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GEOHERITAGE AND GEOTOURISM POTENTIAL OF THE MUNICIPALITY OF ROŽAJE (NORTHEASTERN MONTENEGRO)

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Abstract: Rožaje is a municipality in the north-eastern part of Montenegro. The municipality covers an area of 432 km^2. According to the data of the last census, which was conducted in 2023. 25.247 inhabitants live in this Montenegrin municipality. There are a large number of geolocations in Rožaje that have great potential for the development of geotourism. The aim of this work is to make an inventory of geoheritage objects and their possible valorisation and geoconservation for the development of geotourism in this area. In addition, one of the objectives is to assess various geolocations in the municipality of Rožaje using the GAM (Geosite Assessment Model) and determine whether this area has the potential for geotourism development in the future. The paper proposes representative geolocations of this area that can form an excellent basis for the development of geotourism. The geolocations selected for this study are Musas Pit, Ćirko Cave, Grlja Waterfall, meanders with looping arches in the Ibar River canyon, Grope Cauldron on Hajla Mountain, limestone ridges in the Ganića Karst, Bukovica River canyon, Prvotunelska Cave, Vrelo Ibra Spring and Rujište Marshes. The GAM model will be used to determine which geolocations are suitable for the development of geotourism. In addition, measures for the preservation of geolocations and their geoconservation will be proposed. In other words, it will discuss how the development of tourism in the area can be successfully managed and sustainably planned. Natural resources are the main motive for tourist flows in the area.

Keywords: geosites, geoheritage, geotourism, GAM, Rožaje, Montenegro.

Introduction

Geotourism as a special interest tourism in the era of contemporary tourist trends is based on geodiversity and geoheritage. Another definition states that geotourism is the promotion and protection of geological heritage through tourism

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with the help of education and interpretation (Tomić, 2014). Geotourism has become an increasingly popular form of tourism worldwide (Ruban, 2015). Essentially, geotourism represents the process of recognising and enhancing the significance of geosites, which should lead to better and more efficient conservation of geological heritage and geosites (Hose, 2005).

Montenegro has significant natural and cultural values, some of which are recognised not only nationally but also internationally. In a relatively small area, there is a great variety of geographical diversity and heritage, which is very important for the development of tourism, which plays an important role in the economy of this country, which also applies to the municipality of Rožaje. Tourism, as one of the strategic branches of the development of the Municipality of Rožaje, represents a very important segment in the overall system of economic sectors. When talking about tourism in the municipality of Rožaje in the past period, it can be said that it is a segment that is at a very low level of development, although there were some facilities such as the Hotel Turjak with its accommodation facilities and two ski slopes, the Hotel Rožaje. Currently, the tourist offer is limited to private hotels and guesthouses with a modest offer. Considering the fact that, according to the Rožaje Tourist Organisation, the number of tourists visiting the municipality of Rožaje has increased in recent years, and with it the number of overnight stays, it is clear that the need for new accommodation and new facilities is very pronounced and will be a limiting factor for further development. It is necessary to work on an appropriate categorisation of accommodation capacity, as there are legal regulations and standards that accommodation establishments must meet. According to the 2019-2021 Development Index, Montenegrin LGUs are categorised into five groups. Above the average are 5 LGUs (four coastal municipalities and Podgorica). Below the Montenegrin development average are 19 of the 24 municipalities for which the development index was measured, which indicates a significant development gap between the regions of Montenegro. All municipalities in the northern region are in this category, with the municipality of Rožaje below 50 % (Ministry of Economic Development and Tourism, 2023).

Geotourism depends on the geological heritage of a particular area, which is very important for the further development of geotourism due to its content. Geotourism as tourism encompasses all geological attractions and destinations (Dowling, 2006). The natural and socio-cultural values of protected areas are extremely important in attracting tourists. Geoheritage represents an important potential for the success of tourism (Huayhuaca, Cottrell, Raadik and Gradl, 2010; Brđanin and Sedlak, 2021), such as scientific research, ecotourism, schools in nature and educational tourism. Socio-cultural factors of the destination directly contribute to the development of cultural forms of tourism, which can significantly contribute to the attractiveness of the destination (Stojanović et al., 2024).

Geodiversity is an essential component of geoheritage. The overall geological-pedological and even geomorphological values of geodiversity represent a potential area for geotourism development (Grey, 2018). Geodiversity represents the natural diversity of the geoecological environment (Nikolić, 2018). For this study, the municipality of Rožaje was selected as an area with a large diversity of geoheritage with recognisable geosites for the development of geotourism in Montenegro.

According to the Law on Nature Protection of Montenegro ("Official Gazette of Montenegro", No. 054/16 of 15 August 2016), the term geo-heritage is defined as all geological, geomorphological, pedological and special archaeological values that were created during the formation of the lithosphere, its morphological formation and the interdependence of nature and human cultures (Article 6, paragraph 20). Geoheritage represents a respectable example of geodiversity, while its abundance and representation is only a small part of the total geodiversity (Đurović and Mijović, 2006). One of the main tasks of this research is the geoconservation of geo-heritage objects in the municipality of Rožaje. The aim of geoconservation is also to eliminate and minimise potential threats to geodiversity (Vasiljević, 2015; Lukić and Petrović, 2020). Geoconservation can be described as an "action taken with the intention of preserving and enhancing geological and geomorphological features, processes, sites and specimens" (Burek and Prosser, 2008).

For the future promotion of geotourism, it is necessary to assess the current condition and values of geosites in the area, which can be achieved using the GAM model, i.e. geosite assessment. The GAM model is used to assess which objects are suitable for geotourism development and how their geoconservation can be carried out. Namely, it evaluates how to manage and create a sustainable plan for the development of tourism in the area.

This methodology has already been successfully applied in research on the assessment of various geolocations in neighbouring Serbia (Vasiljević, 2015; Grujičić-Tešić, 2017; Antić, Tomić, 2017; Boškov et al, 2015; Božić et al, 2014; Božić, Tomić, 2015; Tomić et al, 2019; Tomić et al, 2020; the USA (Tomić et al, 2015; Jonić, 2018), Slovenia (Tičar et al, 2018), Iran (Tomić et al, 2021) and Hungary (Pál and Albert, 2018).

Research Area

Rožaje is a municipality in the north-eastern and eastern part of Montenegro. It is one of the municipalities bordering Serbia. The area of the municipality of Rožaje is 432 km^2 with 25,247 inhabitants and 6,595 households (according to the 2023 census). It borders the municipality of Berane and the municipality of Petnjica. The remarkable location of the municipality of Rožaje makes it important for the

development of tourism in this region. From an orographic point of view, the entire area of this municipality on the right side of the river Ibar belongs to the northern range of Prokletije Mt. and on the left side of the Ibar to the highlands Starovlaška-Raška (Skenderović, 2022).

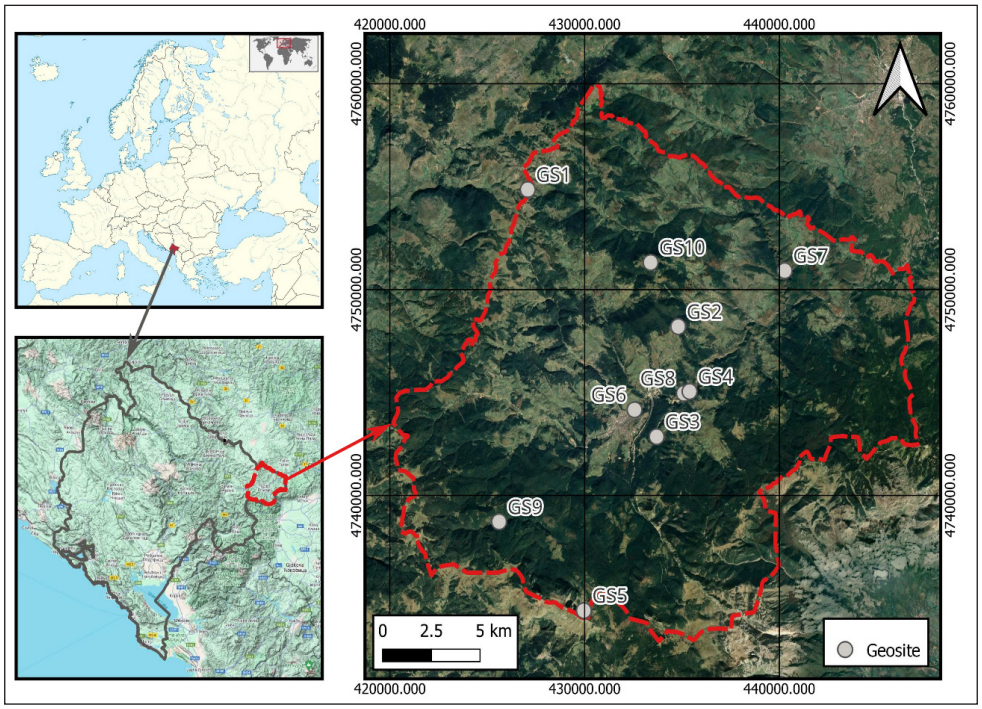

Figure 1. Analyzed localities in the municipality of Rožaje (Montenegro)
Source: Brđanin & Vujović 2024.

The border with the municipalities of Petnjica and Berane runs through the confluence of the Lim and Ibar rivers (Mokra 1,926 m, Cmiljevica 1,963 m, Krš 1,573 m, Turjak 1,409 m, Vlahovi 1,599 m). The border runs along the high mountains of Žljeb (2,352 m) and Hajla (2,403 m), the Republic of Serbia, the Pešter Plateau, Krstač (1,758 m), Gradina (1,691 m) and Vranjača (1,545 m), Petka (1,432 m), Karaula (1,306 m) and others. (Radojičić, 1996, 2008, 2015).

In the municipality of Rožaje, which has a large number of geolocations, the following geolocations were selected for this study and assessment: Musas Pit, Grlja Waterfall, Ibar Gorge, Ćirko Cave, Grope Cirque on Hajla Mountain, limestone ridges in Ganić Karst, Bukovica River Gorge, Prvotunelska Cave, Vrelo Ibra Spring and Rujište Marsh.

altitude of the municipality of Rožaje ranges from 760 metres above sea level (mouth of the Ibar River) to 2,403 metres above sea level (altitude of Mount Hajla) (Radojičić, 2008). At an altitude of 1,643 metres, there are many landforms: vertical rocks, stožine (Ahmica) high mountain passes, ridges and plains, gentle valleys, rough canyons (Ibar Canyon and Bukovica Canyon, as the most prominent geolocations for the development of geotourism), a pond and "Blato" near the village of Biševo (Martinović and Markišić, 2002). Due to its geographical location and altitude, the municipality of Rožaje belongs to the humid continental climate zone, where cold winters and cool summers prevail (Brđanin and Sedlak, 2021).

Materials and Methods

The Geolocation Assessment Model (GAM) was created based on existing methodological assessments. In addition, most of the criteria proposed for the numerical assessment were taken from the existing literature (Vujičić et al., 2011). The complete structure of the GAM is shown in Table 1.

The model is based on geolocation estimation methods used by various authors (e.g. Hose 1997, Pralong 2005, Reynard et al., 2008, Pereira et al., 2007, Zouros 2007).

According to Reynard et al. (2007), most of the existing models can be categorised into several groups that differ in their objectives and purpose. One group refers to the assessment of environmental impacts and spatial planning with a focus on scientific values (e.g. Grandgirard, 1999, Rivas et al., 1997, Bonachea et al., 2005, Coratza and Giusti, 2005), while others mainly assess not only scientific but also so-called "additional values" such as ecological, aesthetic, cultural and economic qualities (Reynard et al., 2007).

Table 1. Structure of the GAM geolocation evaluation models

Indicators/Subindicators	Description
Main values (MV)	
Scientific/Educational value (VSE)	
Rarity	Number of closest identical sites
Representativeness	Didactic and exemplary characteristics of the site due to its own quality and general configuration
Knowledge on geoscientific issues	Number of written papers in acknowledged journals, thesis, presentations and other publications
Level of interpretation	Level of interpretive possibilities on geological and geomorphologic processes, phenomena and shapes and level of scientific knowledge
Scenic/Aesthetic (VSA)	
Viewpoints	Number of viewpoints accessible by a pedestrian pathway. Each must present a particular angle of view and be situated less than 1 km from the site.
Surface	Whole surface of the site. Each site is considered in quantitative relation to other sites
Surrounding landscape and nature	Panoramic view quality, presence of water and vegetation, absence of human-induced deterioration, vicinity of urban area, etc
Environmental fitting of sites	Level of contrast to the nature, contrast of colours, appearance of shapes, etc
Protection (VPr)	
Current condition	Current state of geosite
Protection level	Protection by local or regional groups, national government, international organizations, etc.
Vulnerability	Vulnerability level of geosite
Suitable number of visitors	Proposed number of visitors on the site at the same time, according to surface area, vulnerability and current state of geosite
Additional values (AV)	
Functional values (VFn)	
Accessibility	Possibilities of approaching to the site
Additional natural values	Number of additional natural values in the radius of 5 km (geosites also included)
Additional anthropogenic values	Number of additional anthropogenic values in the radius of 5 km
Vicinity of emissive centers	Closeness of emissive centres
Vicinity of important road network	Closeness of important road networks in the in radius of 20 km
Additional functional values	Parking lots, gas stations, mechanics, etc.
Touristic values (VTr)	
Promotion	Level and number of promotional resources
Organized visits	Annual number of organized visits to the geosite
Vicinity of visitors centers	Closeness of visitor centre to the geosite

Interpretative panels	Interpretative characteristics of text and graphics, material quality, size, fitting to surroundings, etc
Number of visitors	Annual number of visitors
Tourism infrastructure	Level of additional infrastructure for tourist (pedestrian pathways, resting places, garbage cans, toilets etc.)
Tour guide service	If exists, expertise level, knowledge of foreign language(s), interpretative skills, etc.
Hostelry service	Hostelry service close to geosite
Restaurant service	Restaurant service close to geosite

Grades (0.00–1.00)					
	0.00	**0.25**	**0.50**	**0.75**	**1.00**
1.	Common	Regional	National	International	The only occurrence
2.	None	Low	Moderate	Moderate	Utmost
3.	None	Local publications	Regional publications	National publications	International
4.	None	Moderate level of processes but hard to explain to non experts	Good example of processes but hard to explain to non experts	Moderate level of processes but easy to explain to common visitor	Good example of processes and easy to explain to common visitor
5.	None	1	2 to 3	4 to 6	More than 6
6.	Small	-	Medium	-	Large
7.	-	Low	Medium	High	Utmost
8.	Unfitting	-	Neutral	-	Fitting
9.	Totally damaged (as a result of human activities	Highly damaged (as a result of natural processes)	Medium damaged (with essential geomorphologic features preserved)	Slightly damaged	No damage
10.	None	Local	Regional	National	International
11.	Irreversible (with possibility of total loss)	High (could be easily damaged)	Medium (could be damaged by natural processes or human activities)	Low (could be damaged only by human activities)	None
12.	0	0 to 10	10 to 20	20 to 50	More than 50
13.	Inaccessible	Low (on foot with special equipment and expert guide tours)	Medium (by bicycle and other means of manpowered transport)	High (by car)	Utmost (by bus)
14.	None	1	2 to 3	4 to 6	More than 6
15.	None	1	2 to 3	4 to 6	More than 6

16.	More than 100 km	100 to 50 km	50 to 25 km	25 to 5 km	Less than 5 km
17.	None	Local	Regional	National	International
18.	None	Low	Medium	High	Utmost
19.	None	Local	Regional	National	International
20.	None	Less than 12 per year	12 to 24 per year	24 to 48 per year	More than 48 per year
21.	More than 50 km	50 to 20	20 to 5 km	5 to 1 km	Less than 1 km
22.	None	Low quality	Medium quality	High quality	Utmost quality
23.	None	Low (less than 5000)	Medium (5001 to 10 000)	High (10 001 to 100 000)	Utmost (more than 100 000)
24.	None	Low	Medium	High	Utmost
25.	None	Low	Medium	High	Utmost
26.	More than 50 km	25–50 km	10–25 km	5–10 km	Less than 5km
27.	More than 25 km	10–25 km	10–5 km	1–5 km	Less than 1 km

Source: Vujičić et al, 2011.

The first group of indicators, called **main values (MV - Main Values)**, consists of three indicators: scientific or so-called educational values (VSE - scientific and educational values), scenic or aesthetic values (VSA - scenic and aesthetic values), and level of protection (VPr - protection level). The second group of GAM indicators, **additional values (AV - Additional Values)**, is further divided into two indicators, functional (VFn - Functional Values) and tourism values (VTr - Tourism Values), as shown in Table 1. (Vujičić et al., 2011).

In total, there are 12 sub-indicators of main values and 15 sub-indicators of additional values, which vary from 0.00 to 1.00, which can be analyzed by using the following GAM equation:

$$M - GAM = MV + AV \quad (1)$$

MV (Main Values) represent the main values, defined on the basis of 3 subindicators. **AV (Additional Values)** represent additional values, defined on the basis of 2 subindicators. These values consist of many sub-values and are derived from the following formulas:

$$MV = VSE + VSA + VPr \quad (2)$$

$$AV = VFn + VTr \quad (3)$$

VSE – scientific and educational values
VSA – scenic and aesthetic values
VPr – protection level
VFn – functional values
VTr – tourism values

Now that we know that each group of sub-indicators consists of several other sub-indicators, equations (2) and (3) can be written in the following form:

$$MV = VSE + VSA + VPr \equiv \sum_{i=1}^{12} SIMV_i, \text{ leading to } \quad 0 \le SIMV_i \le 1 \ , \quad (4)$$

$$AV = VFn + VTr \equiv \sum_{j=1}^{15} SIAV_i, \text{ leading to } \quad 0 \le SIAV_j \le 1 \ . \quad (5)$$

In the presented equations, SIMVi and SIAVj represent 12 sub-indicators of the main values (i = 1,...,12) and 15 sub-indicators of additional values (j = 1,...,15) shown in Table 1. (Vujičić et al., 2011).

In the GAM model, the values for each sub-indicator are determined only by experts, while M-GAM includes not only the opinion of experts but also the opinion of visitors and tourists regarding the importance of each indicator in the evaluation process. The involvement of visitors in the evaluation process is done through a survey where each respondent is asked to determine/judge the importance (Im) of each of the 27 indicators (from 0.00 to 1.00) using a questionnaire.

The main values are shown on the X-coordinate line and the additional values on the Y-coordinate line. The matrix consists of nine fields, each of which has 4 units on the X-axis and 5 units on the Y-axis. According to the score related to the geolocation value, all locations are displayed in the matrix of the GAM model shown above. For example, if a place has a sum of three additional values and six main values, this means that it has a low level of additional values and a medium level of main values. The results obtained can be used to estimate the value of a particular geographic location. Furthermore, the results can show what tourists value and to what extent these values are present in that area (Vujičić, et al., 2011; Tomić, 2014).

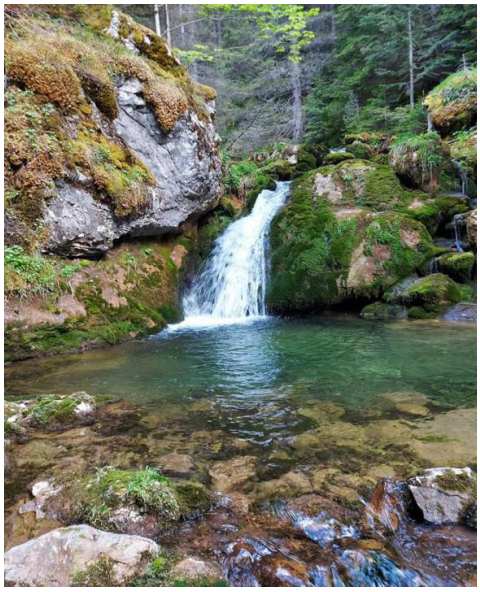

Figure 2. Geolocality Musas pit (GS_1)

Figure 3. Geolocality Waterfall "Grlja" (GS_3)

Figure 4."Bukovica" River Gorge (GS7)

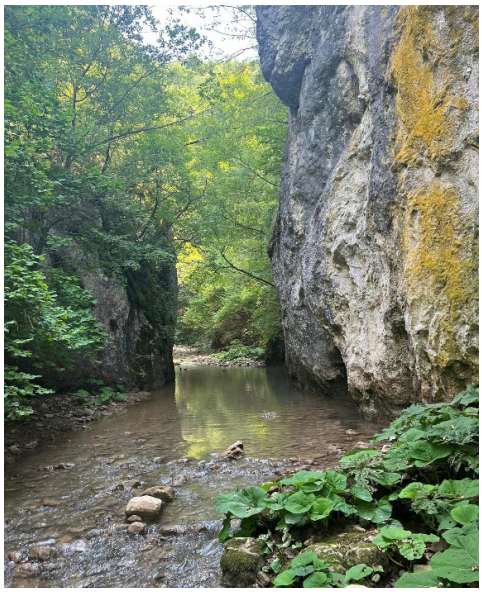

Figure 5. Limestone Ridges on "Ganića" Karst (GS6)

Figure 6. Spring "Vrelo Ibra" Rožaje (GS9)

Figure 7. Bogland Rujište (GS10)

Results and Discussion

In this research study, ten geolocalities in the municipality of Rožaje were evaluated using GAM methods. One of the goals of the paper is to compare the current state of those geolocalities and their potential for the development of geotourism. Furthermore, the goal of this paper is to find out which geolocalities in this researched area have the greatest tourist potential for the development of geotourism in the coming period, as well as their conservation for sustainable tourism. The final evaluation results are shown in Table 2, Table 3, and Figure 8.

Table 2. Sub-indicators and their values are given by experts for geolocalities of the municipality of Rožaje.

Main Indicators/ Subindicators	**Geosites Total value**									
	GS_1	GS_2	GS_3	GS_4	GS_5	GS_6	GS_7	GS_8	GS_9	GS_{10}
Scientific/Educational value (VSE)										
Rarity	0.50	0.25	0.50	0.50	0.25	0.25	0.50	0.25	0.75	0.25
Representativeness	0.25	0.25	0.50	1.00	0.75	0.75	0.75	0.25	1.00	0.50
Knowledge on geoscientific issues	0.50	0.25	0.00	0.50	0.00	0.25	0.50	0.25	1.00	0.25
Level of interpretation	0.50	0.50	0.50	1.00	1.00	1.00	0.75	0.75	0.50	0.50
Scenic/Aesthetic (VSA)										
Viewpoints	0.25	0.00	0.25	1.00	0.75	0.50	1.00	0.50	0.25	0.25
Surface	0.00	0.25	0.00	0.50	0.25	0.00	0.50	0.00	0.50	0.25
Surrounding landscape and nature	0.25	0.25	0.75	0.75	0.75	0.50	0.75	0.25	0.75	0.50
Environmental fitting of sites	0.50	0.50	1.00	0.75	0.75	0.50	0.75	0.25	0.50	0.50
Protection (VPr)										
Current condition	0.50	0.75	1.00	0.50	0.75	1.00	1.00	0.50	0.75	0.50
Protection level	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00
Vulnerability	0.50	0.50	0.75	0.75	1.00	0.50	0.75	0.50	0.50	0.25
Suitable number of visitors	0.25	0.25	0.50	1.00	1.00	1.00	0.25	0.50	0.75	1.00
Additional values (AV)										
Functional values (VFn)										
Accessibility	0.50	0.25	0.25	1.00	0.25	0.50	0.25	0.75	0.75	0.75
Additional natural values	0.00	0.25	0.50	0.50	0.75	0.50	0.50	0.25	0.50	0.25

Additional anthropogenic values	0.00	0.00	0.00	0.25	0.00	1.00	0.00	0.25	0.00	0.25
Vicinity of emissive centers	0.25	0.25	0.25	1.00	0.25	1.00	0.50	1.00	0.75	0.50
Vicinity of important road network	0.25	0.50	0.50	1.00	0.00	1.00	0.75	1.00	0.25	0.50
Additional functional values	0.00	0.00	0.00	0.75	0.00	0.50	0.50	0.50	0.00	0.25
Touristic values (VTr)										
Promotion	0.00	0.00	0.25	0.50	0.75	0.25	0.25	0.00	0.75	0.25
Organized visits	0.00	0.00	0.00	0.25	0.75	0.25	0.00	0.00	0.50	0.25
Vicinity of visitors centers	0.00	0.25	0.50	0.75	0.50	0.75	0.25	0.50	0.50	0.25
Interpretative panels	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.50	0.25
Number of visitors	0.00	0.00	0.25	0.25	0.25	0.25	0.00	0.00	0.25	0.25
Tourism infrastructure	0.00	0.00	0.50	0.25	0.25	0.50	0.00	0.00	0.50	0.50
Tour guide service	0.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00	0.50	0.25
Hostelry service	0.25	0.25	0.50	0.75	0.75	1.00	0.25	0.75	0.75	0.50
Restaurant service	0.50	0.50	0.50	1.00	0.75	1.00	0.25	1.00	0.75	0.50

Table 3. Overall ranking of geolocalities of the municipality of Rožaje - using the GAM model

Geosite	Main Values	Σ	Additional Values	Σ	Total	Field
	VSE + VSA + VPr		VFn + VTr			
GS_1 – Musas pit	1.75+1.00+1.25	**4.00**	1.00+0.75	**1.75**	5.75	Z_{11}
GS_2 – Ćirko's cave	1.25+1.00+1.50	**3.75**	1.25+1.00	**1.25**	5.00	Z_{11}
GS_3 – Waterfall Grlja	1.50+2.00+2.50	**6.00**	1.50+2.75	**2.75**	8.75	Z_{21}
GS_4 – Meanders with Looping Arches in the canyon Ibar	3.00+3.00+2.25	**8.25**	4.50+4.00	**8.50**	16.75	Z_{32}
GS_5 – Grope Cirque on Hajla Mountain	2.00+2.50+2.75	**7.25**	1.25+5.00	**6.25**	13.50	Z_{22}
GS_6 – Limestone Ridges on Ganića Karst	2.25+1.50+2.50	**6.25**	4.50+4.25	**8.75**	15.00	Z_{22}
GS_7 – Bukovica River Gorge	2.50+3.00+2.00	**7.50**	2.50+1.00	**3.50**	11.00	Z_{21}
GS_8 – the Prvotunelska Cave	1.50+1.00+1.50	**4.00**	3.75+2.25	**6.00**	10.00	Z_{22}
GS_9 – Spring Vrelo Ibra	3.25+2.00+2.25	**7.50**	2.25+5.00	**7.25**	14.75	Z_{22}
GS_{10} – Bogland Rujište	1.50+1.50+1.75	**4.75**	2.50+3.00	**5.50**	10.25	Z_{22}

The results of the GAM model study are shown in Table 2 with all values for 27 sub-indicators and the final results for the main and additional values in Table 3. Tables 2 and 3 show that the sum of the main values is significantly greater than that of the

additional values. This indicates that the selected geolocations in the municipality of Rožaje have great tourist potential for the development of geotourism, but that this potential is not yet fully utilised.

Geolocations with the highest main values according to the GAM model assessment are meanders with bends in the Ibar river canyon (8.25), the Bukovica river canyon (7.50), the Vrelo Ibra spring (7.00) and the Grlja waterfall (6.00). The geolocations with the greatest scientific or educational value are the Vrelo Ibra spring (3.25), the meanders of the Ibar canyon (3.00) and the Bukovica canyon (2.50). In terms of rarity and representativeness, the meanders of the Ibar River and the Vrelo Ibra spring are the most outstanding geographical sites with extremely high values. In terms of landscape and aesthetic values, in addition to the above-mentioned geolocations, the Grlja waterfall (2.00) and the Grope Cirque on Mount Hajla (2.50) stand out with extremely high values in terms of viewpoints, surrounding landscapes and environmental adaptation. The rated geolocations with the largest area are the meanders with bends in the Ibar river canyon and the Bukovica river canyon with values (0.50), while the other geolocations fall into the category of small or medium-sized localities by area.

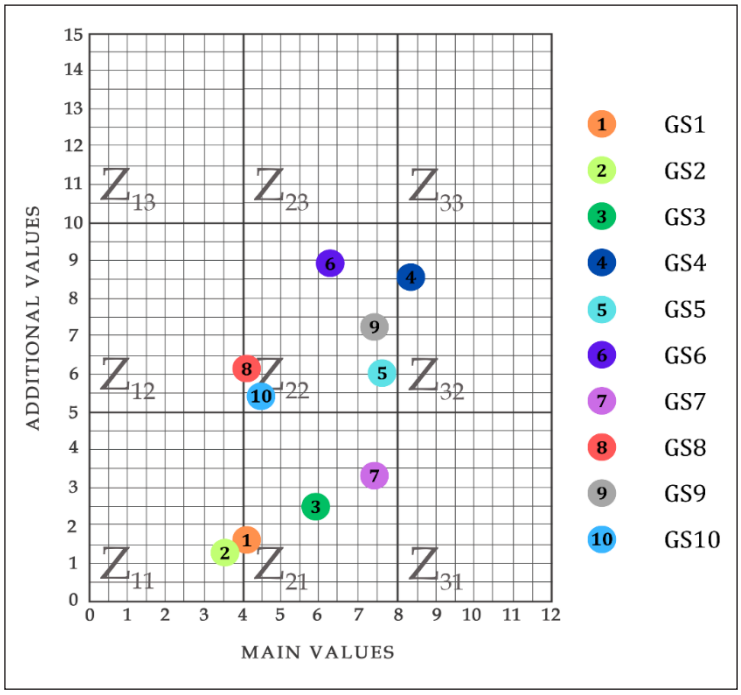

Figure 8. Position of the analyzed geolocalities in the GAM matrix.

The level of protection for all geolocations assessed has low values, especially for the localities: Musas Pit (1.25), Ćirkos Cave (1.50) and Rujište Marsh (1.75). It is particularly worrying that none of the geolocations assessed have any protection status. The current state of the geotopes falls into the "slightly damaged" or "well preserved" category. It is essential that these geolocations are protected by local or state authorities in the future, as they are likely to be endangered, i.e. damage to certain geosites may occur. It is necessary to start protection at the local level, then continue through the regional level and continue with the national or international level of protection for those objects that have been evaluated with high marks for the development of geotourism in the area, since without the transformation of these objects there will be no sustainable tourism in the future. A first protection could be done at the source of Vrela Ibra as a site of international importance for tourism development. Currently, this place is without any protection.

In terms of the most important values, Musas Pit (4.00), Ćirko Cave (3.75) and Prvotunelska Cave (4.00) are rated the lowest, as these sites are not yet fully explored and have only small areas. Knowledge about the geological and geomorphological phenomena and processes of these facilities has not yet been published and is unknown to the population and tourists. Initial valorisation of these areas has also not yet taken place.

Tables 2 and 3 show the assessed added value of all the geolocations analysed. The Limestone Ridge on the Ganića Karst geolocation (8.75) has the highest added value because it is easily accessible by car, is located near the centre of Rožaje, which suggests that there are numerous restaurants nearby, and because it is close to important transport routes. Geolocations wedged in meanders of the "Ibar" and "Vrelo Ibra" gorges are also highly rated because they are close to important regional roads and have additional natural and anthropogenic values.

The geolocations with the lowest ratings are the Musas Pit, the Ćirko Cave, the Grlja Waterfall and the Bukovica River Canyon, as the terrain is extremely inaccessible and a long distance from major centres and important transport routes. Furthermore, there are no organised tours to these geolocations. In terms of added value for tourism, the geolocations Grope cirque (5.00) and Vrelo Ibra (5.00) should be highlighted, as there are organised tourist visits. In most cases, these are visits by mountaineers who go on a hike to the summit of Hajla (2,403 m). They usually also visit the Vrelo Ibra geolocation via Bandžo, which is why this geolocation is so important in terms of organising tourist visits. There are no organised tourist visits to most of the other geolocations.

The importance of the value of tourists should not be diminished. Tourists and their values are very important factors for the promotion and further development of sustainable geotourism. It should be mentioned that there is a tourist infrastructure

in the form of well-maintained and marked hiking trails, resorts up to Mount Hajla, as well as a guide service and information boards on these geolocations. In addition, there are a large number of organised visits to these places, which are even promoted internationally as excellent hiking destinations. With the aim of making the tourist offers more successful and attractive, the installation of display boards with high-quality texts, graphics and materials could make an important contribution to these geolocations. The size and overall external appearance of the panels should be adapted to the natural environment at all geolocations. As tourists are often people who know little about the geology and geomorphology of the places they visit, it is necessary to explain the nature of the surrounding geolocation on the panels in a way that is understandable in relation to the geology and geomorphology of the object.

When analysing the additional functional values, one could say that the biggest problem of these geo-locations is the lack of parking spaces for the development of tourist destinations near the geo-locations. None of the geolocations analysed have car or bus parking. The promotion of geolocations is visible on the official website of the Rožaje Tourist Organisation for the geolocations Cirque Grope on Hajla Mountain, Ibar Spring and Rujište Marshes, while the other seven geolocations are not on the website of the Rožaje Tourist Organisation, although the importance of media promotion of geolocations through electronic media for the development and promotion of the tourist offer in the Municipality of Rožaje should not be neglected.

After the evaluation according to the GAM model of main and additional values, the results are presented in the GAM matrix with their values. In field Z32, there is only one geolocation - meanders with loop bends in the Ibar River canyon (GS4), which indicates that this geolocation stands out from the other geolocations assessed as the geolocation with the greatest potential for the future development of geotourism. In field Z22, there are 50% of the assessed geolocations (GS5, GS6, GS8, GS9, GS10) with high ratings of the main and additional values, which characterises these geolocations as having great tourist potential for the future development of geotourism in the municipality of Rožaje. These geolocations were rated with high scores for the main values, especially for the landscape and aesthetics, which is a very important motive for tourists to visit. Therefore, it can be said that it is very important to invest in the tourist values of these geolocations in order to attract as many tourists and visitors as possible to these geolocations in the coming period.

Conclusion

The main objective of this work was the inventory of geoheritage objects and their valorisation and geoconservation for the development of geotourism in the area of the Municipality of Rožaje using the GAM model (Geosite Assessment Model), in which the assessment of ten geosites determines the degree of potential for the development of geotourism in the future. All ten geolocations assessed have significant tourism potential based on natural resources, especially considering the scenic and aesthetic values that are the most valuable features of this area.

The results of the study show that no place has tourist facilities for a more significant development of tourism in the form of promotion and organised visits, with poor tourist infrastructure in all geographical locations. A major problem is the lack of tourist guides in these places. Regarding the level of protection of these geolocations, the results obtained show that the values are very low, as the geolocations are currently not protected and the objects will be highly endangered in the future. On the positive side, the geolocations are currently undamaged. It is worth noting that additional efforts should be made to place these sites under local or national protection in the coming period.

For the future development of geotourism in the municipality of Rožaje, additional infrastructure is needed in the form of interactive panels, modern maps and brochures with mapped geolocations, possibly with the construction of a visitor centre that would provide the necessary information about the geolocations, as well as interpretation that could be presented to tourists in the form of knowledge transfer by professional staff. Currently, little is known about these geolocations. Geological and geomorphological knowledge is at a low level. Unfortunately, it can be said that the level of interpretation of the analysed geolocations is poor.

The development of geotourism in the municipality of Rožaje would enrich the tourist offer of this town. This area should focus its future development on tourism, as it has great tourist potential. The Municipality of Rožaje and the local tourism organisations of Rožaje should recognise its geotourism potential as a future form of tourism for the development of the municipality in the future. Geotourism in the municipality of Rožaje would enrich the tourist offer in the town and provide additional economic income. In the future, the exploration of the geolocality of this area should be continued, as there is a high concentration of geodiversity in this area, which offers great opportunities for the future development of geotourism.

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