

INVENTORING AND EVALUATION OF GEOMORPHOSITES IN THE BUCEGI MOUNTAINS

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Abstract. Geomorphosites stand for relief forms or geomorphologic processes that in time have gained an aesthetic, scientific, cultural, historical or economic value, as a result of human perception (Panizza, 2001). Taking into consideration the above mentioned definition, the present paper aims at inventorying and evaluating part of the geomorphosites in the Bucegi Mountains. The final purpose is to propose some measures for a better protection and tourist promotion. The presence of numerous geomorphosites in the Bucegi Mountains is the direct result of the presence of limestones and conglomerates, as well as the succession of different modelling systems in time (glacial, periglacial, fluvial). We analysed this area since there are many and varied geomorphosites, and at the same time, it is one of the major tourist destinations (the largest number of tourists and the best tourist infrastructure within the Romanian Carpathian Mountains).

Key words: the Bucegi Mountains, geomorphosite, inventory, evaluation.

Rezumat. Inventarierea și evaluarea geomorfositurilor din Munții Bucegi.

Geomorfositurile sunt forme de relief sau procese geomorfologice care au căpătat în timp valoare estetică, științifică, culturală, istorică sau economică, datorită perceptiei umane (Panizza, 2001). Pornind de la definiția de mai sus, în lucrarea de față ne propunem să inventariem și să evaluăm o parte a geomorfositurilor din masivul Bucegi. Acestea au ca finalitate propunerea unor măsuri privind protecția superioară și apoi promovarea turistică. Prezența a numeroase geomorfosuri în Masivul Bucegi este impusă de existența calcarelor și conglomeratelor, dar și de succesiunea în timp a diferitelor sisteme de modelare (glaciar, periglaciar, fluvial), toate acestea conducând la geomorfosuri specifice. A fost ales spre studiu acest areal datorită prezenței unei game variate de geomorfosuri dar și valorificării turistice foarte intense (cel mai mare număr de turiști și cea mai dezvoltată infrastructură din întreg lanțul carpatic românesc).

Cuvinte cheie: Bucegi, geomorfosit, inventariere, evaluare

1. Introduction

The geomorphosite can be defined as the relief form or geomorphologic process that is important for understanding the evolution of the Earth (Panizza, 2001; Reynard, 2004). The value that is given to the geomorphosites due to the human perception has two main components: the scientific value (reconstruction of some paleo-geographic elements) and additional values (cultural, historical, ecologic, economic and aesthetic value) (Reynard 2005) (Fig. 1).

Other terms have equally been used in the geography literature to designate the geomorphosite; however, they are not perfectly synonymous: geomorphologic values, geomorphologic goods, geomorphologic geotops, sites of geomorphologic interest (Panizza, Reynard, 2005).

This new study direction for geomorphology has only recently emerged (1993), when M.

Panizza gives the first definition of geomorphosites. In 2003, the most important work in the domain was published – *Cultural geomorphology*.

In Romania, this issue is quite vaguely dealt with. The main contributions were made by the professors at the University of Oradea after 2000. Taking into consideration all this, the present paper aims to identify and evaluate the geomorphosites within the Bucegi Mountains, for better knowledge, protection and higher capitalization of the geomorphosites within this massive, having a great touristic potential and well capitalized from the tourist point of view.

Thus, the present paper is an integrating part of the research project PNII/ Ideas (*Inventoring, Evaluation and Mapping of Geomorphosites. Case studies: the Dobrodjea plateau and the Southern Carpathians*) financed by CNCSIS.

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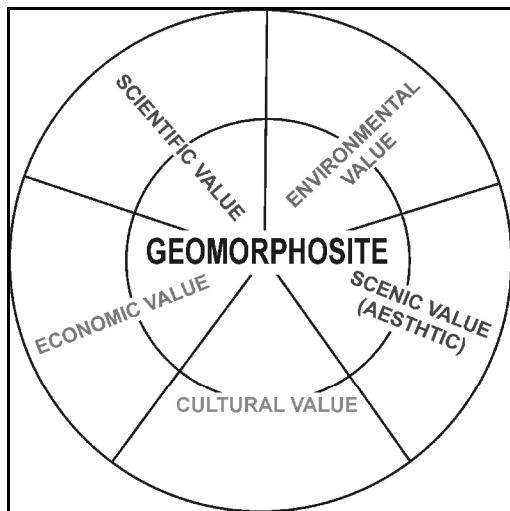
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Table 1

**Terminology used for designating geomorphosites in the geomorphology literature
(according to Panizza, Reynard, 2005, complemented)**

Term	Equivalent / term in foreign literature	Bibliographical references	Values and evaluation criteria
<i>Geomorphologic values/ assets</i>	Geomorphological assets / Biens géomorphologiques	Panizza și Piacente, 1993; Quaranta, 1993	The evaluation may be aesthetic (intuitive) and scientific (quantitative one)
<i>Geomorphologic assets</i>	Geomorphological goods Biens géomorphologiques	Carton și alții, 1994	The geomorphologic goods are evaluated based on various characteristics categories, i.e. scientific, aesthetic and cultural. The scientific value is given by the paleogeomorphologic evolution, the possibility for using them as a teaching tool, the ecologic role and character of geomorphologic rarity.
<i>Geomorphosites</i>	Geomorphological sites Sites géomorphologiques	Hooke, 1994	The geomorphologic sites have three main values: an aesthetic, ecologic and didactic one (the possibility of observing different geomorphologic processes).
<i>Geomorphologic geotops</i>	Geomorphological geotopes Géotopes géomorphologiques	Grandgirard, 1995, 1997, 1999	The geomorphologic geotope is that particular element, the value of which is recognised. The inventory of geomorphologic geotope is important and representative for the diversity of the analysed area.
<i>Sites of geomorphologic interest</i>	Sites of geomorphological interest / Sites d' intérêt géomorphologiques	Rivas și alții, 1997	The sites present great scientific, educational and tourist interest.
<i>Geomorphosites</i>	Geomorphosites Géomorphosites	Panizza, 2001	The geomorphosite is a relief form to which some value may be added.



**Fig.1 The characteristics of geomorphosites
(according to Reynard, 2005, complemented)**

2. Area of study

The Bucegi Mountains include massifs disposed as a horseshoe arch, open southwards and fragmented in the central part by the Ialomita valley, with steep slopes and different looking sectors (gorges and depression-like basins (Ielenicz, Comanescu, 2006).

From the geological point of view, in the Bucegi mountains there are more than 1,00 m thick layers of conglomerates (the Bucegi conglomerates), which caused the formation of numerous geomorphosites due to differentiated erosion. Beside conglomerates, there are also limestones (which also have their own geomorphosites) and a marl-sabulous flysh.

The relief of the Bucegi mountains is diverse and complex due to the morphogenetic conditions and to the external agents, that differ in time and space. Consequently, there emerged different types of geomorphosites, the most famous one being the following (Ielenicz, Comanescu, 2006):

- sectors of structural abrupt (Prahova and Bran) with level difference of more than 1000 m and structural plateaus at more than 1800-2000 m;
- the Ialomita valley with the multitude of depression-like basins and especially gorges (Urșilor, Tătarul Mic, Tătarul Mare, Zănoaga Mică, Zănoaga Mare, Orzei);
- the peaks which offer panoramic views or are a tourist attraction in themselves;
- alpine ridges;

- ruined relief forms, as a result of different erosion, as fangs, towers, the most famous are Babele and the Sfinx;
- the glacial relief with complex developed around Omu Peak (Mălăești, Țigănești, Obârșia, Valea Cerbului);
- karst relief (the most famous being the Ialomita Cave);
- glacial or structural thresholds which generate falls (Urlatoarele).

There were chosen and evaluated geomorphosites from each category following the criteria of importance, complexity, momentousness and degree of tourist exploitation.

3.Method

The inventory and evaluation of geomorphosites is done in several stages:

- reading the existing bibliography and maps (including satellite images);
- trip field to have a complete inventory of geomorphosites;
- making some inventory papers for geomorphosites;

- mapping and evaluation of geomorphosites.

The description ticket for geomorphosites was first conceived by a joint research of the Geography Institute of Lausanne University (E. Reynard and J.P. Pralong), Fribourg University (V. Grandgirard) and Modena and Reggio Emilia University (P. Coratza). The criteria used hint both at the quantitative and qualitative analysis of geomorphosites. If this ticket is applied, there can be done a complete inventory of geomorphosites for different territorial units (region or valley). Here is a model of evaluation paper, a model that was applied for the Bucegi Mountains. Of course, it can be improved.

There are two evaluation methods in the literature for evaluating geomorphosites: *a method for evaluating the global quality of geomorphosites* (IGUL method) which implies an evaluation of scientific value and of additional values; *a method for evaluating the touristic potential* of the sites, which was developed by Jean-Pierre Pralong, a method which led the classification of geomorphologic sites depending on the touristic potential and value.

Table 2

Synthesis table regarding the geomorphosites from the Bucegi Mountains

Nr.	Name	Code	Type
1	Babele	PHed1	punctual
2	Sfinxul	PHed2	punctual
3	Ialomicioara Cave	PHkar3	punctual
4	Omú Peak	PHm4	punctual
5	Urlătoarea Falls	PHstr5	punctual
6	Caraiman Plateau	PHstr6	areal
7	Franz Josef Cliff	PHed7	punctual
8	Tătar Gorges	PHkar8	punctual
9	Circul Gaura	PHgla9	punctual
10	Colții Morarului	PHper10	punctual

Where:

ed-differentiated erosion, *kar*- karst, *m*-morphographic

str-structural, *gla*-glacial, *per*- periglacial, according to the specialised literature

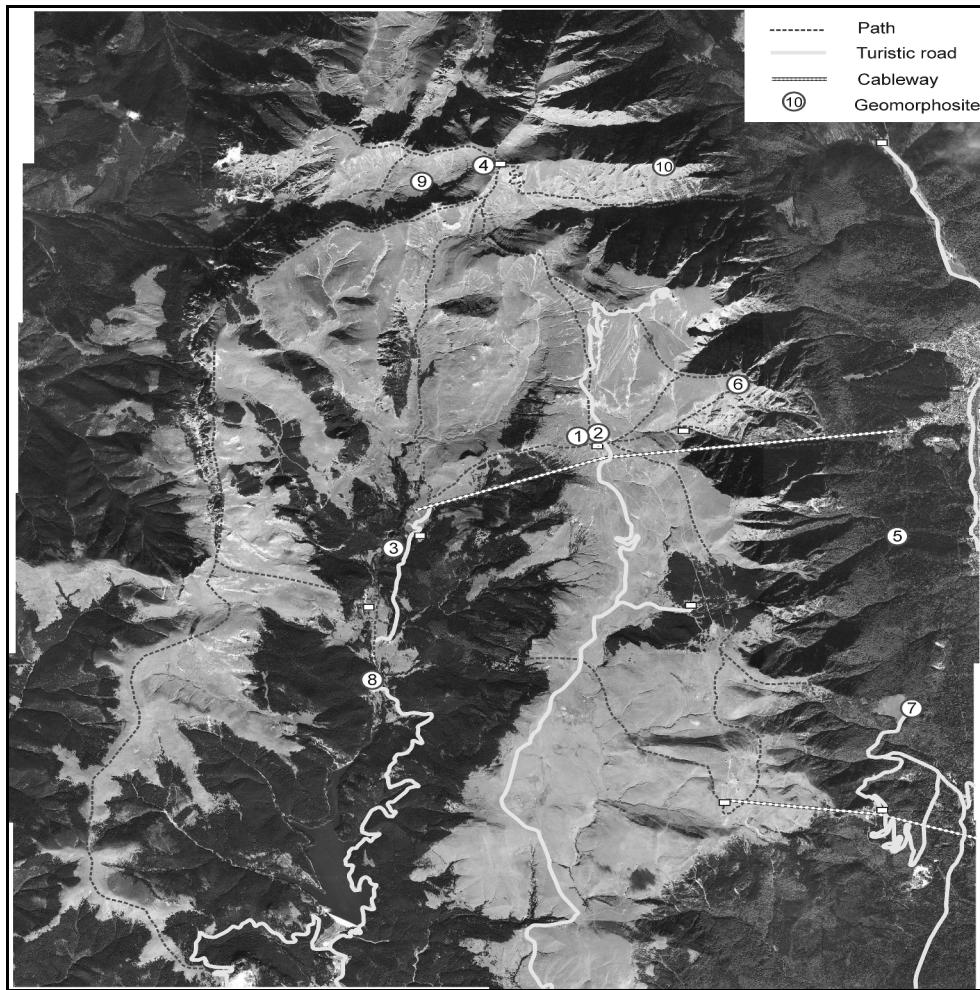


Fig.2. Location of analysed geomorphosites within the Bucegi massive

Results and discussions

The present evaluation was greatly based on the model proposed by Jean Pierre Pralong (2005). The touristic value (table 3) is determined as the average of the four values, according to the formula:

$$V_{tour} = (Vsce + Vsci + Vcult + Veco)/4,$$

where V_{tour} – touristic value, $Vsce$ – aesthetic value, $Vsci$ – scientific value, $Vcult$ – cultural value and $Veco$ – social-economic value.

The average of these values has pointed out to the data that are synthesized in the table below; they

vary between 0.655 (the Caraiman Plateau), 0.625 (Babele and the Sphinx) and 0.387 (Gaura Cirque). These figures are much higher than those from other tourist mountains, also as a result of the high score regarding the economic value, due to the great number of visitors and their accessibility, including cable transport, forest roads and paths. An areal geomorphosite (the Caraiman Plateau) takes the lead since it includes more punctual geomorphosites which gave good scores (Comanescu, Nedelea, 2009).

Table 3

The evaluation of the global value of the geomorphosites within the Bucegi Mountains

No.	Name	Scenic value	Scientific value	Cultural value	Economic value	Global value
1	Babele	0.75	0.65	0.25	0.85	0.625
2	Sphinx	0.75	0.65	0.25	0.85	0.625
3	Ialomicioara Cave	0.5	0.6	0.45	0.6	0.537
4	Omu Peak	0.75	0.45	0.10	0.65	0.487
5	Urlătoarea Falls	0.4	0.45	0.05	0.85	0.437
6	Caraiman Plateau	0.6	0.47	0.6	0.95	0.655
7	Franz Josef Cliff	0.55	0.45	0.3	0.55	0.462
8	Tătarului Gorges	0.65	0.5	0	0.75	0.475
9	Circul Gaura	0.5	0.55	0	0.5	0.387
10	Colții Morarului	0.9	0.6	0.05	0.65	0.55

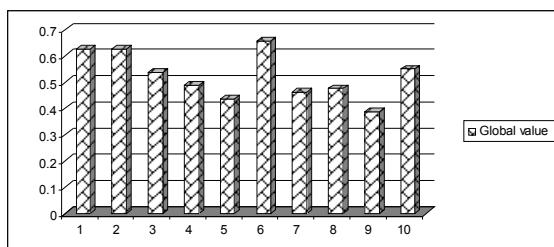


Fig.3. The global value of geomorphosites within the Bucegi massif

In order to determine the scenic value, there were taken into consideration the following elements: the number of visibility points; average distance between the sightseeing points; site area (sqkm) as compared to other sites of the same type within the area; relief intensity; colour contrast. The figures for this value (table 4) vary between 0.9 (Colții Morarului) and 0.4 (Urlătoarea Falls), mainly due to the lack of sightseeing points and the lack of visibility for the latter (Comanescu, Nedea, 2009).

As for the scientific value (Table 5) (which also includes the ecologic value), there were evaluated the paleo-geographical interest, their representativeness, area (per cent), uniqueness, integrity and ecologic interest. It varies between 0.65 (Babele and the Sphinx) and 0.45 (Urlătoarea Falls) (Comanescu, Nedea, 2009).

Table 4
The evaluation of the scenic value of geomorphosites within the Bucegi Mountains

No.	Name	Scenic value					
		Sc1	Sc2	Sc3	Sc4	Sc5	
1	Babele	1	1	0,25	0,5	1	0,75
2	Sphinx	1	1	0,25	0,5	1	0,75
3	Ialomicioara Cave	0	0,25	0,5	0,75	1	0,5
4	Omú Peak	1	1	0,25	1	0,5	0,75
5	Urlătoarea Falls	0,25	0,5	0,5	0,5	0,25	0,4
6	Caraiman Plateau	0,75	0,75	0,5	0,75	0,25	0,6
7	Franz Josef Cliff	0,25	0,5	0,25	0,75	1	0,55
8	Tătarului Gorges	0,5	0,75	0,5	0,5	1	0,65
9	Circul Gaura	0,5	0,5	0,25	0,75	0,5	0,5
10	Colții Morarului	1	1	0,5	1	1	0,9

The cultural value (Table 6) is determined based on the symbolic relevance and the cultural heritage, iconographic representations, historical and archaeological relevance, religious and archaeological relevance, art and culture events. The figures are very low sometimes (0) as a result of the lack of iconographic representations or some history, archaeology or symbolist elements. the Caraiman Plateau has the highest value (0.6), which is present in numerous iconographical representations or different types of geo-tourist products (Comanescu, Nedea, 2009).

The evaluation of the scientific value of the geomorphosites within the Bucegi massif

No.	Name	Scientific value						
		St1	St2	St3	St4	St5	Total	
1	Babele	0,75	1	0,75	0,75	0,75	0	0,65
2	Sphinx	0,75	1	0,75	0,75	0,75	0	0,65
3	Ialomicioara Cave	1	0,5	0,75	0,25	0,75	0,25	0,6
4	Omú Peak	0,5	1	0,5	0,25	1	0,25	0,45
5	Urlătoarea Falls	0,5	0,75	0,75	0,25	0,5	0	0,45
6	Caraiman Plateau	0,25	0,5	0,25	0,5	0,75	0,5	0,47
7	Franz Josef Cliff	0,25	0,25	0,75	0,75	0,75	0,25	0,45
8	Tătarului Gorges	0,25	0,5	0,5	0,5	0,75	0,5	0,5
9	Circul Gaura	0,5	0,5	0,5	0,5	1	0,25	0,55
10	Colții Morarului	0,5	0,75	0,5	0,5	1	0,25	0,6

Table 7 presents the economic value. It is determined as the average of accessibility, natural risks, annual number of visitors, official level of protection, attraction. The values are very high (0.95 for the Caraiman Plateau, due to its accessibility and high tourist flows); Gaura Cirque has only 0.5, because it requires longer routes, which are taken only by the well trained tourists (Comanescu, Nedea, 2009).

5. Conclusions

This method was used only for the mountainous areas from different countries (Italy, Switzerland, Spain, Greece). There is no doubt that there is a need for developing this type of study in Romania as well, taking into consideration the great tourist potential of the Romanian Carpathians in general and the Bucegi Massif in particular, the ultimate aim of our scientific research is to continue the study of geomorphosites and the achievement of some geo-tourist products.

Table 6
The evaluation of the cultural value of the geomorphosites within the Bucegi Massif

No.	Name	Cultural value					
		C1	C2	C3	C4	C5	Total
1	Babele	0,25	1	0	0	0	0,25
2	Sphinx	0,25	1	0	0	0	0,25
3	Ialomicioara Cave	0,5	0,25	0,5	1	0	0,45
4	Omú Peak	0,25	0,25	0	0	0	0,10
5	Urlătoarea Falls	0	0	0	0	0,25	0,05
6	Caraiman Plateau	0,5	1	1	0,5	0	0,6
7	Franz Josef Cliff	0,5	0,25	0,75	0	0	0,3
8	Tătarului Gorges	0	0	0	0	0	0
9	Circul Gaura	0	0	0	0	0	0
10	Colții Morarului	0	0,25	0	0	0	0,05

Table 7
The evaluation of the economic value of the geomorphosites within the Bucegi Mountains

No.	Name	Economic value					
		E1	E2	E3	E4	E5	Total
1	Babele	1	0,25	1	1	1	0,85
2	Sphinx	1	0,25	1	1	1	0,85
3	Ialomicioara Cave	1	0	0,5	1	0,5	0,6
4	Omú Peak	1	0	0,5	1	0,75	0,65
5	Urlătoarea Falls	0,75	0,5	1	1	1	0,85
6	Caraiman Plateau	1	0,75	1	1	1	0,95
7	Franz Josef Cliff	0,5	0,25	0,5	1	0,5	0,55
8	Tătarului Gorges	1	0,75	0,5	1	0,5	0,75
9	Circul Gaura	0,25	0,75	0,25	1	0,25	0,5
10	Colții Morarului	0,25	1	0,5	1	0,5	0,65

In order to fully validate this method, the criteria that were used, and the values granted should be tested in different physical-geographical units (mountains, hills, plains, shore) and tourist units (mass tourism, individual tourism etc.) to be able to adapt the scale for the evaluation. this approach may be subsequently used for defining the geomorphosites capacity to cope with the tourist function, as well as their evolution depending on the exploitation.

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