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EVALUATION AND VALORIZATION OF GEOMORPHOSITES IN SUSTAINABLE TOURISM ACTIVITIES, FĂGĂRAȘ MASSIF (SOUTHERN CARPATHIANS, ROMÂNIA)

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Abstract: The relief is the one that is the basis for the development of a certain type of tourism in an area, it being the one that provides the natural tourist objectives, so, the present work brings to the fore the interde-pendence relationship that forms between relief and tourist activities. The present work proposes an updated and improved geomorphosites evaluation method based only on their scientific and touristic values. The attractiveness of geomorphosites generates the boomerang effect (degradation of geomorphosites through tourist exploitation). For this purpose, the following evaluation criteria were taken into account: for the scientific value: integrity, uniqueness, dynamics, vulnerability, ecological interest and for the touristic value: tourist revelation, accessibility, attractiveness, tourist infrastructure, tourist activities practiced. The study area is the central sector of the main ridge of the Făgăraș Massif, Romania. This space is an unique, characterized by the highest peaks (Moldoveanu 2544 m), deep valleys (Bâlea) and spectacular landforms (many of these being geomorphosites, Custura Sărății, Strunga Ciobanului). We chose this area because is an unique area, it is characterized by the highest peaks, deep valleys, and spectacular landforms, which have been shaped due to glacial modeling, over millions of years and is rich in geomorphosites. These geomorphological features not only have scientific importance but also attract a large number of tourists and play an important role in the ecological sustainability of the region. This work addresses the issue of environmental sustainability of geomorphosites and their inclusion in tourist activity. By applying the proposed method, the highest values were obtained for Bâlea glacial cirque and the lowest values for Strunga Dracului. The changes associated with the integration of geomorphosites into sustainability strategies have been explored, emphasizing the need for careful management to prevent the overuse or deterioration to these fragile natural features.

Keywords: Geotourism, Geoheritage, Geomorphosites, Făgăraș Massif, România

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INTRODUCTION

The relief is the most important element when talking about the tourist potential of an area and it becomes a tourist attraction when it has attractive morphological features and motivates tourists to consume the tourism product. From a tourism perspective, attractiveness in geomorphology refers to the extent to which a landform feature is perceived as appealing or desirable by visitors. This can be measured using various methods, including surveys, visitor counts, and economic indicators, as tourism revenue (Zhang et al., 2017). Touristic attractiveness is influenced by a range of factors, such as infrastructure, accessibility, cultural and historical significance and the availability of recreational activities (Sinambela, 2021).

When the relief-tourism relationship is analyzed, a double meaning of the interaction between the two elements is identified. Since the relief influences and generates tourism by supporting the basic elements, tourism also exerts a certain impact on the relief through the activities practised and the facilities developed (Ovreiu et al., 2019a, 2019b). So, an interdependence relationship is established between the two components and due to the morphometric and morphographic characteristics, the tourist attractiveness can increase significantly in a certain area (Barbălată & Comănescu, 2021).

Geotourism was initially seen as a transmission of scientific details so that tourists could understand and know the geology and geomorphology of a site beyond its aesthetic appreciation (Hose, 1995). Specialized works (Dowling & Newsome, 2006, 2008, 2010, 2018) state that the concept of geotourism aims to understand and appreciate the environment, especially the abiotic elements. When interpreting geotourism, it's crucial to describe its geological (abiotic) aspect in a manner that informs visitors about the area's plant and animal (biotic) components. Subsequently, integrating information from both the abiotic and biotic aspects helps explain the historical and contempo rary human presence in the area (Dowling & Newsome, 2018). The development of geotourism involves reducing the negative impact of mass tourism in tourist spaces that focus on geological and gomorphological attractions. The essential

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components of a territory's natural heritage encompass its significant geomorphological features. They are valuable assets that can be utilized to promote socio-economic development (Carrión-Mero et al., 2020). From a geocultural perspective, geotourism offers an innovative approach to fostering the development of rural and less developed communities due to its economic benefits (Banik & Mukhopadhyay, 2020). The implementation of geotourism on geomorphosites requires, first and foremost, their evaluation within a touristic context (Tamang et al., 2023).

In order to promote the geological heritage of a territory and for the scientific information related to the complexity of the relief to be understood, geotouristic maps were created. Geotouristic maps can promote geomorphological and geological geomorphosites existing in a certain area as well as providing geoscientific information (Coratza et al., 2021; Castaldini et al., 2005). Thus, the geotouristic maps contain information about the relief processes and forms, but also the links established between the relief and the tourist activities (Comănescu et al., 2013).

The evaluation of geomorphosites has been the focus of specialists in the field (Coratza & Giusti, 2005; Bruschi & Cendrero, 2005; Pereira, 2007; Reynard et al., 2007; Serrano, 2005) from the beginning. It was necessary to develop various assessment methods, which were used for different geographical spaces. Geological resources are fundamental components that have influenced the course of human history and the attributes of human society. The preservation of their influence on our landscape highlights the domain of nature conservation referred to as geoconservation (Németh et al., 2021).

One of the primary tasks in geoconservation involves identifying sites for legal protection or establishing a network of significant sites. Geotourism involves the sustainable tourism of geological sites and landscapes, emphasizing education, conservation and community involvement. This approach not only fosters economic benefits but also contributes to the protection and preservation of geoheritage sites for future generations (Brilha, 2018). Brilha (2016), suggest that a geoconservation strategy should follow two stages: inventory and quantitative assesments of sites. The sequential process for geosite inventory varies based on the area size, focusing solely on scientific value. Yet, once geosites are identified, their potential for educational and touristic purposes can also be evaluated. Interest in geoconservation has been on the rise since the 1990s, with the IUCN advocating for initiatives that incorporate geodiversity and geoheritage (Mucivuna, 2022). The scientific community has concentrated its efforts on developing diverse qualitative and quantitative methods to assess geosites for conservation purposes (Mucivuna, 2022). As part of the inventory and evaluation methods, the stages are presented through which the landforms that have the ability to become geomorphosites are identified (Németh et al., 2021; Bruschi & Cendrero, 2005). The practice of conservation of geological heritage of a location, which involves its protection, management, promotion and regular monitoring to ensure ongoing preservation and accessibility as reference sites for the future, is commonly referred to as "geoconservation" (Evelpidou et al., 2021, Comănescu & Nedelea, 2020).

In recent years, the demand for tourism products linked to the exploitation of geoheritage in Nationally Protected Areas and the interest in studying the geotouristic potential of geomorphosites have increased, and a wide range of assessment methodologies have been developed to determine this potential and improve their management and conservation (Ruiz-Pedrosa et al., 2024). Recent studies (Barbălată & Comănescu, 2021; Tamang et al., 2023; Kubalíková & Balková, 2023; Kubalikova, 2024; Ruiz-Pedrosa et al., 2024) in an increasing number, highlight the importance that geomorphosites have gained in recent years as essential resources for the conservation of natural heritage, as well as for the development of sustainable tourism. Geomorphosites inventory is regarded as a fundamental aspect of geoconservation strategies. These inventories serve as a tool to facilitate management by assessing the values, potential uses, and risks of degradation associated with these sites (Comănescu & Nedelea, 2016). The significance of geoconservation has been increasing within the framework of environmental management (Herrera-Franco et al., 2020).

To evaluate geomorphosites, there are generally two approaches: the first approach is based on qualitative and specialized procedures, while the second approach involves the classification of geomorphosites through numerical evaluation and the identification of its potential value (Navarette et al., 2022; Santos et al., 2020). Our research show that the analyzed area contains significant number of geomorphosites with high scientific and touristic value. The scientific value is mainly derived from their geomorphology, geology and natural processes, which are of great interest to scientists and researchers. The touristic value is based on the accessibility, cultural and aesthetic significance of the geomorphosites.

The purpose of the article is to identify the main geomorphosites, formed in the alpine area of the central sector of the main ridge of the Făgăraș Massif, to evaluate them according to our own method, by highlighting the importance of assessing the value of geomorphosites both from a scientific and tourist perspective as well as the identification of vulnerable geomorphosites and the proposal of suggestions for their protection, as well as the valorization and promotion of all identified geomorphosites. We suggest that the inclusion of these geomorphosites in sustainable tourism and environmental management plans can have many benefits, including increased awareness of the importance of the area.

Considering that these sites are extremely fragile and vulnerable to both human activities and natural processes, it is essential to also consider the potential impacts that activities outside the site may have on the features of interest. Therefore, in the future a research about the evaluation of degradation risks and risk analysis should be an integral component of any geoconservation effort (Kubalíková & Balková, 2023; Kubalíková, 2024).

MATERIALS AND METHODS

1. Study area

The Făgăraș Massif is located in the central part of România, within the eastern half of the Southern Carpathians, with an area of approximately 1500 km2, having an east-west orientation. The study area is located in the Făgăraș Massif (Figure 1), the sector between the peaks of Negoiu and Moldoveanu at an altitude of over 1800 m, respectively the alpine sector. These peaks reach the highest altitudes in the country, and the ridge that lies between them were

shaped by glaciers, thus it have the most complex and impressive forms of glacial and periglacial relief. The main ridge has an uninterrupted length of 70 km. Distinctive for the crystalline series in the Făgăraș Massif is the distribution of the petrographic complexes in parallel strips in the east-west direction (Mutihac, 1990).

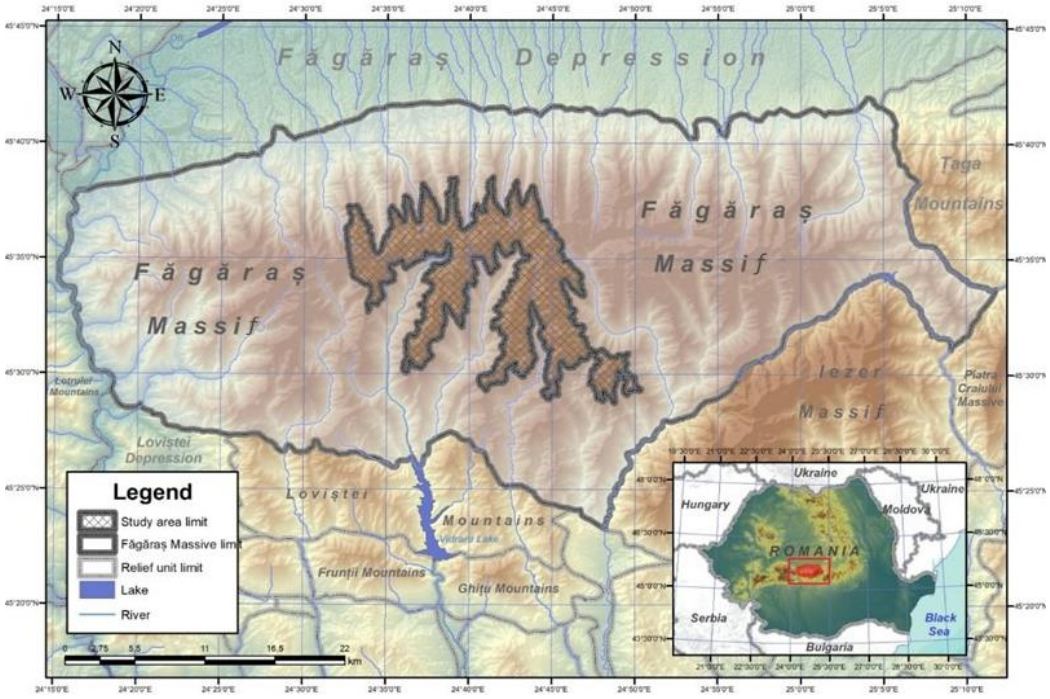

Figure 1. The map of the researched area

METHODOLOGY

The relationship between the geomorphological environment and tourism (Figure 2) is explained by Cannillo & Panizza (1994). The two main elements: the geomorphological environment and tourism pass one by one to the stage of active or passive factor depending on the dominant characteristics.

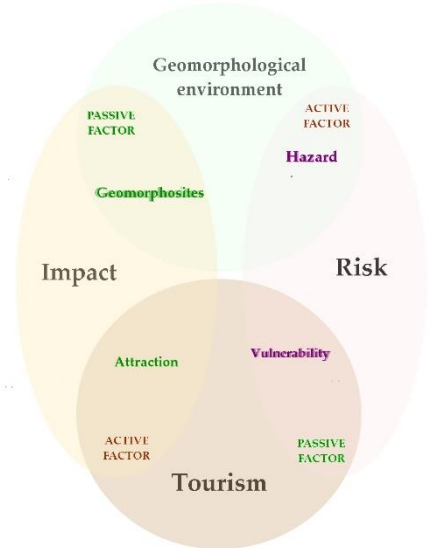

Figure 2. Conceptual scheme of the EIA (Environmental Impact Assessment) model – the relationship between geomorphology and tourism (Source: Cannillo & Panizza, 1994)

The geomorphological environment is the active factor when a hazard occurs that turns into a risk, where human society exists and can be affected. In this situation, tourism (tourists) become the passive factor. The geomorphological environment is the passive factor when represents a source of attractiveness for tourists who, through the tourist activities carried out, produce a positive or negative impact on the environment. Over time, the relationship between the two components is constantly changing (Cannillo & Panizza, 1994; Serrano, 2005). This idea was applied in Romania for the Bucegi Massif, the two terms geotourism and geo-landscape being approached from a geographical perspective, in which the major components of geo-landscapes are biodiversity, geodiversity and cultural value (Necheș & Erdeli, 2015). Geomorphological sites are classified according to their scientific, aesthetic, cultural and economic values (Raeisi et al., 2022).

Method for the geomorphosites inventory

The methodology for evaluating geomorphosites includes several stages. The first stage is represented by the study of specialized materials, analyzing both those of national and international interest. Subsequently, for the studied area, the existing geomorphosites are identified and located, following a classification and an inventory of them as a basis for the evaluation stage. For the purpose of evaluation, in countless studies the criteria were grouped into different sets of values, however, sometimes the value sets overlap (Navarette et al., 2022). The inventory and selection of geomorphosites was focused on their geomorphological characteristics. We specify that the choice of geomorphosites was focused only on their geomorphological features and not on aesthetic, cultural, economic features, since the previously mentioned have a role in increasing the value of the geomorphosites. From a morphological point of view, the selected geomorphosites are part of the category of the following landforms: peaks, ridges, glacial cirques, passes, transfluency saddles, seam.

All the geomorphosites were chosen according to the altitude criterion, at over 1800 meters (except for the peaks), located between the Negoiu and Moldoveanu peaks. This altitude was chosen as the limit because due to the glaciers involvement in shaping the landforms. For the peaks category, only those above 2500 m were chosen, because they are among the highest altitudes in România, 2544 meters maximum in Moldveanu peak. The geomorphosite inventory has the following objectives: protecting vulnerable geomorphosites, identifying the most optimal solutions for the conservation of geomorphosites and the sustainable exploitation of geomorphosites from a tourist point of view (Figure 3). The inventory consisted of the identification and documentation of important geological features for the achievement of the proposed goal, namely the inventory of geomorphosites for their promoting in environmental sustainability (Pereira & Pereira, 2010).

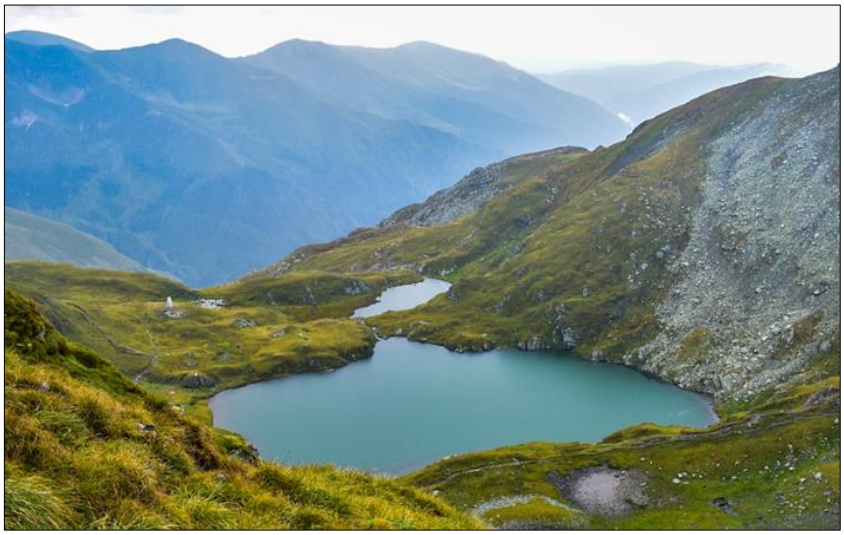

Figure 3. Capra Lake Basin (Source: Personal archive)

The inventory of geomorphosites aims to: protect vulnerable geomorphosites, identify and select the most optimal solutions for their conservation and exploit them for tourism purposes. The inventory process involved collecting vital information to achieve the intended goal, which is the evaluation of geomorphosites for their utilization in tourism.

The Assessment of Geomorphosites. In the present study the scientific and touristic values of geomorphosites were determined. The focus is on the analysis of the criteria of tourist interest, both from a scientific point of view, as well as the main characteristics of tourist interest. According to the method carried out by Pereira (2007) the central component in the evaluation process of geomorphosites is represented by their scientific particularities, on the basis of which the other values can be developed according to the interests of the evaluator.

The methodological approach includes going through several stages, which entailed the research of the specialized literature at national and international level, the realization of a critical and comparative analysis of the evaluation methods of the existing geomorphosites in order to identify and select the criteria that are adapted to the studied area (Herrera-Franco et al., 2020). The next stage consists in the establishment of new criteria necessary for the evaluation, for each criterion being given appropriate points. The last stage consists in determining the calculation formula, used to quantify the total value of a geomorphosite. The proposed method offers the possibility of evaluating the scientific characteristics as well as the tourist characteristics, which are determining factors in increasing their degree of attractiveness. Following the comparison of evaluation methods from the specialized literature, we took a series of criteria such as for the scientific value: according to the University of Valladolid – dynamics (Reynard et al., 2007), the University of Lausanne – ecological interest (Pereira, 2007) the University of Modena – the rarity and the degree of preservation for the tourist side (Coratza & Giusti, 2005) the University of Cantabria targets the number of recreational activities within the site and its accessibility (Bruschi & Cendrero, 2005). The designed method includes two main values, namely, the scientific value (Vs), (which analyzes the relief potential, and the tourist value (Vt), (which analyzes the tourist potential), thus being able to relate the involved elements. Each of the two values were divided into 5 sub-criteria, to evaluate the important characteristics of each value, (some being retained from previously studied methods and others being newly introduced criteria). Each evaluation criterion was assigned result indicators that receive values between 0 and 1, each criterion having 5 indicators.

The formula for calculating the scientific value (Equation 1) is as follows (Bruschi & Cendrero, 2005; Reynard et al., 2007; Pralong & Reynard, 2005; Selmi et al., 2022, with modifications):

$$Sv = (In+Un+Dy+Vu+Ei)/5 \text{ (Equation1)}$$

Where: Sv – scientific value; In – integrity; Un – unicity; Dy – dynamics/frequency of natural risks; Vu – vulnerability; Ei - ecological interest; The formula for calculating the tourist value (Equation 2) is as follows (Bruschi & Cendrero, 2005; Pralong & Reynard, 2005; Mucivuna, 2019, with modifications):

$$Tv = (Tr+Ac+At+Ti+Tap)/5 \text{ (Equation 2)}$$

Where: Tv – tourist value; Tr – tourist relevance; Ac – accessibility; At - attractiveness; Inf - infrastructure; Tap - tourist activities practiced; The inventory and analysis of geomorphosites were initially other and processing the cartographic material (topographical map of Romania, scale 1:25,000, aerial images), then verifying the information and completing it in the field. Field research aimed at the identification and recognition of geomorphosites in the field, associated with bibliographic documentation and detailed mapping of relief forms and geomorphological processes existing in the researched area. The documentation regarding the morphology of the area allowed the recognition and selection of those landforms that have the attribute of geomorphosite.

RESULTS AND INTERPRETATION

The classification of geomorphosites

Following the inventory of geomorphosites within the chosen area, we selected this number to ensure a significant representativeness of the geomorphological diversity in this area, as it could reflect a sufficiently wide range of its geological and geomorphological characteristics. We conducted an online and on-site questionnaire with all the geomorphosites in the area and the 22 selected for assessment were the most widely recognized by visitors to the area. Starting from the 22 inventoried geomorphosites, a brief analysis of the main taxonomies that were identified in the researched area was carried out. Their ranking was made according to the geomorphological complexity, genesis and dynamics of the generative processes. The morphological complexity is characterized in the studied area by: simple geomorphosites (characterized by singular forms or a complex of forms created by a single process, Moldoveanu Peak, Fereastra Zmeilor) and system geomorphosites, where are included those geomorphosites that include other smaller geomorphosites: the Bâlea glacial cirque which includes, the lake basin of Bâlea lake, Șaua Capra, the main ridge of Făgăraș Massif that includes the peaks as independent geomorphosites, with touristic and scientific values. Depending on their dynamics, passive geomorphosites and active geomorphosites can be identified (Németh, 2022).

Passive geomorphosites are those that change their morphological character following very slow dynamic processes in the current climate, regime and represent landmarks of the geomorphological evolution of the respective space (peaks, glacial cirques). Active geomorphosites are those that have a strong dynamic and undergo frequent changes. It represents an element of scientific interest and tourist attraction. In this category are included narrows geomorphosites (such as Strunga Dracului).

Geomorphosites Scientific Value Assessment

Each geomorphosite selected has been subjected to the evaluation process (Table 1), which analyzed the scientific value for the first time. The scientific value is made up of 5 criteria: "integrity", "uniqueness", "dynamics", "vulnerability" and "ecological interest", with 5 evaluation sub-criteria being identified for each one.

Table 1. Geomorphosites scientific value assessment

No.	Geomorphosite	Integrity	Uniqueness	Dynamics	Vulnerability	Ecological interest	Total
1	Călțun glacial cirque	1	0.25	0.50	0.50	0.25	0.50
2	Buda glacial cirque	1	0.25	0.50	0.50	0.25	0.50
3	Bâlea glacial cirque	0.75	0.25	0.75	0.25	0.25	0.45
4	Capra glacial cirque	1	0.25	0.50	0.50	0.25	0.50
5	Doamnei glacial cirque	1	0.25	0.50	0.50	0.25	0.50
6	Iezer Triunghiular glacial cirque	1	0.25	0.50	0.50	0.75	0.60
7	Podul Giurgiului glacial cirque	1	0.25	0.50	0.50	0.25	0.50
8	Galbena glacial cirque	1	0.25	0.50	0.50	0.25	0.50
9	Moldoveanu Peak	1	1	0.25	0.75	0	0.60
10	Vișstea Mare Peak	1	0.75	0.25	0.75	0	0.55
11	Negoiu Peak	1	0.75	0.25	0.75	0	0.55
12	Vânătoarea lui Buteanu Peak	1	0.75	0.50	0.75	0	0.60
13	Călțun Peak	1	0.75	0.50	0.75	0	0.60
14	Fereastra Zmeilor	1	1	0.50	0.50	0	0.60
15	Custura Sărății, ridge	1	1	0.75	0.75	0	0.70
16	Paltinului Saddle	1	0.25	0.50	0.75	0	0.50
17	Caprei Saddle	1	0.25	0.50	0.75	0	0.50
18	Podragu Saddle	1	0.25	0.50	0.75	0	0.50
19	Portița Vișstei Saddle	1	0.25	0.50	0.75	0	0.50
20	Turnu Paltinu	1	1	0.50	0.75	0	0.65
21	Strunga Ciobanului	0.50	0.75	0.25	0.50	0	0.50
22	Strunga Dracului	0.25	0.75	0.25	0.25	0	0.30

They were chosen in relation to their importance for tourism activity. Each geomorphosite was given a score between 0 and 1 for each criterion, obtaining the total scientific value through the arithmetic mean of the 5 criteria.

The lowest score for scientific value is 0.30 and was obtained by the Strunga Dracului. It is a geological formation, it is a narrow and deep gorge. This geomorphosite was created over time through the erosion of flowing water and the effects of wind and snow on the rocks, creating dramatic and spectacular sights. It is part of the tourist route for crossing the Făgăraș Ridge. It is currently closed, being inaccessible due to the high risk of injury caused by the rock-falls that occur in this sector. The highest score from a scientific point of view is 0.70 was obtained by Custura Sărății geomorphosite, is a narrow ridge with jagged appearance, rough and exposed, which connects Vârful Șerbota and Cleopatra's Saddle and represents one of the access routes to Negoiu Peak, the second highest altitude (2535 m) in the country. It obtained the maximum score for integrity and uniqueness, 0.75 for dynamics, as the route can be affected by dangerous weather phenomena such as storms and snow cover, and 0.75 for vulnerability being a 1.3 km rock ridge sector, the resistance of the geomorphosite is high.

Geomorphosites Touristic Value Assessment

The second value analyzed is the tourist value (Table 2). Within the tourist value, 5 criteria were chosen, with 5 sub-criteria each, important for the evaluation of tourists perception of the geomorphosites they visit.

Table 2. Geomorphosites tourist value assessment

No	Geomorphosite	Tourist relevance	Accessibility	Attractiveness	Infrastructure	Tourist activities practiced	Total
1	Călțun glacial cirque	0.50	0.25	0.75	0.75	0.25	0.50
2	Buda glacial cirque	0.25	0.25	0.75	0.75	0.25	0.45
3	Bâlea glacial cirque	1	1	1	1	0.50	0.90
4	Capra glacial cirque	0.75	0.25	0.75	0.75	0.25	0.55
5	Doamnei glacial cirque	0.25	0.25	0.50	0.75	0.25	0.40
6	Iezer Triunghiular glacial cirque	0.25	0.25	0.50	0.50	0.25	0.35
7	Podul Giurgiului glacial cirque	0.50	0.25	0.50	0.75	0.25	0.45
8	Galbena glacial cirque	0.25	0.25	0.25	0.25	0.25	0.25
9	Moldoveanu Peak	1	0.25	1	0.50	0.25	0.60
10	Vișstea Mare Peak	0.50	0.25	0.75	0.25	0.25	0.40
11	Negoiu Peak	1	0.25	0.75	0.25	0.25	0.50
12	Vânătoarea lui Buteanu Peak	0.50	0.25	0.75	0.25	0.25	0.40
13	Călțun Peak	0.50	0.25	0.50	0.50	0.25	0.40
14	Fereastra Zmeilor	0.50	0.25	0.50	0.50	0.25	0.40
15	Custura Sărății, ridge	0.50	0.25	0.50	0.25	0.25	0.35
16	Paltinului Saddle	0.25	0.25	0.25	0.25	0.25	0.25
17	Caprei Saddle	0.50	0.25	0.50	0.50	0.25	0.40
18	Podragu Saddle	0.50	0.25	0.50	0.50	0.25	0.40
19	Portița Vișstei Saddle	0.50	0.25	0.50	0.50	0.25	0.40
20	Turnu Paltinu	0.25	0	0.75	0.25	0.25	0.20
21	Strunga Ciobanului	0.50	0.25	0.50	0.25	0.25	0.35
22	Strunga Dracului	0.75	0.50	0.75	0.50	0.25	0.55

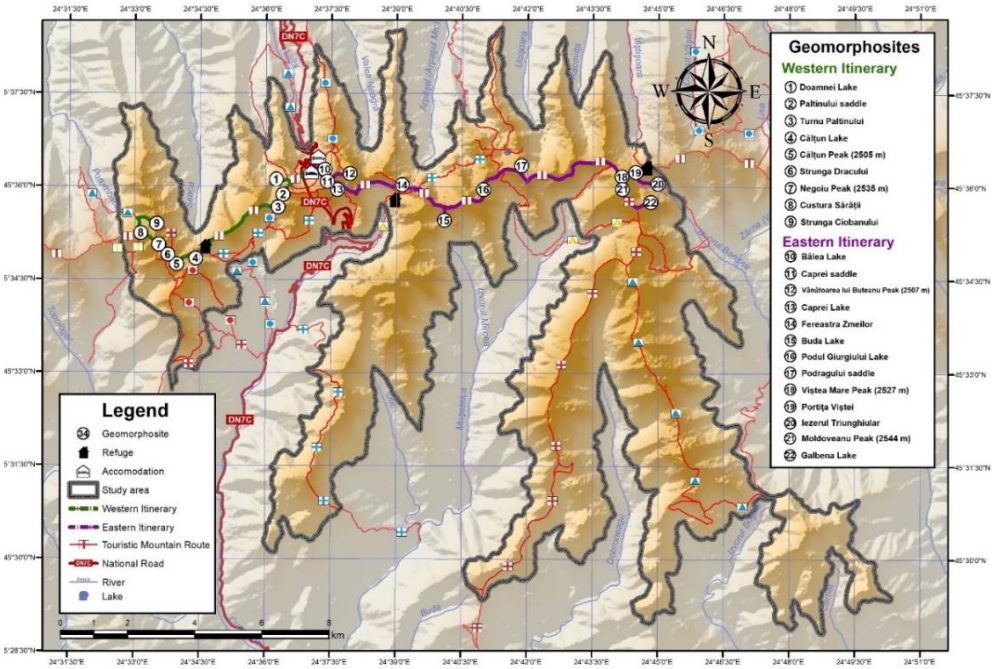

Figure 4. The geotouristic map

The highest tourist value is recorded by the geomorphosite represented by the Bâlea glacial cirque in which Bâlea lake is found, with a score of 0.90. The highest popularity among tourists is due to a very good position, having a direct connection with an easy access provided by the Transfăgărășan road. It is used as a starting point for many tourist routes in the area. Within the tourist value, the lowest score was obtained by the Turnu Paltinu geomorphosite with a score of 0.20.

It has no tourist relevance, being known by a small number of visitors. It is also quite inaccessible to tourists, being a rock wall that requires special equipment and training. The geomorphosites identified and analyzed were marked on the geotouristic map (Figure 4). The proposal of geotourist braids aims to capitalize on the geomorphosites identified in the area by presenting some elements that highlight their value (first of all, the scientific one). Two geotouristic routes are proposed which aim to capitalize on the most important geomorphosites. These were researched from a qualitative and quantitative point of view, including the necessary information for their implementation: The western route is the difficult one, it is shorter but with a large difference in level, but also steep going through the Custura Sărății ridge segment.

The Eastern route is longer, has a smaller difference in level and reaches the highest peak in the country, Moldoveanu (2544 m). Many of these geomorphosites are unknown to the tourists who visit the area. Also, the proposed evaluation method helps to identify the perception that tourists have about the development of tourist attractions in this area and to identify its strengths and weaknesses. As a result of the study, limitations were also identified due to the lack of information and statistics. In the field there is no information about identified geomorphosites or about geotourism.

At the end of the analysis (Table 3), the glacial cirque where Bâlea Lake is located is the one that obtained the highest score 0.675p. Following the application of the method, it was found that the Bâlea glacial cirque area is the most famous and sought after for camping, breaks and hiking. It is the most accessible of the entire massif for tourists, even for the most comfortable, who prefer to go by means of transport to their destination. There are accommodation, camping and food facilities and it is the starting point for numerous routes along the Făgărașului Ridge and offers impressive views.

On the opposite side, the lowest score is obtained by the Strunga Dracului with 0.325, geomorphosite, with a complex genesis, which combines the role of microtectonics, gravitational displacements and differential erosion. Considered a sector with great difficulty and high risk of accidents, it is avoided by many tourists, there are even restrictions on its passage. Strunga Dracului geomorphosite is currently closed for tourist activity due to existing rock fall processes.

Table 3. The total value of the evaluation of geomorphosites

No.	Geomorphosite	Scientific Value	Touristic Value	Total
1	Călțun glacial cirque	0.50	0.50	0.50
2	Buda glacial cirque	0.50	0.45	0.47
3	Bâlea glacial cirque	0.45	0.90	0.68
4	Capra glacial cirque	0.50	0.55	0.52
5	Doamnei glacial cirque	0.50	0.40	0.45
6	Iezer Triunghiular glacial cirque	0.60	0.30	0.45
7	Podul Giurgiului glacial cirque	0.50	0.45	0.47
8	Galbena glacial cirque	0.50	0.25	0.38
9	Moldoveanu Peak	0.60	0.60	0.60
10	Viștea Mare Peak	0.55	0.40	0.47
11	Negoiu Peak	0.55	0.50	0.52
12	Vânătoarea lui Buteanu Peak	0.60	0.40	0.50
13	Călțun Peak	0.60	0.40	0.50
14	Fereastra Zmeilor	0.60	0.40	0.50
15	Custura Sărății, ridge	0.65	0.35	0.50
16	Paltinului Saddle	0.50	0.25	0.37
17	Caprei Saddle	0.50	0.40	0.45
18	Podragu Saddle	0.50	0.40	0.45
19	Portița Viștei Saddle	0.50	0.40	0.45
20	Turnu Paltinu	0.65	0.20	0.42
21	Strunga Ciobanului	0.50	0.35	0.42
22	Strunga Dracului	0.30	0.35	0.33

At the end of the evaluation we have some specific proposals for conservation and geotourism:

The proposed evaluation method helps to identify the perception that tourists have about the presence of tourist attractions related to the relief in this area and to identify its strengths and weaknesses. Thus, to improve the geotourism activity, we propose the following: setting up panels where all the geomorphosites in the area are located and presented (this way tourists know what they can visit, even if they don't know about the existence of a certain geomorphosite); realization of some geotouristic routes; the development of arrangements necessary for the good performance of the activity; limiting access to degraded areas that can endanger the lives of tourists (especially due to collapses and avalanches).

The following measures can be taken into account for the conservation and protection of geomorphosites: limitation of constructions and development of tourist infrastructure to preserve the integrity and natural beauty of the lake and the mountain landscape; monitoring and managing the water quality of Lake Bâlea to ensure a healthy environment for aquatic species and to prevent pollution; promoting sustainable tourism practices, such as recycling, waste minimization and the use of renewable energy in tourism infrastructure; for the Strunga Dracului geomorphosite, specialized studies must be

carried out, as limited travel with certain rules of passage is necessary, as most of the ridge routes, as well as the via ferrata, are carried out under the same conditions as those crossing the Strunga Dracului. Such as, it is necessary to install information boards related to the crossed segment (the beginning of the route and during its course) and the risk of crossing it, as well as keeping a safe distance between tourists to avoid an accident when you cross the lathe and using appropriate equipment (gloves, helmet). It is necessary to clearly and visibly signal the danger of falling stones and to inform tourists about the measures necessary to cross this geomorphosite. Carrying out a periodic monitoring and evaluation of the state of the geomorphosite in order to identify potential risks and take timely preventive measures. This could involve periodic inspections of the area, assessment of rock stability to detect the possibility of instability processes.

Our study highlights the importance of assessing the value of geomorphosites in terms of both their scientific and touristic significance and promoting their inclusion in sustainable tourism and environmental management plans. The Făgăraș Massif is a unique area that contains a significant number of geomorphosites with high scientific and touristic value, which can contribute to the sustainable economic development of the area.

CONCLUSION

The area studied in this research is analyzed for the first time from the perspective of the evaluation and valorization of geomorphosites. This study helps in understanding the complexity of the landscape and its geomorphological wealth, reflected in the large number of geomorphosites identified in a restricted area.

In order to fully validate this method, the criteria for the assigned values should be tested in different physical-geographical units and tourist areas (mass tourism, individual tourism, etc.) to adapt the evaluation scale. This approach can later be used to define the capacity of geomorphosites to sustain tourism functions, as well as their evolution based on exploitation.

Focusing on a specific category of geotourism forms, known as geomorphosites, prompted us to give special consideration to the methodological approaches employed in their analysis (inventory, evaluation, mapping). Consequently, we aimed to establish a systematic sequence of steps for mapping landforms with the potential to be classified as geomorphosites. The inventory process of geomorphosites was grounded in the initial scientific documentation phase. During this stage, we conducted a comprehensive review of geological and geomorphological literature, along with the examination of cartographic materials, specifically focusing on the topography of the Făgăraș Massif.

The primary challenges faced during the study revolved around the absence of information and prior research pertaining to the subject, none of which directly addressed the researched area. This research entailed on-site data collection and information gathering. Additionally, other difficulties included the absence of clear markers, as there were days when dense fog posed an imminent risk of accidents and significantly hindered accessibility.

The present investigation reveals the assessment and valorization of geomorphosites in sustainable tourism activities provide valuable insights into their scientific and touristic values. In this case study conducted in the Făgăraș Massif, 22 geomorphosites were inventoried and evaluated based on their scientific and touristic significance. Also the method can be adapted depending on the evaluator and the specifics of the analyzed area. It is also important to note that the formulas provided can be improved with more detailed research. The findings contribute to a better understanding of the potential of these sites for tourism development. The research also emphasized the importance of geotourism, geoconservation and environmental sustainability in the context of tourism development. Geotourism focuses on promoting responsible tourism practices that respect and appreciate the geological and geomorphological features of an area.

The study highlights the potential of geomorphosites as valuable assets for sustainable tourism, combining the preservation of natural heritage with the economic benefits generated by tourism activities. The findings can inform decision-making processes, guiding the development of tourism strategies that maximize the benefits while minimizing potential risks and negative impacts on the environment. By integrating scientific knowledge, tourism promotion, and conservation efforts, geomorphosites can contribute to the sustainable development of this tourist destination.

The limitations encountered during the research are of a statistical nature (lack of concrete information on the annual number of visitors, overnight stays, as the National Institute of Statistics has a limited and incomplete data volume), academic (lack of research on this area from the geomorphosite perspective), legal (there is no legal framework regarding geomorphosites, as they are not specifically regulated by a dedicated law), and tourism-related (there are numerous unknown geomorphosites that have not been brought to the public's attention, which could lead to further research and a better understanding of the genesis of the visited area by tourists). The limitations encountered during the research can contribute to the development of further studies and to the identification of applicable solutions.

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