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PRELIMINARY GEOSITE ASSESSMENT MODEL (GAM) AND ITS APPLICATION ON FRUŠKA GORA MOUNTAIN, POTENTIAL GEOTOURISM DESTINATION OF SERBIA

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Loess profile »Surduk« in the gully between Novi Slankamen and Stari Slankamen villages – currently the only law protected loess exposure in Serbia with fossil palaeosols

Preliminary geosite assessment model (gam) and its application on Fruška gora mountain, potential geotourism destination of Serbia

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ABSTRACT: This paper presents a preliminary geosite physical assessment model which has the potential to assist in the sustainable planning and management of natural heritage locations and their transformation into tourism destination. The methodology is based on several existing models and presented through two groups of values – main and additional, which are further divided into indicators and subindicators respectively. The resultant model is a graph that consists of nine fields, into which geosites can be classified as fitting into nine general areas of suitability for tourism in terms of their main (scientific/educational, aesthetic/scenic and protection as market appeal and conservation) and additional values (functional and tourism use as current stage of development). This could prove to be of great help to natural heritage protection and tourism managers, as they could assess the current state of a geosite and thence propose a future path for it.

KEY WORDS: geosites, assessment, geotourism, Fruška gora, Serbia

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1 Introduction

As tourists' expectations of quality experiences from the late twentieth century became more demanding, they were reflected in the expansion of their interest in and motivation to adopt new emerging forms of tourism such as special interest (Weiler and Hall 1992) and niche (Novelli 2005) tourism. Furthermore, the slightly earlier and concomitant rapid urbanization and other human-made activities that increasingly degraded the environment (see Fairbrother 1970 for discussion) influenced modern tourists to convert to sustainable and nature-friendly tourism activities commonly in aesthetic landscape settings, commonly identified as sustainable tourism (Page and Connell 2007) and ecotourism (Boo 1990). This indicates that the promotion of natural resources raises tourists' consciousness, not only about their importance and attractiveness, but also their vulnerability and thus conservation necessity. This conservation rationale underpins the geotourism concept as developed in Europe (Hose 1995) that also promotes tourism for both urban and, especially relevant to the model herein presented, rural destinations whilst promoting geoconservation (Hose 2007).

Besides living nature, flora and fauna, recent European leisure trends have shown heightened appreciation of non-living natural resources – geodiversity. This variety of abiotic natural resources is defined by Gray (2004) as »the range of soil, geomorphological and geological features«. The components of geodiversity that have scientific, educational, aesthetical and inspirational significance are considered to be determined as geoheritage (Dixon 1996; Erhartič 2010) and they are identified as having conservation significance (Gray 2004, Erikstad 2008). Conservation of the geoheritage (geoconservation) is a dynamic approach to the preservation and maintenance of geosites (Hose 2003) whose main purpose is to address concerns over their damage or destruction, whilst at the same time recognising the need to ensure through promotion and interpretation their availability and access (Hose 2005a) to a wider audience of casual as well as dedicated geotourists (Hose 2005b). This form of activity is underpinned by what has been defined from the 1990s as 'geotourism' which is focused on »the promotion of geologic and geomorphic sites for their scientific and societal value to ensure their conservation for future use by academics, tourists and casual recreationalists« (Hose 2000, 2008). A recent geotourism model indicates the necessity to select and inventory geosites identified initially through geological and geomorphological research and evaluated against tourism infrastructure, to underpin its development.

In this context, as for every destination and its special places, before any planning at potential geotourism destinations, there should be a thorough assessment made to determine the condition and values of all the geosites of a destination. This assessment should give the clear picture of future activities regarding further development and management of geotourism at these sites. Thus, assessment should not only involve classification of sites, but offer suggestions for their protection, promotion and monitoring (Pereira et al. 2007). The aim of this paper is to propose a new geosite assessment model (in further reading GAM), created by looking on the existing ones (Pralong 2005, Reynard et al. 2008, Pereira et al. 2007, Zouros 2007) which are here integrated into one manifold and for the purpose of this study applied on geosites of the Fruška Gora mountain in the Vojvodina region, north Serbia.

2 Regional settings and geosites inventory

Fruška Gora Mountain is situated at the confluence of the Danube and Sava Rivers, in Autonomous Province of Vojvodina, northern Serbia, between 45° 00' and 45° 15' north latitude and 16° 37' and 18° 01' north longitude (Figure 1). Although there are only a few peaks higher than 500 meters (highest peak, Crveni Čot at 539 meters), it represents a dominant orographic complex in the mostly plain and monotonous landscape of the Vojvodina region. Besides its geomorphologic significance this mountain represents the largest formation of geological and pedological diversity in the Pannonian area of Serbia. Furthermore, this relatively small region reflects a very complicated geological evolution that formed a unique tectonic, lithological and stratigraphic mosaic (Marković 2007b).

For the purpose of this research the inventory of geosites at Fruška Gora Mountain, determined by Marković et al. (2001), was used. These authors identified 14 geosites in situ according to their scientific, educational and aesthetic value, current condition and accessibility. The complete list of these geosites is presented in Table 1. Ex situ sites were excluded from this paper because their characteristics could not be assessed by the selected indicators and thus could not be evaluated properly by GAM.

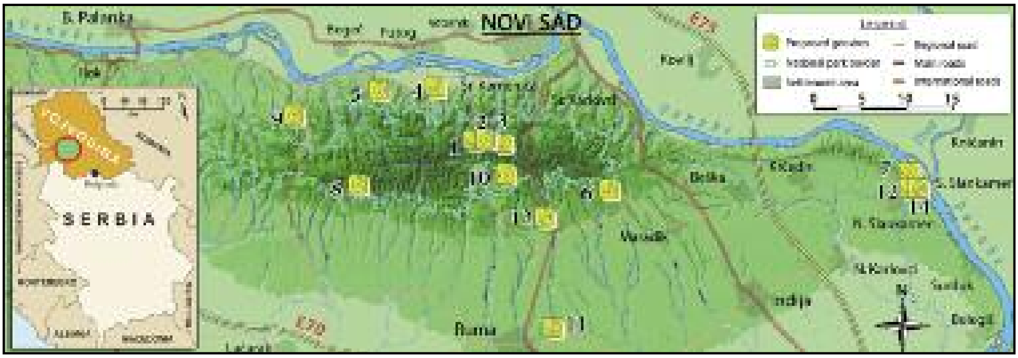

Figure 1: Location of Fruška Gora Mountain with disposition of proposed geosites (Marković, 2007b, modified).

Table 1: Preliminary list of geosites of Fruška Gora Mountain with description (Marković et al., 2001).

No.	Geosite Name and Label	Description
1	The site of volcanic tuff »Galerija« near Rakovac village – GS_1	Tuff horizon (8 m thick) interstratified between Miocene – Tortonian layers. The monument of Nature from 1982 (Knežević, 1998).
2	Trachyte Quarry »Kišnjeva glava« – GS_2	Trachyte dyke injected into Cretaceous formations of sandstone and flysch. The hight of steep slopes up to 80 m (Petković et al., 1976).
3	Trachyte Quarry »Srebro« near Ledinci village – GS_3	Abandoned quarry with lake of exceptional aesthetic values. Steep slopes high up to 110 m. Very good display of geo and biodiversity (Petković et al., 1976).
4	Palaeontological site of Miocene marine fossils- »Filijala« near Beočin village – GS_4	Upper Miocen-Pannonian sediments with rich presence of caspibrackish water fauna. This site is considered as important checkpoint for sediment age determination in the region of ancient Tethys Ocean as a parastratotype (Knežević, 1998).
5	Palaeontological site of Cretaceous marine fossils in Čerević village – GS_5	The most complete succession of the Upper- Cretaceous sediments. Fossil remains of *Orbitoides*, *Loftusias*, corrals, worms, *Brachiopods*, *Gastropods* and *Lamelibranhiats* (Petković et al., 1976).
6	Palaeontological locality of the mio--pliocenic fossils-»Grgeteg« – GS_6	The sediments of Sarmat, Upper Pontian and Pannonian age with rich caspibrachish water mollusk fauna. More than 40 species were extracted and determined from the exposed site (Knežević, 1998; Petković et al., 1976).
7	The structural palaeontological site of Neogene gastropod marine fossils near Stari Slankamen village – GS_7	Pannonian age sediments in discordant and transgressive position overlaying Badenian age limestones with numerous fossil marine gastropods (Knežević, 1998).
8	»Grgurevačka« cave – GS_8	A unique karst underground geomorphological object in Vojvodina, northern Serbia (Petrović, 1966)
9	A gorge-like part of Almaš brook valley – GS_9	Composite valley in the lower course of brook (of around 100 m) sediments with small waterfalls formed in loess sediments (Miljković et al., 1998)
10	Vrdnik mine – GS_{10}	Abandoned coal mine with rich geological depository revealed in 26 underground mine shafts up to 280 m of depth (Vasiljević and Marković, 1999).
11	Loess section (»Ruma« brickyard) – GS_{11}	Detailed evidence of paleogeographic events during the last 450 000 years. Fossil remains of the large Pleistocene mammals: *Mamuthus primigenius* and *Ursus deningeri* (Marković et al., 2004; 2006).
12	Loess profile »Surduk« in the gully between Novi and Stari Slankamen villages – GS_{12}	Currently the only law protected loess exposure in Serbia with fossil palaeosols (Marković, 2000).
13	Loess section in »Irig« – GS_{13}	The most northern profile with temperate and arid like terrestrial fossil malacofauna which indicates the existence of dry and warm glacial palaeoclimate (Marković, 2007c).
14	Loess profile »Čot« in Stari Slankamen village – GS_{14}	40 m tick section with 10 palaeosols (contains valuable paleoclimatic and paleoenvironmental records of the Middle and Late Pleistocene) (Marković, submitted).

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Figure 2: Grgurevac cave – unique karst underground geomorphological object in Vojvodina, northern Serbia.

Fruška Gora was proclaimed a National Park in 1960 with 25,525 ha of protected area due to its rich, rare and endangered biodiversity. Flora is presented by 1,454 species (Butorac 2007), while fauna refers primarily to ornithofauna with more than 200 species (Habijan-Mikeš 2007). Additionally, within the Park and wider area of Fruška Gora Mountain, there are numerous historical and cultural monuments with almost 20 orthodox monasteries hidden in the woods which earned this destination the epithet 'the Holy Mountain' apropos Serbian Atos (Davidov 2007).

Although some of the proposed geosites are within the National Park and thus officially under national concern, these sites do not have an adequate level of protection. Even worse, several sites (e.g. loess sections in Ruma and Irig, palaeontological site »Filijala«) are in the possession of commercial companies and exploited as construction resources (Vasiljević et al. in press). On the other hand, some features are less well known to the public, in remote or inaccessible areas, or perfectly hidden by nature and therefore still intact and preserved.

3 Methodology

The evaluation of geosites has been developing since the 1990s in terms of their interpretative potential and provision (Hose 1997, 2000). Three main physical domains (Reynard 2008) have also been recognised from the 1990s onwards: within the context of Environmental Impact Assessment (EIA) procedures (Rivas et al. 1997, Cendrero and Panizza 1999); for the elaboration of geographic knowledge on the geomorphological heritage in the context of land planning (Stürm 1994, Grandgirard 1999); and finally, and more recently, in the context of the promotion of the geomorphological heritage (geotourism, cultural heritage in a broad sense; see Panizza and Piacente 2003). Very useful comparison of four major assessment models (respectively: Reynard et al. 2007, Pereira et al. 2007, Pralong 2005 and Serrano and Gonzales-Trueba 2005) was given by Erhartič 2010 who also claims that contemporary models should reduce the subjective factor with the assistance of numerical evaluation which could raise the level objectiveness and provide more effective geosite comparison in general.

In order to create GAM, various relevant publications on these issues were consulted. For over a decade numerous papers were written concerning the evaluation of scientific, aesthetic and other values of geosites (e.g. Hose 1997, Pralong 2005, Reynard et al. 2008, Pereira et al. 2007, Zouros 2007, etc). According to Reynard et al. (2007) most of them could be divided in several groups, due to their scopes and aims. Consequently, one group regards preferentially environmental impact assessment (EIA) and land-use inventories evaluating only scientific values (e.g. Grandgirard 1999, Rivas et al. 1997, Bonachea et al. 2005, Coratza and Giusti 2005), while other evaluates not only the scientific quality of the sites, but also their additional values, such as ecological, aesthetic, cultural and economic (Reynard et al. 2007). Methods of the most recent group of research (e.g., Bruschi and Cendrero 2005, Serrano and Gonzales-Trueba 2005, Pralong 2005, Pereira et al. 2007), besides the quality of the sites, also evaluate their use or potential for use, as they take into consideration accessibility, visibility, present use of the geomorphological interest, present use of other natural and cultural interests, legal protection and equipment and support services, which are very important for tourism development. Pralong (2005) has developed a specific method for the assessment of the tourist quality of geomorphosites and their use by the tourism sector as he evaluates cultural and economic potentials of geosites.

The Geosite Assessment Model (GAM) was created according to several existing evaluation methods and most of the criteria proposed for the numerical assessment were taken from extant literature on the field. The complete structure of GAM is presented in Table 2. With the slight modification of existing models (e.g. Reynard et al. 2007, Pereira et al. 2007) that specify two groups of indicators – scientific and additional, GAM proposes main and additional values.

The first group, main values, comprises three indicators: scientific/educational, scenic/aesthetical and protection values. The first indicator in main values group is scientific and educational value (VSE) as suggested by Zouros (2007) with subindicators also proposed by Reynard et al. (2007), Pereira et al. (2007) and Pralong (2005), but with additional component »level of interpretation« as key element for understanding and explanation to wider audience and non-specialists. In contrast to before mentioned references, scenic and aesthetic values (VSA) are by GAM identified as main values, as they are relatively constant in time and not significantly human-influenced in general. This indicator was mostly created after Pralong (2005) with addition of »environmental fitting of site«, e.g. does certain manmade outcrop fit to its natural surroundings. Opposite to some previous models (e.g. Legal protection and use limitations, Pereira et al. 2007; Threats/Endangerment level, Reynard 2007; Potential threats & protection needs, legal protection and vulnerability, Zouros 2007), protection (VPr) is here presented as indicator of main values, it should be essential activity before any promotional or tourism development in general.

The second indicator group of the geosite assessment model, additional values, is further divided in to two indicators, functional and touristic values, as presented in Table 2. Some authors previously proposed some functional elements such as (e.g. Accessibility, Pralong 2005, Pereira et al. 2007 Zouros 2007), but for the purpose of this paper and model Functional value (VFn), was further developed and it consists of six elements. New elements that were added are additional natural values, additional anthropogenic values, vicinity of emissive centers, vicinity of important road network and additional functional values. Purpose of these elements is not tourism development and they do not directly contribute to tourism, but are essential.

The third and last indicator, Tourism values (VTr), evaluates the current state of (geo) tourism services and facilities. Several authors proposed some elements of the tourism values – e.g. Equipment and support services as a part of Use value (Pereira et al. 2007), management measures (Reynard 2007), economic potential as a potential for use indicator (Zouros 2007), annual number of visitors and attraction as part of economic values (Pralong 2005). In contrast to the previous models, GAM offers tourism values as independent indicator with nine subindicators (see Table 2).

In total sum, there are 12 subindicators of Main Values, and 15 subindicators of Additional Values which are graded from 0 to 1 (see Table 2) that define GAM as a simple equation:

- GAM = Main Values (VSE + VSA + VPr) + Additional Values (VFn + VTr)

Table 2: The structure of geosite assessment model (GAM).

Indicators/Subindicators	Description
Scientific/Educational value (VSE)	
Rarity	Number of closest identical sites
Representativeness	Didactic and exemplary characteristics of the site due to its own quality and generalconfiguration (Perreira, 2007)
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 colors, 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.
Functional (VFn)	
Accessibility	Possibilities of approaching to the site
Additional natural values	Number of additional natural values in the in radius of 5 km (geosites also included).
Additional anthropogenic values	Number of additional anthropogenic values in the in radius of 5 km.
Vicinity of emissive centers	Closeness of emissive centers.
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 center	Closeness of visitor center 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, wellsprings 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 (0–1)				
0	0.25	0.5	0.75	1
Common	Regional	National	International	The only occurrence
None	Low	Moderate	High	Utmost
None	Local publications	Regional publications	National publications	International publications
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
None	1	2 to 3	4 to 6	More than 6
Small	–	Medium	–	Large
–	Low	Medium	High	Utmost
Unfitting	–	Neutral	–	Fitting
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
None	Local	Regional	National	International
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
0	0 to 10	10 to 20	20 to 50	More than 50
Inaccessible	Low (on foot with special equipment and expert guide tours)	Medium (by bicycle and other means of man-powered transport)	High (by car)	Utmost (by bus)
None	1	2 to 3	4 to 6	More than 6
None	1	2 to 3	4 to 6	More than 6
More than 100 km	100 to 50 km	50 to 25 km	25 to 5 km	Less than 5 km
None	Local	Regional	National	International
None	Low	Medium	High	Utmost
None	Local	Regional	National	International
None	Less than 12 per year	12 to 24 per year	24 to 48 per year	More than 48 per year
More than 50 km	50 to 20 km	20 to 5 km	5 to 1 km	Less than 1 km
None	Low quality	Medium quality	High quality	Utmost quality
None	Low (less than 5000)	Medium (5001 to 10.000)	High (10.001 to 100.000)	Utmost (more than 100.000)
None	Low	Medium	High	Utmost
None	Low	Medium	High	Utmost
More than 50 km	25–50 km	10–25 km	5–10 km	Less than 5km
More than 25 km	10–25 km	10–5 km	1–5 km	Less than 1 km

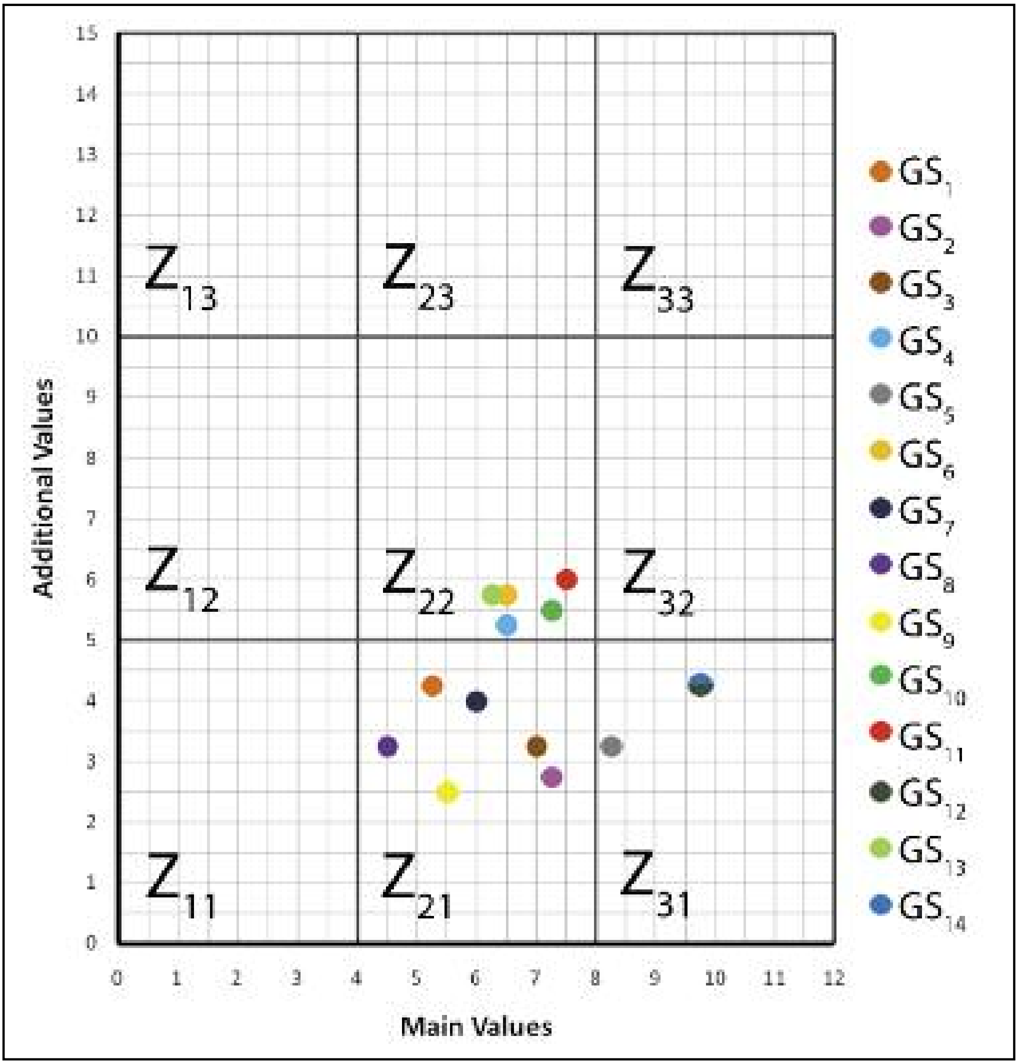

Figure 3: Disposition of geosites to certain fields according to GAM.

Based on the results of the assessment, a matrix of main and additional values could be created (Figure 3), where these values are presented via X and Y axes respectively. The matrix is divided into nine fields (zones) that are indicated by Z(i,j) (i,j=1,2,3) based on the grade they received in the previous evaluation process. Major gridlines that create fields, for X axe have value of 4 and for Y axe of 5 units. This means that, for example, if sum of Main Values is 7 and of additional values is 4, the geosite would be in the field Z21 which indicates moderate level of Main Values and low level of Additional Values.

During the quantification phase, the importance of sites is determined by attribution of values to predetermined criteria. According to certain assessment, each geosite can be plotted in the field of the matrix with regard to its position in relation to each continuum (main and additional values) as indicated in Figure 3.

It then could be linked to an appropriate overall tourism development, market appeal and conservation management policy which could benefit its future. When evaluating a geosite, managers need to asses current condition. As mentioned, there are five subindicators that evaluate the geosite and its main and additional values. After ratings are done, every geosite is put in one field or cell of the matrix. For example, geosites that fit in cell Z31 and Z32 have high scientific, aesthetic and protection values, but low developed tourist and functional sector. So managers have to promote, plan and enhance these assets, while not degrading the first one. On the other side, geosites that fit in Z11 and Z12 cell have low main values and also low additional values. In this case there are two scenarios: the first one is that the geosite has no main values, and because of that additional values are also low; the second scenario is where the geosite is not fully researched and because of that is not protected, which implies that there is no need for additional values. Geosites that fit in Z33 and Z23 have high ratings in main and additional values. On these sites managers should measure the impact of tourism and threats; a solution for this problem is the constant monitoring of proposed subindicators.

4 Application of GAM to Stari Slankamen loess geosite

In order to thoroughly elucidate utilization of GAM, the proposed method will be applied to loess profile Čot near Stari Slankamen (Table 1 (GS14), Figure 4). Accordingly, the proposed methodology is clarified in some detail.

The first group of main indicators, scientific and educational (VSE) values, shows highest values (Grade 1) of subindicators rarity and representativeness as this site represents one of the most complete palaeoclimatic and palaeoenvironmental archive on European land (Marković et al., 2007a). Also, numerous scientific papers regarding this site, published in acknowledged international journals (e.g. Marković et al. 2007a, 2008, 2009, submitted), also bring the highest grade for knowledge on geoscientific issues. All this resulted in the highest interpretation level as it is concluded that the Stari Slankamen loess profile represents an excellent example of palaeoclimatic and palaeoenvironmental records of the Middle and Late Pleistocene

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Figure 4: Profile Čot near Stari Slankamen village, the most significant loess section in the Vojvodina region.

that could provide simple and interesting stories to common tourists who are non-specialists or casual geotourists (Hose 2005b).

Apart from the above mentioned values, the Stari Slankamen site also possesses notable scenia (VSA) that can be observed from three different viewpoints (0.5). Furthermore, the site is situated and well fitted on the far slopes of Fruška Gora Mountain, with exquisite natural surroundings and a view at confluence of Danube and Tisza rivers, river islands and wetlands on the opposite bank. This earned high grades for surrounding landscape and nature (0.75), its surface (1) in comparison to other sites and environmental fitting of sites (1).

As formerly stated, the last group of main values is based on level of protection (VPr) and human involvement. The Stari Slankamen loess profile, although not officially protected (Grade 0) is only slightly damaged due to the natural processes (0.75). Damage to this site could occur only in a long time due to the natural processes (0.75) and due to its large surface area it can withstand more than 50 visitors at once (1).

Opposite to main, subindicators of additional values have mostly medium or low values. Functional indicators (VFn), such as accessibility, vicinity of important road network or additional functional values have average grade (0.5) as the site is accessible only on foot and bicycle, the regional road is in its vicinity and the mediocre level of additional functional values – no proper parking lot, but it has all the other needed functional commodities. Additional natural values and anthropogenic values also earned medium grade for the Danube and Tisza rivers vicinity, loess profile »Surduk« in the gully between Novi and Stari Slankamen villages, mineral spring »Slanka«, remains of Roman fortification Acuminicum, Stari Slankamen spa, oldest one in the Vojvodina region and Ottoman bath house, etc. As the closest greater emissive (Novi Sad and Belgrade) are more than 50 km from the site, this subindicator is graded by 0.25.

As geotourism is a still only theoretical phenomenon in Serbia, (geo) touristic (VTr) characteristics have the lowest values of all indicators as there are no organized visits and visitors at all, nor tour guide service (grade 0), with low level of interpretative panel, tourism infrastructure, hostelry and restaurant service (grade 0.25).

Based on the sum of grades the Stari Slankamen loess profile has high level of main values (9.5 of 12) and low level of additional (4.25 of 15). The overall grade puts the Stari Slankamen loess profile in the Z31 cell which is shown in Figure 3. This indicates that further attention towards creating tourism attractive geosite should be directed to tourism infrastructure and services. Although in good condition, the protection status of this site should never be neglected.

5 Results and discussion

By following the evaluation methodology of the Stari Slankamen site, all fourteen proposed geosites at Fruška Gora Mountain have been assessed (see Table 3). A more visual approach to the evaluation results can be presented as a matrix (see Figure 3) in which every site is presented by dots with their pertinence to the relevant field.

The matrix evidently indicates that six sites fit in the Z21 field, five of them in Z22 field and three in Z31 field. These results show that the sites are graded with high (21%) and medium (79%) levels of the main values, with no single site in the low level, which leads to the conclusion that Fruška Gora Mountain has adequate levels of natural resources for geotourism development. However, the analysis also shows that nine geosites (64%) have low additional values, with none belonging to the high level of this group. This implies that there is an urgent need for the more rapid, though sustainable, development of tourism infrastructure and services. The presence of the National Park should hasten this process as certain facilities already exist and could regain their functionality with slight modifications. With the development of additional values, the main values would also advance through public awareness and appreciation of the geosites. This would lead to a much thorough investigations of this destination and, with new discoveries, the protection and thus promotion of these locations would bring more consideration to the additional values. As is perhaps obvious, the development of both main and additional values is a closed circle where affecting one influences the other.

The proposed geosite assessment model is only a preliminary one, and the next step should be the evaluation of weighting criteria. Tourists, conservation managers and tourism managers should be inter-

Table 3: Overall ranking of Fruška gora mountain geosites using GAM.

Geosite Label	Values			
	Main VSE+VSA+VPr	Additional VFn+VTr	Overall	Field
GS_1	2+1.25+2	2.75+1.5	9.5	Z_{21}
GS_2	2.25+2.5+2.5	2.25+0.5	10	Z_{21}
GS_3	1.75+3.5+1.75	3+0.25	10.25	Z_{21}
GS_4	2.5+2.25+1.75	3.25+2	11.75	Z_{22}
GS_5	2.25+2.75+3.25	2.25+1	11.5	Z_{31}
GS_6	2.5+1.75+2.25	3.75+2	12.25	Z_{22}
GS_7	2.25+1.75+2	3+1	10	Z_{21}
GS_8	1+1.5+2	1.75+1.5	7.75	Z_{21}
GS_9	1.75+2.25+1.5	1.75+0.75	8	Z_{21}
GS_{10}	2.25+3+2	4+1.5	12.75	Z_{22}
GS_{11}	3.25+2.75+1.5	4+2	13.5	Z_{22}
GS_{12}	3.25+3.25+3.25	2.75+1.5	14	Z_{31}
GS_{13}	3.5+2.25+1.5	4+1.75	12	Z_{22}
GS_{14}	4+3.25+2.5	2.75+1.5	14	Z_{31}

viewed in order to assess the value of each indicator's elements, as the elements are of unequal importance with regard to tourism planning and management. For example, within the main values, interpretation level and rareness or representativeness of site, which are relatively constant in time (except if major discoveries occur), should be considered as more valuable than its surface or environmental fitting. Evidently, for the purpose of geotourism development, it is more important to form or improve guide services or interpretive panels (Figure 5) than to have the road network or some additional functional values developed. Consequently, this is why scientific/educational and protection values should be evaluated by experts

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Figure 5: Geosite Grgeteg – palaeontological locality of the mio-pliocenic fossils, interpreted by T. Lukić during the Geotrends 2010 conference fieldtrip.

and conservation managers, while aesthetic/scenic, functional and tourist values should be evaluated by visitors and their experiences. Based on the newly developed grading criteria of evaluated indicators, this model could then give clearer guidelines for recognising important geotourism destinations.

6 Conclusion

Nowadays, geosites have the potential to be acknowledged as both natural heritage and tourist resources with potential economic benefits (Hose 2005b), especially if located in protected areas, and when made readily physically and intellectually accessible to tourists (Hose 1996, 2000). The results of the assessment indicate that the Fruška gora Mountain geosites have significant main values, but low additional values so they could be considered only as potential tourist attractions in terms of their scientific/educational values and aesthetic/scenic appeal, the latter has yet to be discovered and will require suitable tourism promotion. Further steps should involve improving and supplementing the essential geotouristic infrastructure (such as interpretive panels, marked paths, signs, etc.) and the promotion within the National Park itself and more globally (brochures, web promotion, fairs, seminars, etc.) its geosites. Also, there is an active initiative for proclaiming Fruška Gora a GEOpark, as it fulfils most of criteria (geodiversity, surface, etc.), but designation awaits the resolution of detailed political, managerial and planning issues. However, it is apparent that, in addition to all the other complementary natural and cultural values of this area, Fruška Gora Mountain provides a timely perspective on a potential sustainable (geo) touristic destination.

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