Glacial and periglacial geo-morphosites in the upper basin of Ialomiţa river (Bucegi Massif, Romania)

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ABSTRACT: The analysis of geo-morphosites as a method used to appreciate the value of geomorphological sites is one of the most accurate methods one can use, as it relies on their comparison and on their integration into a series of patterns that largely eliminate subjectivism and errors. There are several approaches in the evaluation of geo-morphosites, known by the name of those who initiated them (E. Reynard, J. P. Pralong etc.) and they can be applied as such or can be adapted according to the specific features of the region that the geo-morphosites belong to, as well as according to the purpose of their analysis (scientific, touristic, economic etc.). In the present study, we have tried to identify the sites with a glacial and periglacial genesis of a scientific, economic and tourist interest from the upper basin of Ialomiţa River, using the Pralong method. The application of the evaluation criteria (scenic, scientific, cultural and economic) have allowed us to obtain global values for the geo-morphosites in the area under analysis, which later on could be used in the framework of the Bucegi Massif and then could be compared to others from the Romanian Carpathians (Ciucaş, Ceahlău etc.).

KEY WORDS: geo-morphosites, glacial, periglacial, Ialomiţa, identification assessment, potential

1. Introduction

Geo-morphosites represent forms of relief or geomorphological processes that have acquired an esthetic, scientific, cultural, historical or economic value in time, due to human perception (Panizza, 2001, Piacente, 1993, as quoted by Pralong, 2005). Forming the actual geomorphologic patrimony, "geo-morphosites are relevant to the study of Earth's history, the climate's evolution, the evolution of life on the planet, as well as also being important from an ecological, economic and cultural perspective". (Grandgirard, 1997, quoted by Reynard et al., 2007).

In specialized literature, a series of terms have been so far used to designate the components of the geomorphological patrimony (Reynard, 2007): geomorphological values (Panizza, Piacente, 1993); geomorphological estate (Carton et al., 1994); geomorphological sites (Hooke, 1994);

geomorphological geotops (Grandgirard, 1997, 1999); sites of geomorphological interest (Rivas et al., 1997); geo-morphosites (Panizza, 2001).

In Romania, so far, the issue of geo-morphosites has been rarely tackled. A representative approach of the geomorphological patrimony in Romania was realized by A. Szepesi (2007) for the geomorphological geotops of the Iezer Mountains, which he also calls "obiective geomorfologice" ("geomorphological sites"). Their evaluation was carried out relying on two types of criteria: factors (integrity, specificity, exemplarity – representativeness, rarity, paleo-geographic value, sites of special interest) and indicators (dimension, geometric configuration of the forms of relief, constitution, age, geo-diversity, number of forms, their associations, their distribution, context, environment, morphogenetic activity, their function etc.).

Since 2000. important contributions to the study and knowledge of the geo-morphosites have also come from N. Josan, Dorina Camelia Ilieş (2009), Laura Comănescu, A. Nedelea and R. Dobre (2009), the latter with reference to the geomorphosites from the Bucegi and Ceahlău Mountains.

2. Area under analysis

The upper basin of the Ialomiţa Valley, developed in the Bucegi Natural Park, offers a special general framework whose morphological particularities, by their diversity and harmony, is appealing to tourism. The ordinary lithology is dominated by Jurassic and Cretaceous sedimentary rocks, among which one can note complex conglomerates of Bucegi - wide variety of fascies, from solid layered ones to the type of breccias and conglomerates of Raciu, to the layers of rock specific to Sinaia - predominantly limestone in rhythmic alternations with sandy limestone, sandstone, marl, calcareous sandstones, shale and clays, calcareous sandstones framed canvas Teleajen-type suites with flysch sandstone and sandstone-conglomerates.

The lithology can highlight the possibility of development of multiple geo-morphosites. In this study we approached some of the most representative geo-morphosites of a glacial and periglacial genesis (Omu Peak, Babele, Sfinx, the erratic block of Ialomiţa Valley, the glacial cirque of Ialomiţa, Mecetul Turcesc, Bucura-Dumbravă Peak, Strunga) as components of this landscape. Taking as a basis the classical methodology, the selected geo-morphosites were evaluated in a synergistic relationship with the tourist impact they generate, emphasizing their morphological and scientific attributes.

Highlighting the two attributes was necessary because, for the area under analysis, the geomorphological and scientific value, although well quantified, are often ignored in the perception of tourists, who are predominantly attracted by the aesthetic and cultural component, strongly boosted by tourist and exploitation potential indicators such as infrastructure facilities, the socio-economic conditions of the region, advertising etc.

3. Methods

In the specialized literature, when evaluating geo-morphosites, one can distinguish between two main assessment methods:

A first method is to evaluate the global value of the geo-morphosites (The IGUL method – initiated by the Geographic Institute of the University of Lausanne - Switzerland), which involves

the knowledge and measurement of the scientific value (with the 4 components put forward by Grandgirard: rarity, representativeness, integrity and paleo-geographic value) along with other additional values. This method was used in many studies by E. Reynard and his collaborators, the evaluation being based on an inventory sheet (Reynard, et. al., 2007), with 6 chapters (criteria), each containing a number of subchapters.

The second method meant to evaluate the touristic potential of the geo-morphosites was developed by J.P. Pralong. This method allows one to know the tourist potential and the degree of exploitation of the geo-morphosites through the use of certain values (scenic, scientific, cultural-historical and economic) which are given marks ranging between 0 and 1 (Pralong, 2005).

After establishing the marks for each value in turn, the touristic potential or the global value of the geo-morphosite (its tourist value) is determined by calculating the mean of the values obtained, using the formula:

$$V_{tour} = (V_{sce} + V_{sci} + V_{cult} + V_{eco})/4$$

where:
V_{tour} = tourist value
V_{sce} = scenic value
V_{sci} = scientific value
V_{cult} = cultural value
V_{eco} = ecological value.

For each of these values, separate evaluation tables are drawn, in which every criterion has a predetermined score (table 1).

Table 1. The scenic criterion according to the Pralong observation sheet

Criterion / score	**0**	**0.25**	**0.5**	**0.75**	**1**
Sce. 1 Number of observation points	-	Only one	2 or 3	4,5 or 6	> 6
This criterion refers to the number of observation points accessible for pedestrians. Each needs to present a specific observation angle and has to be situated at less than 1 km away from the site					
Sce 2 Average distance to the observation points (m)	-	under 50	50-200	200-500	>500
This criterion has in view the sum of the shortest distances between each observation point and the site, separately for the different observation points					
Sce 3 Area	-	small	average	large	very large
Here, the whole area of the site is taken into account. For each type of site (glacier, cave, etc.) there is a quantitative scale of the area (ha) in harmony to the other identical sites from the area under analysis					
Sce 4 Height	zero	low	average	high	very high
This criterion has in view the whole height of the site. For each type of site (glacier, cave, etc.) there is a quantitative scale of the area (m) in harmony to the other identical sites from the area under analysis					
Sce 5 Chromatic contrast with the surroundings	identical colors	-	different colors	-	opposite colors
This scenic criterion refers to the coloristic contrast between the site and its surroundings.					

Table 2. Glacial and periglacial geo-morphosites from the upper basin of Ialomiţa

No.	Name	Code	type
1	Vf. Omu	BUCstr001	PCT
2	Babele	BUCed002	PCT
3	Sfinxul	BUCed003	PCT
4	The so-called erratic block from Ialomiţa Valley	BUCgla004	PCT
5	The glacial circle of Ialomiţa	BUCgla005	ARE
6	Mecetul Turcesc	BUCkar006	PCT
7	Bucura-Dumbravă Peak	BUCstr007	PCT
8	Şaua Strunga	BUCstr008	PCT

For the analysis of the geo-morphosites in the upper basin of the Ialomiţa Valley, we have used the assessment method proposed by J.P. Pralong, considering that – although it has no consistent geographic component and is rather an economic evaluation, it can be regarded as much more accurate and the results obtained can be compared to those from similar alpine massifs.

The glacial and periglacial geo-morphosites under analysis are: Vârful Omu, Babele, Sfinxul, The so-called erratic block from Ialomiţa Valley, the glacial cirque of Ialomiţa, Mecetul Turcesc, Bucura Dumbravă Peak, Şaua Strunga. (table 2, fig. 1, photos 1-4).

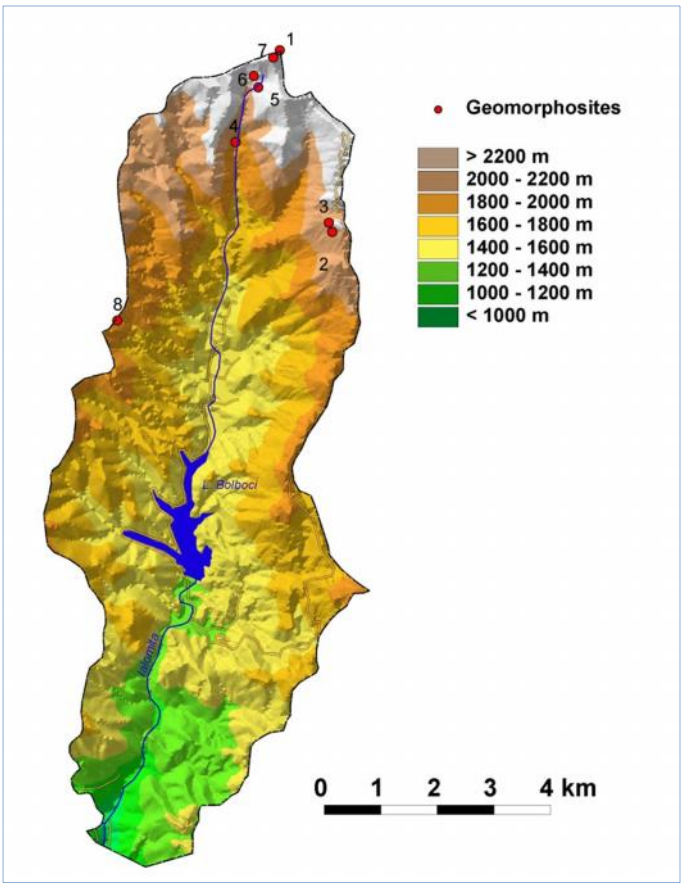

Figure 1. The glacial and periglacial geomorphosites from the upper basin of Ialomiţa river. This figure is available in colour online at www.georeview.ro.

4. Results

After using the Pralong assessment methodology for geo-morphosites, we went on to analyze the sites from the upper valley of Ialomiţa, from the viewpoint of their scenic, scientific, cultural and economic value (table 3, fig. 3, fig. 4).

The scenic value refers to: number of observation points (Sc 1), average distance to the observation points (Sc 2), area (Sc 3), height (Sc 4) and chromatic contrast (Sc 5). The maximum score (table 3) was obtained with an equal number of points by two sites: the glacial cirque of Ialomiţa and Mecetul Turcesc (0.75), while the minimum score was granted to Şaua Strunga and the so-called erratic block from Ialomiţa Valley (0.50).

Figure 2. Geo-morphosites from the study area: **2a.** The so-called erratic block from Ialomiţa Valley; **2b.** Mecetul Turcesc; **2c.** The Bucura-Dumbravă Peak; **2d.** Strunga Saddle. This figure is available in colour online at www.georeview.ro.

The scientific criterion relies on the evaluation of the interest from a paleo-geographic perspective (St 1), representativeness (St 2), area (St 3), rarity (St 4), integrity (St 5) and ecological importance (St 6). The maximum score was obtained by the glacial cirque of Ialomiţa (1.0), and the lowest value was allotted to Babele, the so called erratic block from Ialomiţa Valley Mecetul Turcesc and Bucura-Dumbravă Peak (0,50).

Table 3. The values obtained by the geo-morphosites analyzed using the Pralong method

Name	Scenic value	Science value	Cultural value	Economic value	Global value
Vf. Omu	0.65	0.625	0.3	0.45	**0.5062**
Babele	0.55	0.5	0.451	0.5	**0.5002**
Sfinxul	0.55	0.541	0.451	0.5	**0.5105**
The so-called erratic block from Ialomiţa Valley	0.5	0.5	0.1	0.45	**0.3875**
The glacial cirque of Ialomiţa	0.75	1	0.1	0.45	**0.5750**
Mecetul Turcesc	0.75	0.5	0.2	0.45	**0.4750**
Bucura-Dumbravă Peak	0.65	0.5	0.3	0.45	**0.4750**
Şaua Strunga	0.5	0.666	0.2	0.5	**0.4665**

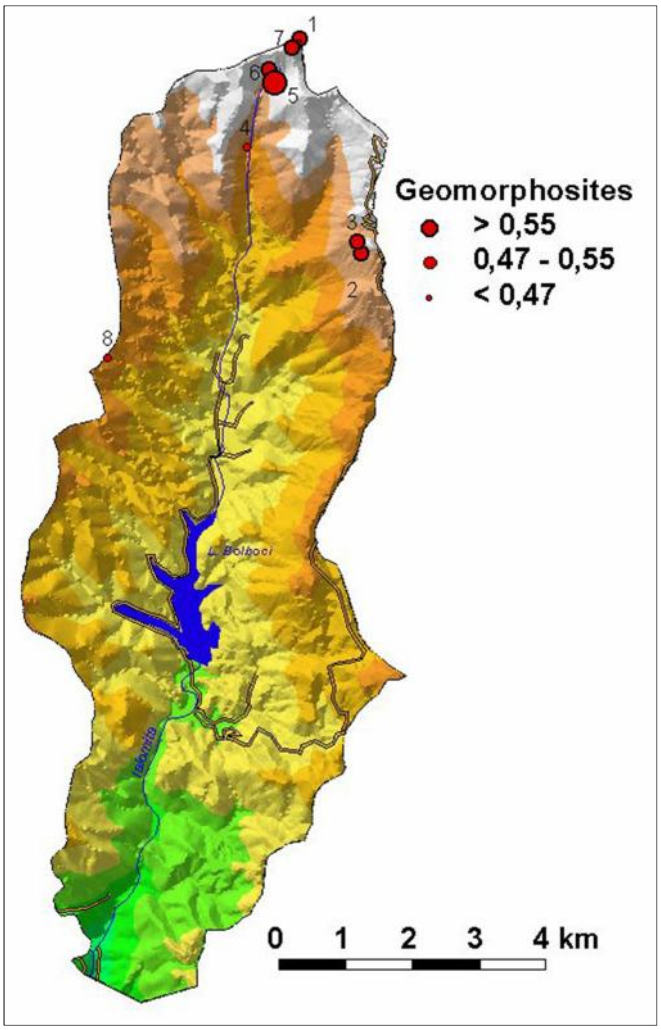

Figure 3. The values obtained by the geo-morphosites analyzed using the Pralong method. This figure is available in colour online at www.georeview.ro.

The cultural criterion provided the lowest values for this area as, being closely related to the connections between man and the respective geo-morphosite in history, we have not been able to identify important aspects related to these connections: cultural and historical traditions (C 1), iconographic representations (C 2), important historical and archeological aspects (C 3), religious and metaphysical importance (C 4), cultural and artistic events (C 5). Vcult= (Cult 1 + 2 x Cult 2 + Cult 3 + Cult 4 + Cult 5) / 6, where *Cult 1*, *Cult 2*, *Cult 3*, *Cult 4* and *Cult 5* correspond to the criteria scores mentioned above. Weighting is introduced because *Cult 2* could also assess the number of literary correlations, which are seen as proportional to any iconographic material (Pralong, 2005). However, the largest score was obtained by Babele and Sfinxul (0.451) and the lowest scores (0.1) went to the so-called erratic block from Ialomiţa Valley, and the glacial cirque.

The economic value is calculated starting with accessibility (E 1), the degree of exposure to natural hazards (E 2), the annual number of visitors from the region in which the site is situated (E 3), the official site protection level (E 4), the level to which it appeals (E 5). The maximum score (0.50) was obtained by Babele, Sfinx and Şaua Strunga, the others having the constant value of 0.45.

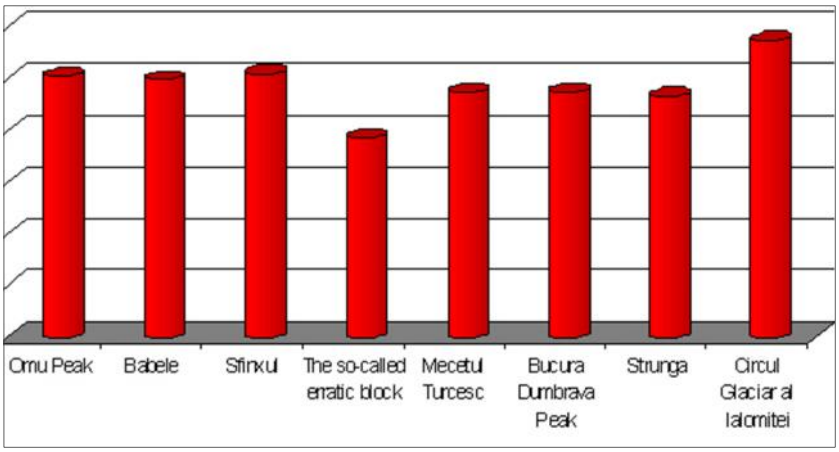

Figure 4. The values obtained by the geomorphosites analyzed using the Pralong method

The global value represents the arithmetic average of the scenic, scientific, cultural and economic value. The highest value is recorded by the glacial cirque of Ialomiţa (0.575), first of all because of the fact that the most important access paths to Vârful Omu and to the important touristic sites from Bucegi Mountains pass through it, and also because of the large area it covers. Last in line comes Şaua Strunga (0.4665) and the so-called erratic block from Ialomiţa Valley (0.3875).

5. Conclusions

Following the application of the assessment criteria (scenic, scientific, cultural and economic), we obtained global values for the glacial and periglacial geo-morphosites from the upper valley of Ialomiţa River ranging from 0.3875 to 0.575.

These values are large enough to allow us to consider that better future advertising would be able to turn the less known touristic sites into important and appealing touristic and scientific spots, while already famous sites such as Babele and Sfinxul no longer need any promotion, being well-known among tourists.

Given their characteristics, geo-morphosites have contributed to the development of the touristic potential of the area under analysis. By evaluating them, we mean to display their degree o complexity, since they are not only forms of relief, but must also be seen as a whole, taking into consideration all their values in order to render highlight their importance. At the same time, they must also be valued with a view to developing geo-tourism.

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