature and culture-based experiences (Antón et al., 2014; Buckley & Mossaz, 2018). When aligned with local landscapes and managed appropriately, speleological tourism can support both conservation and economic goals (Beames et al., 2022). It draws tourists who are motivated by a desire to experience natural phenomena and cultural narratives in a responsible and meaningful way (Dashchuk et al., 2024). However, as Buckley et al. (2025) caution, enjoyment and well-being alone do not guarantee environmental protection—visitor behavior and evidence-based management are critical. Well-crafted speleological tourism experiences can en-

hance visitor awareness, authenticity, and satisfaction, potentially contributing to long-term conservation goals (Câmara et al., 2023).

This paper begins with the hypothesis (H) that caving experiences, when developed under eco-friendly and niche adventure tourism principles, significantly contribute to the sustainable tourism development of destinations, as exemplified by Grotte di Castellana, with potential application to the caves of Sokobanja. The main aim is to explore how this form of tourism can act as a catalyst for destination development, using Grotte di Castellana as a benchmark and assessing the applicability of its practices to Sokobanja, Serbia. The research first analyzes the motivations and attitudes of tourists who visited Grotte di Castellana, identifying three core motivational factors: Mythic Trails, Purposeful Adventure, and Cave Insights—each reflecting emotional, physical, and intellectual engagement with cave environments. It further evaluates the site’s management and visitor experience as a model for developing similar offerings in Sokobanja. Finally, recommendations are proposed to improve the attractiveness and sustainability of Sokobanja’s speleological assets—such as the Ozren, Sesalac, and Ledenica caves—through eco-friendly and adventure-based tourism strategies.

Cave tourism

Since the 20th century, caves have been utilized for tourism, contributing to local economies and benefiting various stakeholders (Antić et al., 2022b). Caves serve as motivators for rest and escape from daily routines, offering adventure, mystery, natural beauty, knowledge, and outdoor experiences (Chylińska, 2024). As a form of geotourism (Farsani et al., 2011), cave tourism is increasingly popular due to its nature-based appeal, although it poses challenges for sustainable management (Cvijanović et al., 2025). Research on Polish speleologists emphasizes physical motivation, effort, and satisfaction derived from cave exploration (Chylińska, 2024). Attractions such as cave formations and accessibility influence tourist appeal. Show caves are important tourism assets in many developed countries, generating substantial revenue—\$850 billion annually (Piano et al., 2024). In Spain, Las Güixas cave demonstrates the role of guides in conservation and safety (Giménez et al., 2024). Romanian caves showcase history and natural beauty while ensuring heritage preservation (Meleg et al., 2018). Slovenia’s Postojna and Škocjan caves are prominent examples with historical and UNESCO recognition. Environmental protection is essential, with emphasis on carrying capacity to prevent degradation (Bolechová et al., 2022). Caves in Slovakia support both tourism and speleotherapy.

Grotte di Castellana in Italy exemplifies good cave management (Parise, 2003). Discovered in 1938 and opened to tourists soon after (Iannace & Trematerra, 2014), it is noted for its acoustics and cultural uses, biodiversity (Marzo et al., 2016), and environmental resilience to tourism (Cigna & Forti, 2013). It attracts over 250,000 visitors annually. Sustainable cave tourism requires geoethical practices and long-term strategies (Antić et al., 2022a). In Serbia, cave tourism is less developed. Most caves are unknown and inaccessible to tourists, though they interest hikers, recreationists, and scientists (Antić et al., 2022b). Only about 18,000 tourists visit Serbian caves annually, with Resava Cave being a notable site. Eastern Serbia, including Sokobanja, holds untapped potential with various speleological features (Milojević et al., 2015). However, many are not protected or guided. Responsible cave tourism depends on proper management (Antić et al., 2022b). Guidelines for converting caves into show caves are vital to preserve their value (Cigna & Burri, 2000; Cigna & Forti, 2013).

Methodology

The research was conducted in August 2024 among tourists visiting Grotte di Castellana, one of the most renowned and frequently visited tourist caves in Italy, located in the Puglia region. The site receives approximately 250,000 visitors annually, with August being the peak month, attracting around 150,000 tourists. This high volume underscores its importance as a flagship destination in European cave tourism. The sample consisted of 388 respondents, which satisfies the recommended sample size for a population of 250,000 visitors, based on a 95% confidence level and a 5% margin of error (Ahmed, 2024). A convenience sampling method was used, as researchers approached tourists at the cave entrance and exit points during multiple visits across August. Participants were invited to voluntarily complete the questionnaire on-site after their cave tour, ensuring they had direct and recent experience with the attraction. The data collection instrument was a structured questionnaire comprising 20 items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaire was pre-tested in a pilot study with 25 visitors prior to the main data collection, to ensure clarity, reliability, and content validity. Minor revisions were made based on feedback from the pilot to improve question wording and response flow. The final instrument demonstrated acceptable internal consistency across items, and the results of the main survey were subjected to factor analysis, which identified three core motivational dimensions: Mythic Trails, Purposeful Adventure, and Cave Insights. These constructs represent the emotional-symbolic, physical-experiential, and cognitive-educational aspects of cave tourism motivation, respectively. Understanding how tourists

engage with these dimensions offers practical insights for developing tailored, sustainable, and experience-rich speleological tourism products.

The first factor reflects tourists' interest in mystical and less-explored caves, exemplified by Ozren Cave. Located at 540 meters above sea level, it features several chambers and five galleries, with a walkable stretch of 580 meters. Historical findings include Neolithic pottery and cave bear remains. Due to its unique microclimate and presence of radioactive particles, it has been considered for asthma therapy, although tourism projects initiated in the 1980s were never completed (Milojević et al., 2015). The second factor emphasizes adventure and social experiences, illustrated by Sesalac Cave, located 19 km from Sokobanja. It is a well-studied speleological site, visited by about 15,000 people annually (Tourist Organization of Sokobanja). It features a 200-meter illuminated path, various karst formations, and one of Europe's largest colonies of protected bats. In 2022, a request was submitted to designate it as a category III protected area due to its ecological and scientific value (Milojević et al., 2015; Nešić et al., 2022). The third factor addresses educational and intellectual motivations for cave visits, represented by the Ledenica Pit, a karst feature near Mt. Rtanj. Documented since 1836, the pit is 96 meters deep with a year-round ice presence, offering a unique natural phenomenon. Despite the lack of tourist infrastructure, it attracts adventurers who descend to experience the ice firsthand (Milojević et al., 2015).

The paper started from the initial hypothesis H that Caving experiences, when developed with eco-friendly and niche adventure tourism principles, significantly contribute to the sustainable tourism development of tourist destinations, as exemplified by Grotte di Castellana and with potential application to the caves of Sokobanja. The study conducted by Psatha (2024) on caves as tourist attractions in Greece suggests that benchmarking and sharing best practices can improve the management and promotion of cave destinations. The example of a tourist cave in Italy, which was included in the research, should serve as a foundation for further development of show cave tourism in Sokobanja. The results of the analysis identified three key factors that can be compared across multiple caves and pits in the Sokobanja area.

To test the initial hypothesis, it was necessary to formulate several supporting sub-hypotheses.

H1: Tourists are significantly motivated by the cultural and mythic narratives associated with cave environments (Mythic Trails). This hypothesis is based on findings that emphasize the role of cultural symbolism, mythology, and storytelling in enriching the tourism experience, particularly in heritage and nature-based settings (Chronis, 2005; Kim et al., 2008). Caves, often steeped in local legends and spiritual significance, provide a rich narrative landscape that appeals to tourists seeking symbolic meaning and emotional engagement.

H2: Tourists prefer caves that offer active, adventurous, and immersive physical experiences (Purposeful Adventure). Adventure tourism literature frequently highlights the importance of physical challenge, exploration, and experiential immersion as key motivational factors (McIntosh, 1999; Buckley, 2007). Caves that involve guided exploration; climbing, or navigating complex underground paths attracts tourists looking for purposeful, physically engaging experiences that go beyond passive sightseeing.

H3: Tourists show high interest in caves with educational, scientific, or natural uniqueness (Cave Insights). Nature-based tourists are often driven by a desire for learning and intellectual stimulation through direct encounters with natural phenomena (Ballantyne & Packer, 2011). Caves that feature rare geological formations, paleontological artifacts, or educational interpretation panels meet this demand by offering insight into the natural world, scientific discovery, and environmental processes.

These three dimensions—Mythic Trails, Purposeful Adventure, and Cave Insights—are conceptually aligned with broader categories of tourist motivation: emotional-symbolic, physical-experiential, and cognitive-educational. As such, the sub-hypotheses serve as a theoretically informed framework for investigating how different motivational drivers influence tourist engagement in cave environments.

Following the identification of key motivational dimensions through **exploratory factor analysis**, the study proceeded with **Structural Equation Modeling (SEM)** to further examine the relationships between the extracted factors and their influence on tourist engagement in caving experiences. SEM was employed as a robust multivariate technique that allows for the simultaneous analysis of multiple dependent relationships. This method enabled the researchers to test the theoretical model developed from the factor analysis, assess the strength and direction of the relationships between the factors—namely *Mythic Trails*, *Purposeful Adventure*, and *Cave Insights*—and evaluate the overall appropriateness of fit. The application of SEM contributed to a deeper understanding of how these motivational constructs interact and shape tourists' perceptions and behaviors, providing a solid analytical foundation for formulating destination development recommendations for Sokobanja.

This study adopts a **positivist epistemological approach**, which is based on the premise that knowledge can be acquired through objective observation, measurement, and analysis of empirical data. By employing a structured questionnaire using a five-point Likert scale and analyzing the responses of a statistically valid sample of 388 tourists who visited Grotte di Castellana, the research aims to identify consistent patterns in tourist motivations and behaviors. The use of quantitative methods enables the researchers to uncover underlying motivational factors and draw generalizable conclusions. This approach aligns with

the research goal of providing evidence-based recommendations for the development of eco-friendly and niche adventure tourism in Sokobanja, based on the successful example of Grotte di Castellana.

Results and Discussion

The analysis of the factors (see Table 1) produced a model that classifies the variables into three distinct factors, which together represent 77.27% of the variance. Examination of Table 1 reveals that there are three factors with an Eigenvalue greater than 1, indicating that the extracted factors are both adequate and sufficient. Although standard diagnostic tests such as the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are commonly reported in exploratory factor analysis, they were not emphasized in this study due to the theory-driven design of the instrument. The analysis aimed to confirm the alignment of predefined motivational constructs with respondent data rather than to uncover unknown factor structures. The factor solution, based on Principal Component Analysis with Varimax rotation, yielded three factors with Eigenvalues greater than 1, accounting for 77.27% of the total variance, thus supporting the adequacy of the construct classification.

Table 1
Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.862	48.846	48.846	1.756	14.631	14.631	4.571	38.093	38.093
2	1.871	15.592	64.438	5.323	44.356	58.988	2.085	17.375	55.468
3	1.540	12.832	77.270	1.310	10.918	69.906	1.733	14.438	69.906
4	0.586	4.882	82.153						
5	0.99	4.161	86.314						
6	0.476	3.970	90.284						
7	0.392	3.267	93.551						
8	0.273	2.278	95.829						
9	0.232	1.936	97.765						
10	0.143	1.193	98.958						
11	0.081	0.677	99.636						
12	0.044	0.364	100.000						

Table 2
Factor Matrix

	Factor		
	Mythic Trails	Purposeful Adventure	Cave Insights
Natural Marvels	-0.014	0.574	0.717
Cave Chronicles	0.042	0.321	0.620
Shared Moments	0.047	0.874	0.145
Captured Depths	0.108	0.808	0.006
Inner Triumph	0.022	0.732	0.053
Green Journey	0.049	0.613	-0.065
Hidden Escapes	0.852	-0.043	-0.014
Underground Wonders	0.054	0.719	-0.032
Guided Exploration	0.070	0.975	-0.107
Mythic Echoes	0.999	-0.003	0.000
Cave Conquest	0.061	0.935	-0.135

The content identifies three main motivational factors driving tourists to visit Grotte di Castellana. The first, Mythic Trails, appeals to visitors seeking mystical, cultural, and lesser-known aspects of the cave, including the exploration of hidden, authentic environments and engaging with local legends and myths. The second, Purposeful Adventure, emphasizes active participation, personal achievement, and social connection, with motivations such as capturing memories, overcoming physical challenges, supporting sustainability, and discovering underground wonders through guided tours or conquering the cave's obstacles. The third, Cave Insights, reflects an intellectual curiosity about the cave's natural history, geological formations, and cultural significance, attracting visitors eager to learn about its scientific and historical background. Overall, these factors highlight a diverse range of motivations, from mystical exploration and adventure to education and environmental consciousness.

The structural equation model presented (Graph 1) illustrates the relationships between tourists' motivations and three latent factors—Mythic Trails, Purposeful Adventure, and Cave Insights—in the context of visiting Grotte di Castellana. Each factor is represented as a latent variable (F1, F2, F3) and is associated with a set of observed variables that reflect specific motivational constructs. Factor 1: Mythic Trails (F1). This factor encapsulates tourists' motivations related to exploring the cave's mystical, cultural, and less commercialized aspects. Tourists driven by this factor are drawn to the hidden, spiritual, and mythical dimensions of the cave experience. Hidden Escapes (HE): Tourists seek to discover places off the beaten path, immersing themselves in a more authentic, raw environment. Grotte di Castellana, while a known attraction, provides

an opportunity for such exploration, offering a break from heavily commercialized tourist experiences. This reflects a desire to connect more deeply with nature and less-known destinations. Mythic Echoes (ME): Tourists are motivated by the folklore, legends, and historical myths surrounding the cave. The cultural narratives and supernatural elements associated with the cave add a rich, mystical dimension to the visit, transforming it into a spiritually and culturally enriched experience. This factor highlights a strong intellectual and emotional connection to the cave's intangible heritage. The structural model shows a strong loading for Mythic Echoes (1.29) and a moderate loading for Hidden Escapes (0.66), indicating the strength of these motivations in defining this latent construct. Furthermore, F1 is positively correlated with Cave Insights (F3), suggesting that mythic curiosity often accompanies a desire for learning and understanding. This confirmed the sub-hypothesis H1 that tourists are significantly motivated by the cultural and mythic narratives associated with cave environments.

Factor 2: Purposeful Adventure (F2). This factor reflects a multifaceted motivational profile that includes personal challenge, bonding, sustainability, and experiential engagement. Tourists associated with this factor are actively involved in shaping their experience and often seek both emotional satisfaction and physical achievement. Shared Moments (SM): Visitors seek to bond with friends or family during the adventure, using the cave setting to create meaningful shared experiences; Captured Depths (CD): Motivation to document the cave experience through photography or video. The visual appeal of cave formations drives the desire to preserve and share memories; Inner Triumph (IT): Represents the challenge and accomplishment tourists feel by physically navigating the cave environment; Green Journey (GJ): Reflects tourists' interest in sustainability and eco-conscious tourism. These visitors are mindful of their environmental impact and value the conservation efforts in place; Underground Wonders (UW): Captures the aesthetic and emotional impact of the cave's geological features. Visitors are intrigued by the mystery and beauty of the underground world; Guided Exploration (GE): Indicates the preference for structured, informative tours led by experts, which provide deeper knowledge and safety; Cave Conquest (CC): Emphasizes the physical effort required to explore the cave, appealing to thrill-seekers and adventure enthusiasts. This factor is heavily defined by high loadings for Guided Exploration (0.98) and Cave Conquest (0.94), suggesting that the blend of physical and intellectual stimulation is a key component of the cave tourism experience. Purposeful Adventure also moderately correlates with Cave Insights (F3) (0.46), indicating an overlap between adventure and educational interests. This confirmed the sub-hypothesis H2 that tourists prefer caves that offer active, adventurous, and immersive physical experiences.

Factor 3: Cave Insights (F3). Cave Insights represents the educational and intellectual motivations that draw tourists to the cave. This includes an interest

in the geological, natural, and cultural significance of the site. Natural Marvels (NM): Tourists are fascinated by the cave's geological features, such as stalactites, stalagmites, and crystals. These formations reflect natural processes and evoke a sense of wonder; Cave Chronicles (CC): Captures the desire to learn about the history, science, and cultural relevance of the cave. Visitors want to understand how the cave was formed, its role in the ecosystem, and its place in local or human history. The model shows a particularly high loading for Natural Marvels (1.24), indicating a strong attraction to the cave's natural beauty. Cave Chronicles has a lower, though still significant, loading (0.58), showing that while intellectual curiosity is present, the aesthetic experience may be more dominant. This confirmed the sub-hypothesis H3 that tourists show high interest in caves with educational, scientific, or natural uniqueness. The correlation between Mythic Trails (F1) and Cave Insights (F3) is shown to be 0.00, indicating that these two motivational factors are independent rather than overlapping. This suggests that tourists interested in myths and hidden stories (Mythic Trails) do not necessarily also prioritize learning about the cave's natural and historical significance (Cave Insights). Purposeful Adventure (F2) and Cave Insights (F3) share a moderate correlation (0.46), suggesting that the drive for adventure and social connection often coexists with an educational interest. The correlation between Mythic Trails (F1) and Purposeful Adventure (F2) is weak (0.06), indicating these two sets of motivations are largely distinct. The structural equation model confirms that cave tourism motivation is a multidimensional construct. Tourists visiting Grotte di Castellana are influenced by a complex interplay of motivations that span mystical and cultural curiosity (Mythic Trails), experiential and social adventure (Purposeful Adventure), and educational interests (Cave Insights). Understanding these motivational dimensions allows for better-targeted interpretation strategies, tour planning, and sustainable management of cave tourism experiences.

Mythic Echoes (loading = 1.744): This is the strongest defining indicator for Factor 1, emphasizing that the core motivation for this factor is the tourist's curiosity about folklore, legends, and the mystical dimensions of the cave. The high loading shows this is central to the experience.

Hidden Escapes (loading = 0.488): Tourists are also motivated by the desire to discover less commercialized and authentic places, although this is a moderate influence compared to the mythic aspect. It reflects the appeal of hidden, tranquil, and raw environments away from mass tourism. Factor 1 appeals primarily to those seeking mystery, folklore, and authenticity. These visitors value spiritual enrichment, hidden stories, and less mainstream experiences. "Mythic Trails" tourists are drawn to the cultural and symbolic significance of the cave. Guided Exploration (loading = 0.974): Tourists greatly value structured, informative experiences through guided tours. This is the strongest loading in the model,

underscoring the importance of educational and secure exploration. Cave Conquest (loading = 0.939) & Shared Moments (0.872): These suggest visitors are motivated both by the physical challenge of exploration and the social bonding that occurs during group activities. Captured Depths (0.820), Underground Wonders (0.728), Inner Triumph (0.738): These emphasize the significance of documenting experiences, aesthetic appreciation, and personal achievement through overcoming challenges.

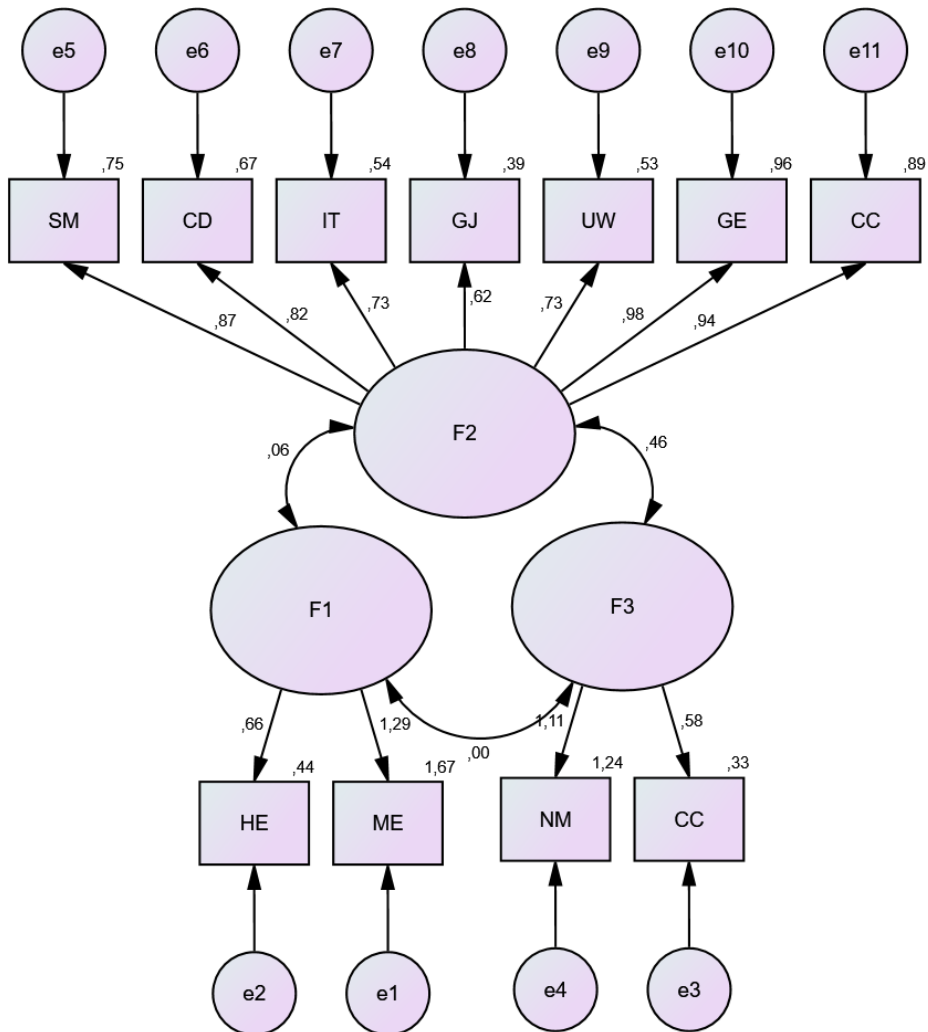


Figure 1
Structural Equation Modeling (SEM). Source: Prepared by the authors (2025)

Table 3
 Summary of Tourist Motivation Factors in Cave Tourism

Factor	Motivational Indicator	Estimate (Standardized Weight)	Interpretation
Factor 1: Mythic Trails	Mythic Echoes	1.744	Strong attraction to folklore, legends, and mystical stories
	Hidden Escapes	0.488	Seeking non-commercial, authentic, tranquil cave experiences
	(Low influence on F3)	-0.001	Little to no connection with intellectual motivations
Factor 2: Purposeful Adventure	Guided Exploration	0.974	Preference for structured, informative, and safe tours
	Cave Conquest	0.939	Seeking physical challenge and exploration
	Shared Moments	0.872	Social connection through group experiences
	Captured Depths	0.820	Desire to document and share cave experiences
	Inner Triumph	0.738	Emotional reward and personal accomplishment
	Underground Wonders	0.728	Visual/aesthetic appreciation of cave formations
	Green Journey	0.626	Interest in sustainability and environmental responsibility
	(Drives Factor 3)	1.000	Intellectual interest stems from this adventure-centered mindset
	Factor 3: Cave Insights	Natural Marvels	0.520
Cave Chronicles		0.287	Interest in learning cave history and scientific facts
(Derived from F2)		1.000	Strongly predicted by Purposeful Adventure

Green Journey (0.626): Indicates a meaningful concern with sustainable practices and environmentally responsible tourism. Factor 2 captures tourists who are seeking meaningful, action-oriented, and socially conscious adventures. The combination of physical, social, and environmental motivations shows a well-rounded, purpose-driven mindset in their cave visits. Natural Marvels (loading = 0.520) and Cave Chronicles (0.287): Tourists are drawn to the beauty of geological formations and the scientific/historical knowledge about the cave, although the relatively lower loadings suggest these are fewer central motivations compared to other factors.

Interpretation: Factor 3 represents a more reflective, educational type of tourist—those interested in learning about natural processes and cultural contexts. However, this factor seems to play a supporting role rather than a dominant one in shaping tourist motivations.

Factor F3 is fully predicted by F2 (1.000), suggesting that intellectual/educational motivations (F3) emerge from purposeful adventure (F2). Factor F1 has a very low and negative link to F3 (-0.001), meaning mystical/cultural interests are largely independent of intellectual motivations. Mythic Echoes is strongly predicted by F1 (1.744), reinforcing its importance as a unique dimension. Mythic Trails (F1): Appeals to those seeking mystery, cultural depth, and spiritual connection. Purposeful Adventure (F2): Dominates the model, appealing to adventure-seekers, eco-conscious tourists, and those desiring connection and growth. Cave Insights (F3): Offers an educational layer, but it is often embedded within the broader adventure experience.

The model demonstrates good fit based on conventional SEM thresholds: **CFI (0.965)** and **TLI (0.918)** indicate strong incremental fit, while **GFI (0.902)** reflects acceptable absolute model fit. The **RMSEA value (0.087)**, though slightly above the optimal <0.08 benchmark, remains within the acceptable range for moderately complex models. Together, these indicators suggest that the proposed model is robust and adequately captures the relationships among the motivational constructs of speleological tourism.

To justify the transferability of insights from the Grotte di Castellana case study to the caves of Sokobanja, it is necessary to establish a clear comparative framework. Both regions are characterized by karst landscapes featuring notable underground formations, chambered passages, and unique speleological biodiversity. While the Grotte di Castellana has long been developed for tourism—with structured pathways, lighting, trained guides, and over 250,000 annual visitors—Sokobanja's caves remain underdeveloped, lacking infrastructure and visibility despite their similar geological and ecological value. The tourism potential of Sokobanja is further supported by existing interest from niche markets such as adventure tourists, recreational hikers, and cultural tourists, mirroring the profiles of visitors to Castellana. Both sites appeal to overlapping motivational dimensions, including the pursuit of natural beauty, intellectual enrichment, personal challenge, and cultural immersion. These shared attributes form a solid foundation for adapting the successful interpretative, educational, and sustainability strategies used at Castellana to the Sokobanja context, particularly in shaping future development trajectories and visitor engagement frameworks.

Conclusion

Cave and pit visits represent a promising segment of cave tourism by attracting tourists with diverse interests, ranging from adventure and education to novelty and socialization. The karst formations in Sokobanja hold significant potential as tourist attractions that can drive sustainable tourism development if managed with eco-friendly and niche adventure tourism principles. Our research confirms the hypothesis that well-developed caving experiences contribute positively to the local economy and community. The underground sites in Sokobanja currently remain underexplored and inaccessible, limiting their tourism potential. Addressing this requires targeted financial investment to improve infrastructure, develop tailored visitor routes, and implement effective promotion strategies. Efforts such as the Ministry of Environmental Protection's planned third-category protection for Sesalac Cave and local investments in guide training highlight ongoing progress toward sustainable tourism growth. Our findings demonstrate that tourists' motivations cluster around three key factors: adventure, mystery, and education. The strongest motivation involves shared adventurous experiences with friends or family, complemented by guided tours and opportunities to capture memorable moments. Visitors also value green, protected speleological sites that encourage responsible behavior. Sesalac Cave, in particular, stands out as a site with high potential to develop show cave tourism that can benefit both tourists and the local community.

To unlock this potential, we recommend the following practical strategies: Developing thematic guided tours that emphasize local legends (Mythic Trails), adventure and sustainability (Purposeful Adventure), and educational insights (Cave Insights); Improving accessibility through safe pathways and lighting while preserving natural cave features; Strengthening community involvement by training local guides and supporting complementary tourism services; Enforcing protection measures to maintain ecological and cultural integrity; Promoting integrated multi-site itineraries and leveraging digital marketing to attract niche tourist segments. By implementing these recommendations, Sokobanja can transform its underground sites into attractive, sustainable tourist destinations that meet modern travelers' diverse motivations while supporting local economic development and environmental preservation.

STATEMENT OF ETHICS

This study was conducted in accordance with the World Medical Association Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Singidunum University, Belgrade, Serbia (protocol code 169, 16 May 2024).

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interests with respect to the research, authorship, and/or publication of the article *Eco-Friendly and Niche Adventure Tourism: Caving Experiences as a Factor of Tourism Destination Development*.

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AUTHORS' CONTRIBUTIONS

Martina Arsić: Data Curation, Investigation, Review & Editing.

Aleksandra Vujko: Conceptualization, Methodology, Original Draft.

Petar Bojović: Analysis, Visualization, Validation.

All authors approved the final version of the manuscript.

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