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EVALUATION OF THE GEOTOURISM POTENTIAL OF THE MOUNTAIN LAKES IN THE CĂLIMANI MASSIF: COLIBIȚA LAKE, IEZER LAKE AND ZÂNELOR LAKE

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ABSTRACT. Evaluation of the Geotourism Potential of the Mountain Lakes in the Călimani Massif: Colibița Lake, Iezer Lake and Zânelor Lake. This paper evaluates the key geosites in the Călimani National Park: Colibița Lake, Iezer Lake and Zânelor Lake. The internationally recognized methodology used in this study has a crucial role in the development of tourism and the conservation of natural resources. The obtained results show that these geosites have a significant potential for tourism development. Colibița Lake, an artificial lake, attracts tourists with its picturesque landscape and recreational activities. Iezer Lake impresses with its natural beauty and ecological importance, being a crucial habitat for local flora and fauna. Zânelor Lake offers a unique cultural experience, thanks to the charming landscape and local legends. The evaluation and management of these geosites will contribute to the management and conservation of natural resources in the Călimani Massif. The development of sustainable tourism requires appropriate management strategies that ensure responsible use and conservation of the environment. Promoting sustainable tourism and respecting conservation principles will ensure the preservation and sustainable exploitation of these geosites, benefiting both local communities and visitors.

Keywords: *Geotourism, Geosite, Călimani Massif, Carpathian Mountains, Romania.*

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Introduction

The expression "geosite" refers to a particular category of geographical characteristics or geological phenomena that holds substantial significance in comprehending the Earth's developmental history (Chakraborty et al., 2018; Martins & Pereira, 2018; Panizza, 2001).These geosites are evaluated according to their scientific importance as well as other aspects such as their cultural-historical, ecological, economic and aesthetic value (Pereira & Pereira, 2010; Reynard et al., 2009). In recent years, the increased focus on environmental conservation has changed the direction of research in geomorphology, paying special attention to landscapes and geosites as an integral part of natural heritage (Panizza, 2001; Pralong, 2005; Brilha, 2016). This has led to the development of geodiversity and geosite research and assessment methods (Phuong et al., 2017; Gordon, 2018; Catana and Brilha, 2020). In the area of the Carpathian Mountains in Romania, including the Călimani Mountains, numerous studies have been carried out to inventory, evaluate and use geosites (Bâca, 2010, 2011; Cocean, 2011; Rus, 2018; Stoleriu, 2014).

Geotourism and geomorphology play a significant role in understanding terrestrial systems and can be used in education to foster a solid comprehension of the changes occurring on Earth over time (Amiri, Nohegar, and Bouzari, 2018). Moreover, they can yield economic benefits by promoting sustainable tourism, which encourages the cultural and environmental interpretation of a region and supports local communities (Pralong, 2005). This work focuses on assessing the scientific and cultural value of three important geosites in Călimani Massif: Colibiţa Lake, Iezer Lake, and Zânelor Lake. Colibiţa Lake, despite being an artificial lake, serves as a tourist attraction due to its picturesque scenery and recreational activities. Iezer Lake impresses with its natural beauty and ecological significance, while Zânelor Lake offers a unique cultural experience, featuring charming landscapes and local mythology. Evaluating these geosites will contribute to the management and conservation of natural resources in the Călimani Massif, considering their potential for sustainable tourism development. Through this study, we aim to identify the scientific and cultural value of the mentioned geosites and explore opportunities for sustainable tourism development.

Data and Methods

Study area

Călimani National Park is located in the Călimani Massif and covers an area of 24,041 hectares. It was designated as a protected area according to law no. 5/2000 and Government Decision no. 230/2000, being classified in category II

according to the IUCN (see Fig. 1 for the geographical localization of the Călimani Massif).

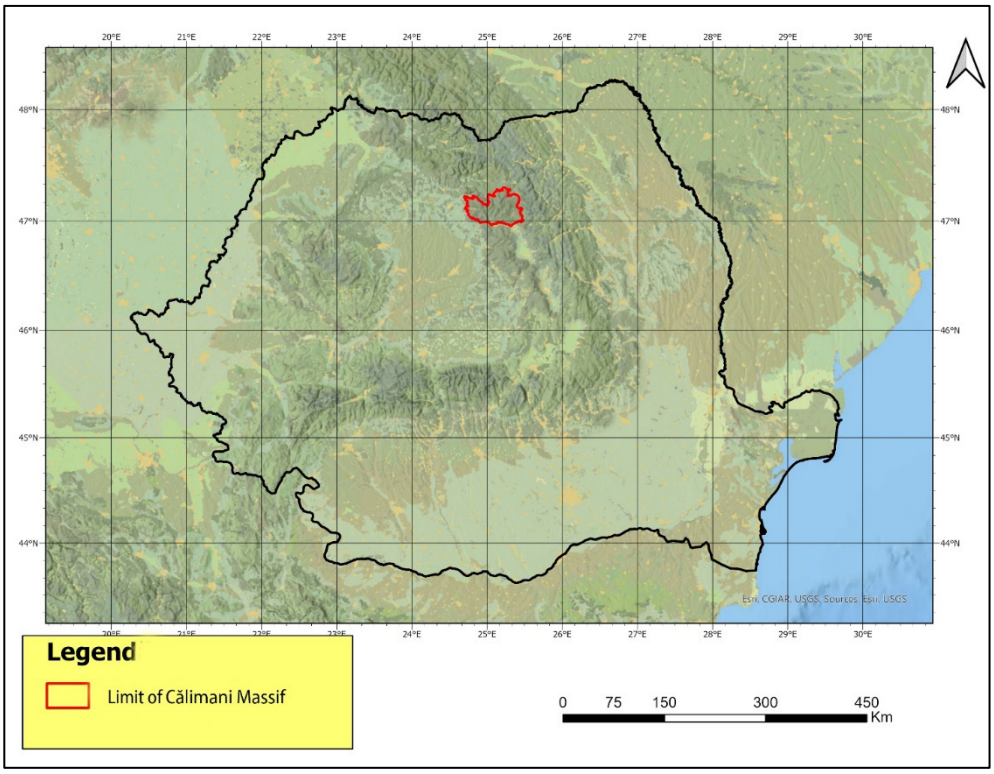

Fig. 1. Geographical localization of the Călimani Massif

Within the Călimani National Park there are several notable scientific reserves, including the Jneapăn Scientific Reserve with *Pinus cembra*, which covers an area of 384.2 hectares and is part of the IV category according to the IUCN. The Park also includes the Iezer Lake Reserve in Călimani, which covers an area of 322 hectares and is also classified in category IV according to the IUCN. In addition, the 12 Apostoli Geological Reserve, with an area of 200 hectares, is also included in category IV according to the IUCN (Romsilva, 2022).

The procedure of inventorying and assessing geomorphosites is executed through multiple phases. These stages encompass the review of specialized literature and the retrieval of available maps, which may also comprise satellite imagery. Subsequently, a field expedition is undertaken to comprehensively

document geosites, culminating in the development of inventory documents for each distinct geosite. The concluding steps involve the cartographic representation and assessment of the recognized geosites using the standards advocated by Pralong and Warowna (Pralong, 2005; Warowna et al., 2014). The evaluation of geomorphosite exploitation involves considering the extent and manner of usage, taking into account variables like the area utilized, infrastructure availability, the level of seasonal occupation, and the daily duration of use (Pralong, 2005). To determine the total value of a geomorphological site, the structural and functional values are combined, with any restrictive value being subtracted (Pralong, 2005).

These assessments are conducted following the analysis model established by Pralong (2005) and the Warowna method, which is employed for the evaluation of geomorphosites and the determination of their value and significance within the realms of geotourism and geomorphological heritage preservation (Warowna, et al., 2014).

The methodologies used are rooted in the principles and practices developed by Pralong and Warowna (Pralong, 2005; Warowna, et al., 2014), making them essential tools for comprehending and evaluating geosites in the context of geotourism and geomorphological heritage conservation.

Through the application of these methods, a more profound understanding of the scientific, cultural, aesthetic, ecological, and economic worth of geosites like Colibița Lake, Iezer Lake, and Zânelor Lake can be achieved (see Fig. 2 for location of geosites of interest: Colibița Lake, Iezer Lake and Zânelor Lake). The assessment of these geosites plays a pivotal role in their safeguarding and preservation, as well as in fostering the development of sustainable tourism in these regions. Hence, this paper concentrates on appraising the scientific and cultural values of the aforementioned geosites and examines their potential for advancing sustainable geotourism. By utilizing the Pralong and Warowna methodologies, the goal is to pinpoint and evaluate specific criteria that reflect the significance and tourism potential of these geosites.

This approach contributes to a deeper comprehension of the geosites in the Călimani Mountains and the formulation of appropriate strategies for their preservation and promotion. By harnessing the tourism potential of these geosites in a sustainable manner, it becomes possible to ensure the protection of the environment and the economic and cultural advancement of local communities.

In conclusion, the evaluation of the Colibița Lake, Iezer Lake and Zânelor Lake geosites by means of the Pralong and Warowna methods represents an important step in understanding and capitalizing on their tourist potential and in promoting sustainable tourism in the Călimani Mountains. This paper focuses on the scientific, cultural, aesthetic, ecological and economic evaluation of these geosites and explores ways of conservation and sustainable development in this scenic area.

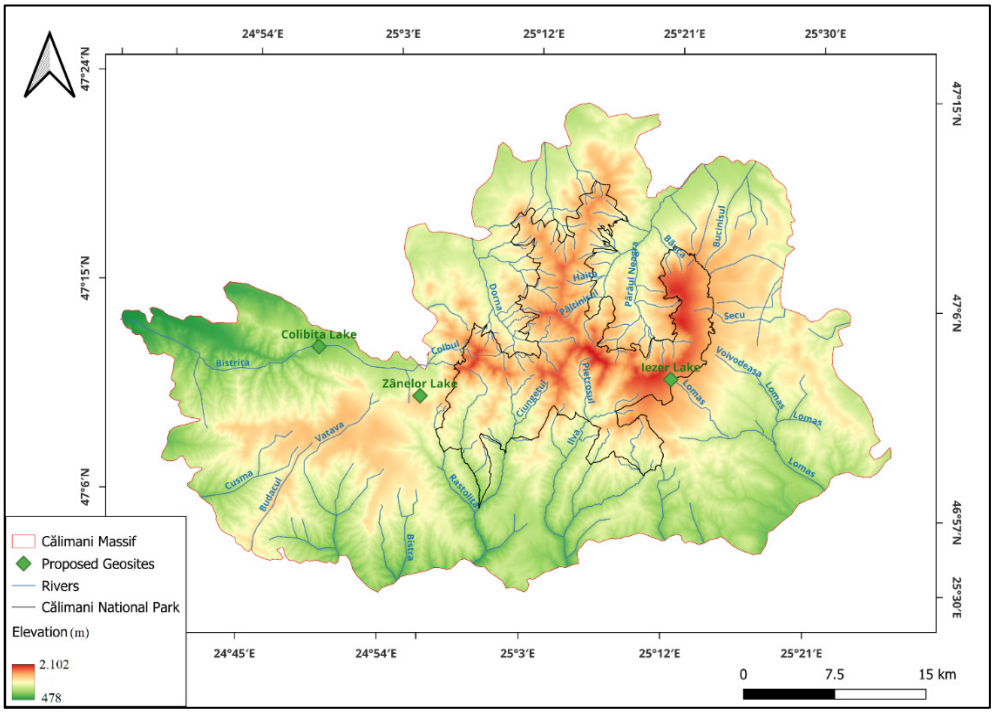

Fig. 2. Location of geosites of interest: Colibiţa Lake, Iezer Lake and Zânelor Lake

Results and discussion

Anthropogenic Geosite, Colibiţa Lake

Colibiţa Lake is an anthropogenic lake located in the Călimani Mountains, Bistriţa-Năsăud County, Romania. Built in the 1990s as a result of the Bistriţa River's development, the lake is considered one of the most beautiful and largest artificial lakes in the country with an approximate surface area of 270 hectares and a maximum depth of around 70 meters, Colibiţa Lake impresses with its picturesque landscape, surrounded by forest-covered slopes and mountain peaks (refer to Fig. 3 for a photo of Colibiţa Lake). Colibiţa Lake impresses with its extremely clear water and the variety of blue shades, creating a relaxing and tranquil atmosphere. It is a popular destination for tourists and nature enthusiasts, offering numerous recreational activities such as fishing, boating or kayaking, paddleboarding, swimming in the crystal-clear waters, hiking, cycling, as well as wildlife and flora observation. Colibiţa Lake also holds significant economic importance for the region due to the development of tourism. Facilities such as

guesthouses, hotels, and restaurants have been built to ensure the comfort of visitors.

However, it is crucial to adopt sustainable tourism practices in the Colibiţa Lake area to protect the environment and natural resources. Local authorities and the community are involved in conservation initiatives for the lake and the promotion of responsible tourism, adhering to environmental protection rules and promoting ecotourism.

Through proper management and the promotion of sustainable tourism, Colibiţa Lake remains an attraction for tourists, contributing to economic development and the conservation of natural resources in the area (Bâca & Şteff, 2014).

Fig. 3. Personal photo of Colibiţa Lake

Table 1. Inventory sheet for the Colibiţa Lake

Name	Colibiţa Lake
Indicative	23
Location	Located in the eastern part of the county
Territorial administrative unit	Colibiţa village, Bistriţa Bârgăului commune, Bistriţa – Năsăud County
Typology	Geosite, reservoir
Total value	22.5
Structural value	7
Functional value	15.5
Restrictive attributes	1

STRUCTURAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
GEOMORPHOLOGICAL	2.25	• Formed by a single relevant factor, it is an artificial lake (0.25 p). • More than 3-4 points of interest (0.75 p). • Unchanged relief form (0.25 p). • Affected geosite (0.5 p). • Nationally unique geosite (0.75 p)
AESTHETICAL	3.75	• Geosite with common physiognomy (0.25 p). • Chromatic contrast (1 p). • Altitude of 830 m (1 p). • Landscape is an essential component in the overall panorama (0.75 p). • Panoramic receptive geosite (0.75 p).
ECOLOGICAL	1	• Common forest vegetation (0.5 p). • Representative biotope of the area's fauna (0.5 p). • Unprotected geosite (0 p).
FUNCTIONAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
CULTURAL	3.5	• Defining vestiges on a national scale (1 p). • Presence of prehistoric sites (1 p). • Sunk church (0.5 p). • Over 50 representations in works of art (literature, photography) (1 p).
SCIENTIFICALLY	3.5	• Geosite with national representativeness (0.75 p). • Appearance of the geosite in multiple scientific works in international journals (1 p). • A good example of processes but moderate pedagogical interest (0.75 p). • Versatile educational resource (1 p).
ECONOMIC	8.5	• More than 5 feasible activities (1 p). • Direct car access from the main road (1 p). • Distance of less than 5 km to modern and complete service centers (1 p). • Urban areas and centers with over 10,000 inhabitants located within 50 km (0.25 p). • Tourist attraction of national interest (0.75 p). • Accommodation facilities in hotels, villas, guesthouses near the attraction (1 p). • Modern facilities and services within the geosite perimeter (1 p). • Permanent tourist exploitation (1 p). • Tourist exploitation between 6 and 9 hours per day (0.75 p). • National-level tourism promotion (0.75 p).
RESTRICTIVE ATTRIBUTE		
SCORE	**JUSTIFICATION**	
1	• The geosite has intensive tourist exploitation (0.25 p) • The presence of household waste, industrial residues (0.75 p)	

Source: These data represent the analysis of geosites using the Pralong method

Iezer Lake

Within the Călimani National Park, there is an exceptionally interesting area known as the Iezer Lake. This reserve falls under the IV category according to the IUCN and is located at the base of Răchitiș Peak. It covers an area of 1,200 square meters, with a length of 45 meters and a width of 35 meters. Situated in the northwestern part of Harghita County, it is part of the European ecological network Natura 2000, as per the information provided by Romsilva in 2022. Iezer Lake is fed by two springs and flows into the Puturosul stream, with a water depth ranging from 3 to 5 meters (refer to Fig. 4 for a photo of Iezer Lake taken by Administration of Călimani National Park). Although its correct name is Iezerul Răchitiș, it is also known as Iezerul Călimani due to its proximity to Răchitiș Peak, which stands at an elevation of 2021 meters. This peak is popular among mountain enthusiasts and features a well-equipped weather station cabin.

The Iezer Lake is a natural dam lake surrounded by a variety of shrubs and plant species. Here, one can find species such as pine tree (*Pinus mugo*), mountain rhododendron (*Rhododendron kotschyi*), bird's-foot violet (*Viola dacica*), sword-leaved helleborine (*Cephalanthera longifolia*), long-leaved hawkweed (*Bupleurum longifolium*), globeflower (*Trollius europaeus*), spotted gentian (*Gentiana punctata*), wood cranesbill (*Geranium sylvaticum*), spring sandwort (*Minuartia verna*), and exalted lousewort (*Pedicularis exaltata*). These floral species are protected at the European level in accordance with the EU Directive 92/43/EEC dated May 21, 1992. The reserve hosts a rich variety of animal species, including mammals, insects, reptiles, amphibians (including species on the IUCN Red List), and birds (according to Romsilva, 2022). In this area, you can encounter red deer (*Cervus elaphus*), gray wolves (*Canis lupus*), red foxes (*Vulpes vulpes crucigera*), wild boars (*Sus scrofa*), Eurasian lynx (*Lynx lynx*), squirrels (*Sciurus carolinesis*), and otters (*Lutra lutra*) (information from Romsilva, 2022; according to Stoica, 2007). In addition to its natural beauty, Iezer Lake is also of interest because very few official records are available regarding its formation. It is considered to be a natural dam lake in the volcanic mountains, a rare example in this region. Therefore, Iezer Lake attracts a steady flow of tourists during the warm season, offering a wide range of tourist activities. Here, you can experience various forms of tourism, such as scientific, sports, cultural, educational, religious, and ecotourism.

It is crucial to harness and protect this geosite potential to conserve the natural heritage and promote sustainable tourism in this area.

Fig. 4. Photo of Iezer Lake taken by Administration of Călimani National Park

Table 2. Inventory sheet for the Iezer Lake

Name	Iezer Lake	
Indicative	17	
Location	It is located at the northwestern tip of Harghita County, at the foothills of Mount Răchitiș.	
Territorial administrative unit	Toplița, Harghita County	
Typology	Nature reserve of mixed type, natural dam lake	
Total value	20.75	
Structural value	10.5	
Functional value	10.25	
Restrictive attribute	0	
STRUCTURAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
GEOMORPHOLOGICAL	4	• Complex genesis, with the involvement of several morphogenetic, volcanic, tectonic, geomorphological, hydrological and level-glacial processes (1 p) • More than five elements of interest: geological, volcanological, hydrological, biological and tectonic (1 p)

		• Slow-evolving landforms (0.5 p) • Unaffected geosite (1 p) • Unique regional geosite (0,5 p)
AESTHETICAL	4	• Geosite with chromatic contrast provided by nearby vegetation and the lake water (1 p) • Geosite protected due to its landscape content (1 p) • Located at an altitude of 1650 meters (1 p) • Common physiognomy (0.25 p) • Geosite appreciated from a viewpoint perspective (0.75 p)
ECOLOGICAL	2.5	• Geosite with glacial relic plants, a multitude of shrubs, numerous species of mountain pine (*Pinus mugo*), mountain rhododendron (*Rhododendron kotschyi*), bird's-foot violet (*Viola dacica*), sword-leaved helleborine (*Cephalanthera longifolia*), long-leaved hawkweed (*Bupleurum longifolium*), globeflower (*Trollius europaeus*), spotted gentian (*Gentiana punctata*), wood cranesbill (*Geranium sylvaticum*), spring sandwort (*Minuartia verna*), and exalted lousewort (*Pedicularis exaltata*). These floral species are protected at the European level under the EC Directive 92/43/EEC of May 21, 1992 (1 p). • Faunal biotope representative of the area, Fauna is represented by mammals, insects, reptiles, amphibians (which are on the IUCN red list), and birds. We mention the following animals: deer (*Cervus elaphus*), gray wolf (*Canis lupus*), fox (*Vulpes vulpes crucigera*), wild boar (*Sus scrofa*), Eurasian lynx (*Lynx lynx*), squirrel (*Sciurus carolinesis*) and otter (*Lutra lutra*) (0.5 p). • Completely protected area, the Iezer Lake is an area of interest inside the Călimani National Park, included in the IV category of the IUCN, being a mixed type reserve and located at the foot of the Răchitiș Peak (1p).
FUNCTIONAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
CULTURAL	1	• More than 50 representations in works of art (photo, personal albums) (1 p)
SCIENTIFICALLY	4.75	• Geosite with national representativeness (0.75 p) • Featured in multiple scientific works in international journals (1 p) • A good example of processes and a valuable educational resource (1 p) • Geosite of very high paleogeographic interest (1 p) • With versatile addressability (1 p)

ECONOMICAL	4.5	• Over 5 activities that can be carried out in this geosite. The forms of tourism that can be practiced in this geosite are: scientific tourism, sports tourism, cultural tourism, educational tourism, religious tourism, and ecotourism (1 p) • Accessible forest roads (0.5 p) • Within a distance of less than 25 km from modern centers and full services (0.5 p) • Urban areas and centers with over 10,000 residents located within 50 km (0.25 p) • National tourist attraction (0.75 p) • Accommodation facilities ranging from 2 to 10 km from the attraction, as the weather station is located near the geosite (0.25 p) • Seasonal tourist exploitation, 2 seasons (0.5 p) • National-level tourism promotion (0.75 p)
RESTRICTIVE ATTRIBUTE		
SCORE	**JUSTIFICATION**	
0	The site is not vulnerable (0 p) Absence of destructive activities (0 p)	

Source: These data represent the analysis of geosites using the Pralong method

Zânelor Lake

Zânelor Lake geosite is a nationally recognized area and has been declared a natural reserve in accordance with Law No. 5 of March 6, 2000 (Bâca, 2010). It falls into the IV category of the International Union for Conservation of Nature (IUCN) and is located in eastern Transylvania, in Bistrița-Năsăud County (Integrated Management Plan for the Natura 2000 Site ROSCI0051 Cuşma, 2015). The reserve covers an area of approximately 15 hectares and is also part of the Cuşma Site of Community Importance (Integrated Management Plan for the Natura 2000 Site ROSCI0051 Cuşma, 2015).

Zânelor Lake is situated at an altitude of approximately 1214 meters and has an area of around 500 square meters with a depth of about 4 meters. This lake was formed as a result of the collapse of volcanic rocks from the slope of Mount Țiganca, which belongs to the Călimani Massif and the surrounding area. The area is predominantly forested with spruce trees (*Picea abies*) and hosts a variety of European protected flower species, including mountain snowdrop, fritillary, checkered lily, darie, buttercup, and harebell.

The fauna of the reserve is also significant, with species such as the stoat, wildcat, pine marten, yellow-bellied toad, Carpathian salamander, crested newt, fire-bellied toad, and the European fire-bellied toad, all of which are included in the IUCN Red List (Integrated Management Plan for the Natura 2000 Site ROSCI0051 Cuşma, 2015). Zânelor is a natural dam lake formed by the

collapse of volcanic conglomerates from the slope. It is fed by a surface spring located near the slope, which gives rise to the stream known as the Upper Zânelor Stream (Bâca, 2010).

There is also a popular story associated with the lake. It is said that on a full moon night, two shepherds named Pasăre and Scurtu were wandering through the Poiana Zânelor and noticed fairies dancing naked in the meadow. The fairies made a pact with the shepherds not to come to that place on full moon nights anymore. In return, the shepherds received a mountain and a stream from the fairies. However, the shepherds did not honor the pact and returned on another full moon night to admire the fairies once again. That night, the fairies became angry and caused a powerful storm. A mountainside was struck by lightning and collapsed onto the shepherds, and as a result of this event, Zânelor Lake was formed (Bâca, 2010).

Thus, Zânelor Lake is a potential geosite with cultural significance and associated legends (refer to Fig. 5 for a photo with Zânelor Lake). It is considered a natural curiosity in the Călimani Mountains, with picturesque beauty and remarkable ecological richness. The protection and conservation of this geosite are essential for maintaining biodiversity and promoting cultural and tourist values in the area.

Fig. 5. Personal photo of Zânelor Lake

Table 3. Inventory sheet for Zânelor Lake

Name	Zânelor Lake	
Indicative	19	
Location	At the north-eastern base of the Țiganca Peak (north-west Călimani Mountains)	
Territorial administrative unit	Bistrița – Bârgăului commune, Bistrița - Năsăud County	
Typology	Geosite – Natural dam lake	
Total value	18	
Structural value	9	
Functional value	9	
Restrictive attribute	1	
STRUCTURAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
GEOMORPHOLOGICAL	3	• Genesis involving at least two significant morphogenetic factors: volcanic and geomorphological processes (0.5 p). • Two points of interest: the steep slope nearby (Mount Pasăre) and Zânelor Lake (0.5 p). • A slowly evolving landform (0.5 p). • An unaffected geosite (1 p). • A regionally unique geosite (0.5 p)
AESTHETICAL	3.5	• Geosite with interesting physiognomy (0.5 p). • Color harmony (0.5 p). • A geosite protected due to its landscape content (1 p). • Selectively received geosite (0.5 p). • Zânelor Lake is located at an altitude of approximately 1214 meters (1 point).
ECOLOGICAL	2.5	• Plants protected under the EU Directive 92/43/EEC dated May 21, 1992, flora that is protected at the European level, such as wild hyacinth, globe flower, fritillary, gentian, pasque flower, cowslip, and hawkweed (0.75 p). • Rare faunistic biotope, listed on the IUCN Red List (spadefoot toad, wildcat, pine marten, yellow-bellied toad, Carpathian salamander, crested newt, red frog of the forest and mountains) (0.75 p). • Protected area, a zone of national interest declared a natural reserve by Law No. 5 dated March 6, 2000, included in IUCN category IV, being a mixed-type reserve (1 p).
FUNCTIONAL VALUE		
TYPE	**SCORE**	**JUSTIFICATION**
CULTURAL	1.75	• The presence of captions (0.75 p) • More than 50 representations in works of art (1 p)
SCIENTIFICALLY	3.75	• National representativeness (0.75 p) • Appearance in at least one scientific paper in national journals (0.5 p)

		• A good example of processes and a great pedagogical resource (1 p) • Geosite of moderate paleogeographical interest (0.5 p) • Polyvalent formative addressability (1 p)
ECONOMICAL	3.5	• 5 possible activities: hiking, geotourism, recreation, educational, scientific (1 p) • Car access on forest roads (0.5 p) • Distance under 25 km from modern centers and full services (0.5 p) • Areas and urban centers over 10,000 inhabitants located less than 50 km (0.25 p) • Tourist objective of national interest (0.75 p) • Accommodation bases from 2 km to 10 km from the objective (0.25 p) • Lack of complete services (0 p) • Occasional tourist exploitation (0 p) • Local tourism promotion (0.25 p)
RESTRICTIVE ATTRIBUTE		
SCORE	**JUSTIFICATION**	
1	• The site is partially vulnerable (0.25p) • Logging of nearby forests (0.75 p)	

Source: These data represent the analysis of geosites using the Pralong method

Colibița Lake, as an anthropogenic geosite, stands out for its artificial origin and impressive dimensions (Table 1). Its large area of approximately 270 hectares and maximum depth of 70 meters place it among the most beautiful and largest artificial lakes in Romania (Bâca & Șteff, 2014). Colibița Lake attracts tourists and nature lovers with its picturesque landscape and clear waters, offering a diverse range of recreational activities. The development of tourism around the lake has also had a significant impact on the local economy, attracting investment in tourism facilities and creating development opportunities for the community.

Iezer Lake stands out for its location in the Călimani Mountains and its ecological value (Table 2). This geosite, located within the Călimani National Park, protects a natural dam lake surrounded by a variety of shrubs and floristic species protected at European level. The reserve provides habitat for a variety of mammals, insects, reptiles, amphibians and birds, and its ecological importance is underlined by its inclusion in the European ecological network Natura 2000. Iezer Lake is also a popular destination for tourists, who can explore its landscape beautiful and can engage in various tourism and recreation activities.

Zânelor Lake highlights its value as an area of national interest, declared a nature reserve. Located in the east of Transylvania, this geosite includes a lake formed by a landslide and hosts a diversity of protected flora and fauna species (Table 3). The surrounding area offers opportunities for cultural and

scientific tourism, with defining vestiges and the presence of prehistoric sites. Zânelor Lake is surrounded by picturesque landscapes and benefits from tourist facilities nearby, contributing to the economic development of the region. Comparatively, Colibița Lake stands out for its impressive dimensions and extensive tourist development, having a significant economic impact. Iezer Lake emphasizes its ecological value and the importance of biodiversity conservation. Zânelor Lake is distinguished by its cultural and scientific aspects, including the presence of vestiges and prehistoric sites.

Thus, the comparative interpretation of the results (see Fig. 6 for the graph of Pralong Assessment) shows that each geosite has its specific peculiarities and its distinct values. Colibița Lake stands out for its size and tourist development, and Iezer Lake for its ecological value and biodiversity conservation. Zânelor Lake attracts attention with its cultural and scientific aspects. This comparison reveals the diversity of geosites and their importance in the geographical and tourism context, providing a broad perspective on the different values and attractions that the respective regions can offer.

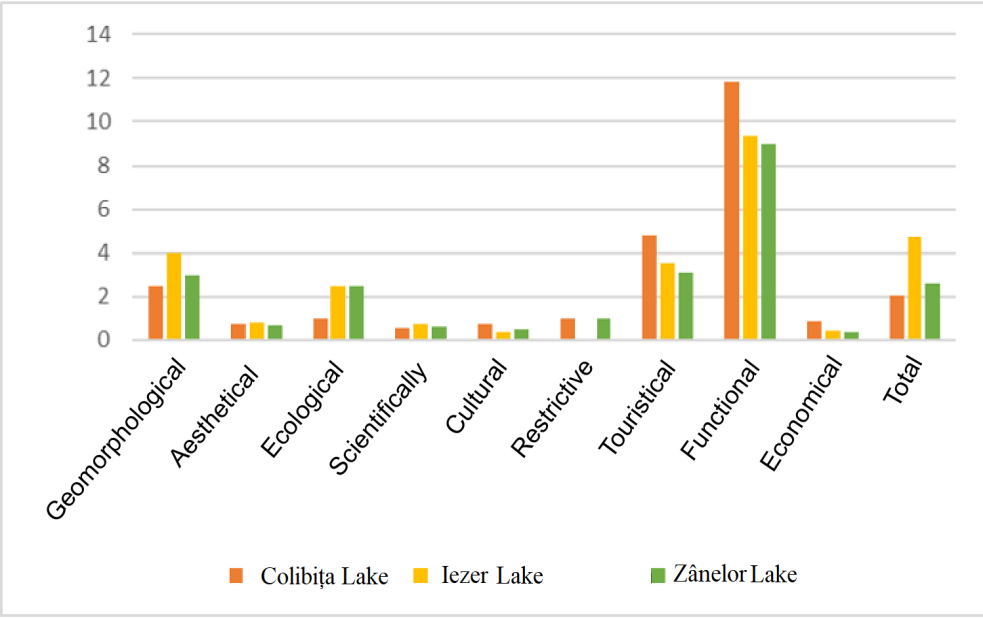

Fig. 6. Graph of Pralong Assessment

From a structural point of view: Iezer Lake obtains the highest score, respectively 10.5, indicating a significant structural value due to its complex genesis, the presence of several elements of interest, the relief form with slow

evolution, the unaffected character of the geosite and the regional uniqueness. Zânelor Lake receives a score of 9, also reflecting a high structural value due to its specific genesis, the presence of several elements of interest and regional uniqueness. Colibiţa Lake receives a score lower than 7, indicating a lower structural value compared to the other two geosites. From a functional perspective: Colibiţa Lake obtains a functional value score of 15.5, indicating the highest functional value among the three geosites. Iezer Lake receives a score of 10.25 for functional value, while Zânelor Lake receives a score of 9 for functional value. Both Colibiţa Lake and Zânelor Lake score 1 for restrictive attributes.

For Colibiţa Lake, this is due to intensive tourist exploitation and the presence of household waste and industrial residues. For Zânelor Lake, the restrictive attribute refers to the partial vulnerability of the site and the forestry exploitation of nearby forests.

Iezer Lake does not have any restrictive attributes.

The Colibiţa Lake geosite has the highest score in terms of geomorphological, aesthetic, scientific, cultural and functional values, indicating that it has a high potential in these areas. The superior functional and touristic value of this geosite is particularly noteworthy. However, the ecological and economic values are relatively moderate compared to the other two geosites. The Iezer Lake scores high in all aspects analyzed, except economic value. The geosite has excellent structural and aesthetic value, and scientific and functional values indicate significant potential in these areas. However, the economic aspect of the reservation is more limited. Zânelor Lake achieves moderate scores in most aspects analyzed. The geosite has good values in terms of aesthetics, ecology and functionality. It also has significant cultural value and reasonable tourism potential. However, the geomorphological and scientific values are less pronounced compared to the other two geosites.

Overall, the three geosites have distinct characteristics and offer potential in different areas. Colibiţa Lake stands out for its touristic and functional value, Iezer Lake for its scientific and aesthetic value, and Zânelor Lake for its cultural and functional value. Zânelor Lake geosite is a valuable resource from a scientific and educational point of view, with relevant publications and information (Table 4). It is considered rare and unique in the region, being legally protected and unaffected by degradation. The geosite offers a diverse range of educational features and presents significant tourism potential. With cultural, aesthetic and biotic value, it contributes to the natural landscape and provides additional nearby attractions. However, accessibility and tourism infrastructure are limited, and educational trails and paths are absent. Nevertheless, the Zânelor Lake geosite has a high protection status, underlining its importance and values within the Warowna method.

Iezer Lake geosite represents a valuable resource from a scientific point of view, with potential for research and education. It also has significant tourism value due to additional attractions, biotic and aesthetic value. However, it is important to pay attention to infrastructure and tourism services, as well as to continue protection and conservation efforts to maintain the integrity of this valuable geosite.

Colibița Lake is a geosite with a special touristic and functional value, benefiting from excellent facilities for visitors. However, there are opportunities for improvement in terms of the scientific and educational value as well as the biotic value of the geosite.

Table 4. Geosite Analysis Using the Warowna Method

Criteria	Indicators	Colibița Lake	Iezer Lake	Zânelor Lake
Scientific and educational value	A1. Scientific knowledge	0.5	1	0.5
	A2. Rarity	0	1	0.5
	A3. Geo-diversity	0	1	0
	A4. Level of degradation	0	1	1
	A5. Educational content	0	0	0.5
	A6. Legal protection status	0	1	1
	A7. Exposure	1	1	1
	A8. Existing educational products	0	0.5	0.5
	A9. Available educational products	0.5	0.5	0.5
Functional value	B1. Accesibility	1	0	0.5
	B2. Direct access	1	1	1
	B3. Website capacity	1	1	1
	B4. Presence of tourist infrastructure	1	0	0.5
	B5. Ownership form	0	0.5	0.5
	B6. Fragility (risks)	0.5	1	0.5
	B7. Food and accommodation services	1	0	0
Touristic value	C1. Cultural value	1	0.5	1
	C2. Additional attractions	1	1	1
	C3. Biotic value	0.5	1	1
	C4. Aesthetic value	1	1	1
	C5. Nearby viewpoints	1	1	1
	C6. Surrounding landscape	0.5	1	1
	C7. Presence of tourist trails and educational paths	1	1	1
	C8. Location in relation to major tourist centers	1	0	0
	C9. Demand potential	1	0	0.5
D. Restrictive attributes		1	1	1

Source: These data represent the analysis of geosites using the Warowna method

Conclusions

Analyzing the three geosites, namely Zânelor Lake, Iezer Lake, and Colibița Lake, using both the Pralong method and the Warowna method, we can draw some important conclusions regarding their scientific, educational, functional, and tourist values.

Recommendations for these geosites include promoting and developing educational products and scientific knowledge related to each geosite. Additionally, investment in infrastructure to enhance accessibility and tourist facilities is advisable. Maintaining and protecting the restrictive attributes is crucial for the conservation and sustainability of these geosites.

In conclusion, these analyses based on the Pralong and Warowna methods have provided a detailed perspective on the values of the Zânelor Lake, Iezer Călimani, and Colibița Lake geosites, highlighting both their strengths and opportunities for improvement. This information can be used in the planning and management of these geosites, with the aim of promoting responsible tourism and preserving natural heritage.

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