The Evaluation of Geomorphosites from the Ponoare Protected Area

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Abstract

In the present paper we present a new method of evaluating the geomorphosite. The method is presented by us/ our team and it was tested in the protected area Ponoare. In the first part of the article, we will apply, for the geomorphosites inventorized here, the other methods of evaluation known worldwide, and after that we will evaluate geomorphosites by following the new method proposed by us, a method which is adapted to geomorphological reality and to the reality of touristic exploitation of the analysed area. There were taken into account the methods developed up to now in the specialized literature, namely: *the method of evaluating the touristic value of geomorphosites* for the evaluation of the touristic value conceived by J. P. Pralong in 2005, *the method developed* in 2007 by E. Reynard et al.; *the method developed at the University of Modena and Reggio Emilia* by P. Coratza and C. Giusti in 2005; *and the method proposed at the University of Cantabria* by V. M. Bruschi and A. Cendrero in 2005; *the method developed by the University from Valladolid* by E. Serrano and J. J. Gonzales Trueba in 2005; *the method proposed by the University of Minho* in 2007 by P. Pereira, *the Greek method* developed by N. Zourous in 2005 and *the Slavonian method* proposed in 2012 by B. Erhatic. The results obtained show different quantitative values compared to previous methods, but comparing the rank obtained by each geomorphosite during the evaluation, the rank stays the same. The values are situated in a different deviation compared to other methods, having in view that for additional values firstly the cultural value is reduced in the analysed area.

Keywords: *geomorphosite, carst, evaluation, method, Ponoare*

Rezumat. Evaluarea geomorfositurilor din aria protejată Ponoare

În lucrarea de faţă vă aducem în atenţie o nouă metodă de evaluare a geomorfositurilor propusă de noi şi care a fost testată în aria protejată Ponoare. În prima parte vom aplica pentru geomorfositurile inventariate aici celelalte metode de evaluare cunoscute pe plan mondial, după care vom evalua geomorfositurile urmând metoda propusă, metodă care este adaptată realităţii geomorfologice şi de exploatare turistică a spaţiului analizat. Au fost luate în considerare metodele dezvoltate până acum în literatura de specialitate şi anume: metoda de evaluare a valorii turistice a geomorfositurilor pentru evaluarea valorii turistice a geomorfositurilor concepută de J. P. Pralong în 2005, metoda dezvoltată în 2007 de E. Reynard et al.; metoda dezvoltată la Universitatea Modena şi Reggio Emilia de P. Coratza şi C. Giusti în 2005; metoda propusă la Universitatea Cantabria de V. M. Bruschi şi A. Cendrero în 2005; metoda dezvoltată la Universitatea din Valladolid prin E. Serrano şi J. J. Gonzales Trueba în 2005; metoda propusă de Universitatea din Minho în 2007 de către P. Pereira, metoda grecească dezvoltată de N. Zourous în 2005 şi metoda slovenă propusă în 2010 de B. Erhatic. Rezultatele obţinute ne arată valori cantitative diferite faţă de metodele anterioare, însă comparând rangul obţinut de fiecare geomorfosit în evaluare poziţia se menţine aceiaşi. Valorile sunt situate într-un ecart diferit faţă de celelalte metode având în vedere că valorile adiţionale în primul rând valoarea culturală este redusă în spaţiul analizat.

Cuvinte-cheie: *geomorfosit, carst, evaluare, metodă, Ponoare*

Introduction

The definition universally accepted today considers geomorphosites as forms of relief which have a special value in time, due to their perception by the human society (Panizza, Piacente, 2003). Reynard (2005) considers the values held by geomorphosites are: scientific value (central value) and additional values (ecological, cultural, aesthetic and economic). Hereinafter, we will apply the methods of evaluation known in Geography literature for the selected geomorphosites, and then we will propose a new method of evaluating them.

The following methods were applied: *the method of evaluating the touristic value of geomorphosites,* developed by IGUL (the Institute of Geography of the University of Lausanne) for evaluating the touristic value of geomorphosites conceived by J. P. Pralong în 2005, *the method developed* in 2007 by E. Reynard et al.; *the method developed at the University Modena and Reggio Emilia* by P. Coratza and C. Giusti in 2005; *the method proposed at the University of Cantabria* by V. M. Bruschi and A. Cendrero in 2005; *the method developed at the University of Valladolid* by E. Serrano and J. J. Gonzales Trueba in 2005; *the method proposed by the University of Minho* in 2005 by P. Pereira, *the Greek method* developed by N. Zourous in 2007 and *the Slavonian method* proposed in 2010 by B. Erhatic.

For each of the methods mentioned above, the qualitative (subjective) value was eliminated, being taken into consideration strictly the qualitative (objective) value. The purpose of our demarche is to establish the most efficient method of quantifying the value of geomorphosites, from which the subjectivism of the person who evaluates must be dropped out, a method which could be applied for different areas. This is the reason why we will continue to test this method in other areas with diverse geomorphosites from the genetical point of view and also by the degree of touristic exploitation.

Study area

The area taken into study is represented by the Ponoarele Natural Reserve from the Mehedinti Plateau, comprising a surface of 100 hectares with karst forms and phenomena, with a high scientific value, some of them being unique on the territory of Romania (Fig. 1).
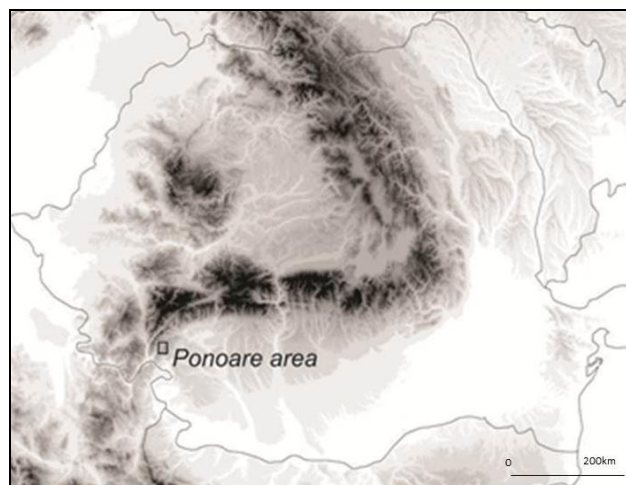

Fig. 1: The geographic location of the Ponoare protected area

From the geological point of view, the Mehedinti Plateau is formed by crystalline schists and sedimentary rocks (inclusively chalks) disposed in fasciae which are parallel (Ielenicz, 1999) (Fig. 2). On the chalks having a Mesozoic age (they occupy only 5 per cent of the surface of the plateau), specific forms developed, namely: erosion witnesses (popularly named trumpets/ horns), carst depressions which in the superior part are modelled in non-soluble sedimentary rocks or in crystalline and which present a flat bottom, having the appearance of a polje (Zătonul Mare and Zătonul Mic), the gorges sectors as the Băluț and Cosuștea Gorges, the natural bridge from Ponoare, the sinkholes which are aligned along some valleys, forming sinkholes valleys, the fields of limestones - karrenfield (Aphrodite Field and Cleopatra Field), karst springs and caves (Topolnița, Gramei, Isverna, Cave of Epuran, Bulba, Băluța and Ponoare).

All these geomorphosites are part of the Mehedinti Plateau Geopark, enclosed in the list of Natura 2000 sites, which has a total surface of 105.000 hectares. Within the geopark there are 17 natural reserves, very different as typology, but with a special scientific value.

Hereinafter, all geomorphosites from the reserve area will be inventorized and evaluated, all of them having karst origin (Table 1).
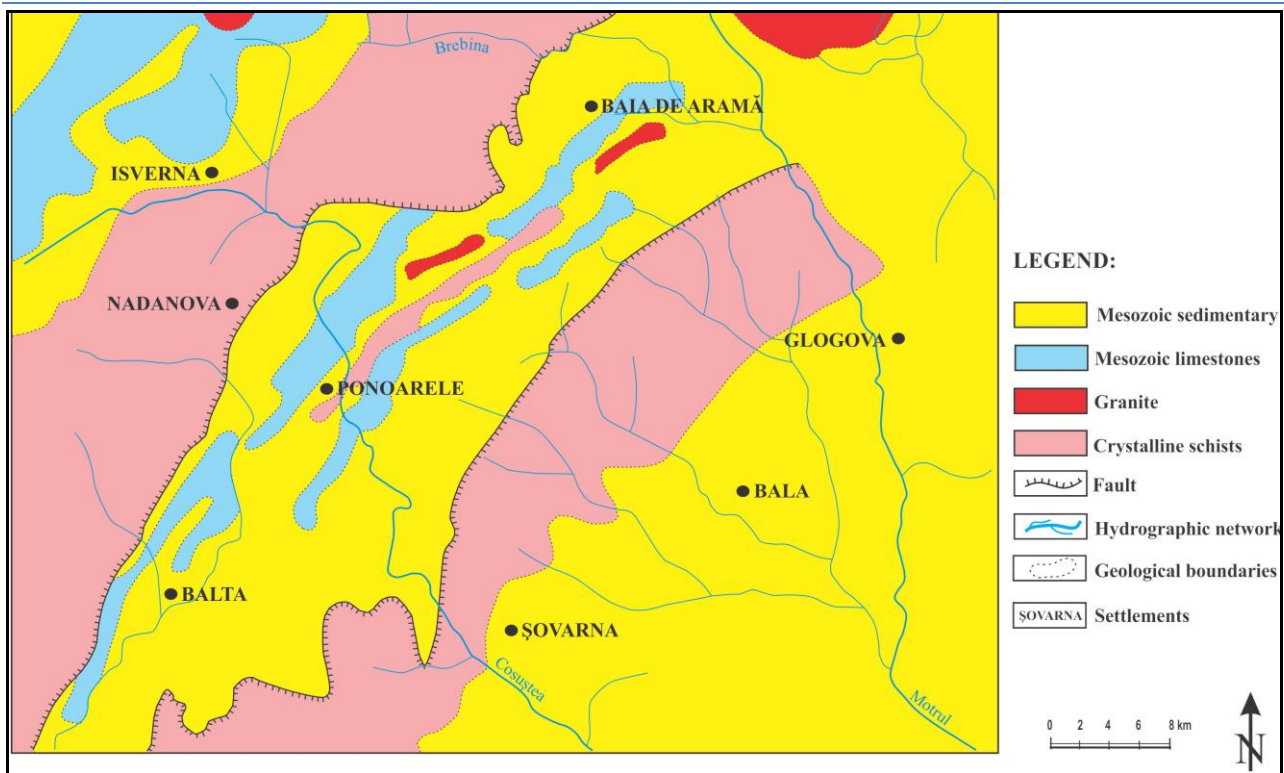
Fig. 2: The geological map of the areal Ponoare (after Geological Map- Baia de Aramă, 1977, 1: 50.000)

Table 1 Geomorphosites from the Ponoare protected area

Nr crt	Name	Origin	Type
1	Băluța Cave	karst	punctual
2	Zătonul Mare Depression	karst	areal
3	Zătonul Mic Depression	karst	areal
4	The field of limestones-karrenfield from Ponoare	karst	areal
5	Ponoare Cave	karst	punctual
6	Băluța Gorges	karst	linear
7	Sinkholes Field	karst	areal
8	PonoareNatural Bridge (God's Bridge)	karst	linear

Method

The methods enumerated are based on different objectives, but the following criteria are included in all of them: rareness, representativeness and integrity. Thus, some methods (Coratza and Giusti, 2005) emphasize the evaluation of the environmental impact, in other methods (Serano and Gonzales Trueba, 2005) the accomplishment of an inventory of geomorphosites is followed, the method developed by J.P. Pralong has as an objective to promote geomorphosites in the touristic activity, and in the methods developed by Pereira et al. in 2007 and Zourous N. in 2005 the accent lays on the evaluation of geomorphosites in the management of natural parks or geoparks.

The methodology proposed (Fig. 3) for evaluating geomorphosites consists in the following stages:

- studying the specialized literature, formulating observations and field mappings, able to lead to accomplishing the general morphologic map;
- identifying geomorphosites, localizing and inventorising them – the identification is done based on the aerial views and existent maps, and especially from the field. For each geomorphosite which was identified, the localization on the topographic map is done, as well as their description based on the standard inventory fiche from the specialized literature.
- accomplishing a database regarding geomorphosites – the existence of a correct and complete database, a very important operation which finally will lead to the implementation of the geomorphosites' map, a map which also forms a basis for the geotouristic map. The database must include the most important attributes of geomorphosites and it must be easily to access, the information in it must be uniform.
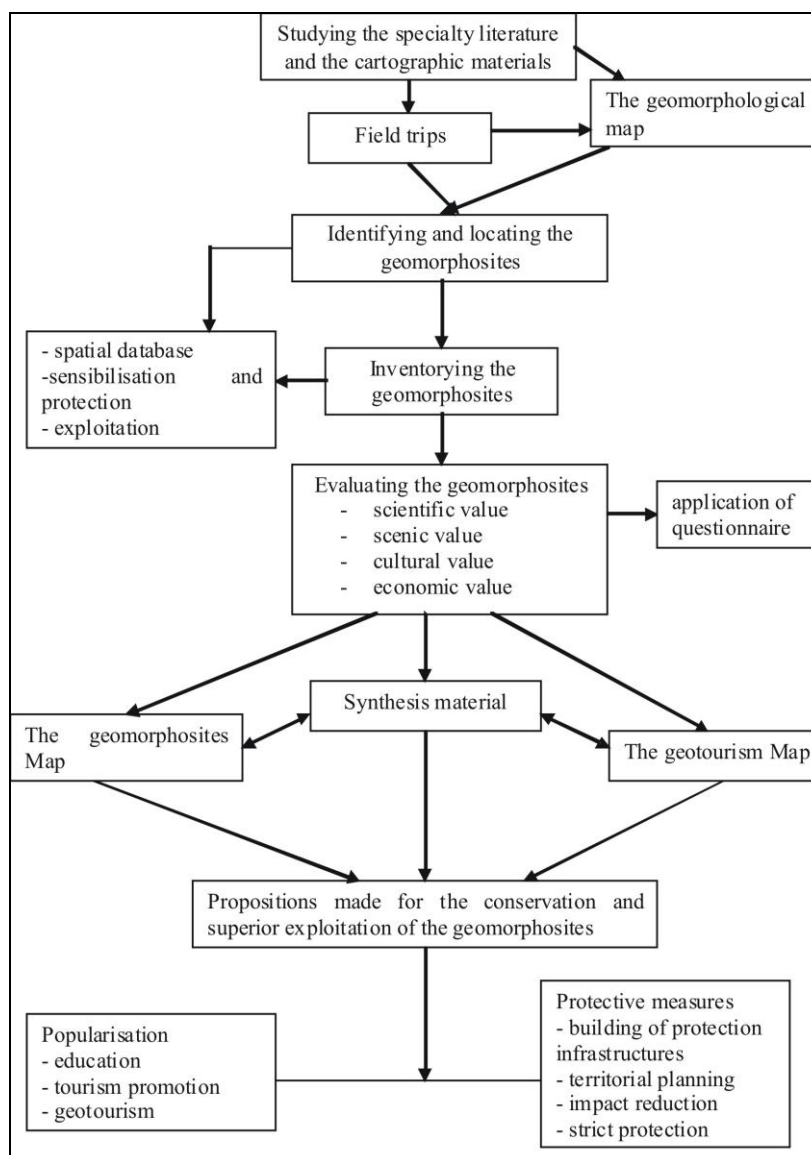
Fig. 3: The stages of studying geomorphosites (Comănescu and Nedelea, 2010)

- the evaluation of geomorphosites according to criteria proposed in table 2; the total value is calculated following the formula:

Vtot = (Vsci +Vsce +Vcult +Veco+Mg)/100. We considered necessary to calculate the division by 100 in order to do the comparison to the other methods. As it also comes out from table 2, the method proposed by us starts from the methods previously enumerated, but unlike those, it tries to globally evaluate geomorphosites. The methods known up to now in the specialized literature emphasize one or another value, depending on the purpose of evaluation.

- accomplishing the geomorphosites' map and the touristic map;

- establishing some measures for preserving geomorphosites and also for popularizing them in the touristic activity (touristic promotion, establishing some geotouristic tracks or including some of these geomorphosites in the already existent touristic tracks) or as a model in the educational promotion (their inclusion within some tracks made pupils or students).

For each of the criteria mentioned above, a score between 0 and the maximum value given to the criterion is considered, the appreciation scale being subject to modifications depending on the area and the typology of the geomorphosites taken into discussion. The sum for each criterion is calculated, and also the sum for all criteria, according to the above formula.

Table 2 The criteria and scores proposed for evaluating geomorphosites

Scientific value – 20 points	Aesthetic value - 20 points	Cultural value - 20 points	Economic value - 20 points	Management and use - 20 points
paleogeographic interest -3p	visibility – 4p	cultural characteristics -4p	accessibility -4p	preservation degree -4p
representativeness- 2p	space structuring – 4p	historical characteristics -4p	infrastructure-4p	protected sites - 3p
rareness – 2p	colour contrast - 4p	religious characteristics - 4p	yearly visitors number -4p	vulnerability/ natural risks - 3p
integrity -2p	level difference- 4p	iconographic/ literary representations -2p	number of types and forms of use (inclusively touristic) -4p	the intensity of use - 4p
degree of scientific knowledge -3p	landscape framing- 4p	festivals/ cultural manifestations -2p	economic potential (incomes) -4p	the use of aesthetic, cultural and economic value -3p
use in educational purposes - 3p		symbolic value -4p		relationship with planning policies- 3p
ecologic value-3p				
diversity-2p				

As we mentioned before, the appreciation criteria stay the same, but the scale will differ depending on the concrete situation in the field and on the purpose and objectives of the evaluation. Thus, whether the evaluation aims firstly the scientific value, its results being used for the specialist, a higher weight will be given to paleogeographic interest, the degree of knowledge/ recognition or the ecological value. If the evaluation purpose regards educational activity, then the use in this purpose will be better measured.

In accomplishing a geotouristic map, the accent will fall on the aesthetic value, which is most often perceived by the tourists, and also on the cultural value. In the studies dedicated to the impact upon environment, the most important category, whose weight must increase, is the management and economic use.

Results and discussions

For the selected geomorphosites (Table 1) there were applied (Table 3) the methods of evaluation mentioned above. For each of them, the total value was calculated and subsequently the rank held by the respective geomorphosite within the

classification resulted from the respective evaluation, which allowed their comparison. The total rank results from the sum of ranks for each evaluation and it gives a generalized picture of every geomorphosite's value (Table 4). It is obvious that the subjectivism of the person who does the evaluation cannot be eliminated, and this is the reason why we consider this classification on ranks to be very important in minimizing it.

There can be noticed differences between the values obtained by different methods depending on the variables analysed, but the classification is usually the same, the variations being situated especially in the lower part of the classification (Table 4, 5).

There can be noticed that in all evaluations the Natural Bridge from Ponoare holds the first position, due to its uniqueness on the territory of Romania, to its special geomorphologic value, its status of monument of nature but also to the good accessibility and the large number of yearly visitors. This has the combined lowest rank (8). The field of limestones from Ponoare ranks second, both in the method proposed by us and as combined rank of all other methods (17). Except one geomorphosite – the

Băluța Cave, there is a perfect correspondence between the ranks from the two evaluations.

Table 3 The evaluation of geomorphosites' value by different methods

Nr. crt	Name	Eval. of touristic value	Rank	Swiss	Rank	Modena	Rank	Cantabria	Rank
1	Băluța Cave	0.5	4	0.40	3	0.23	4	0.45	5
2	Zătonul Mare Depression	0.5	4	0.33	4	0.44	2	0.50	4
3	Zătonul Mic Depression	0.46	5	0.25	5	0.44	2	0.66	3
4	The field of limestones- karrenfield from Ponoare	0. 75	2	0.66	2	0.44	2	0.67	2
5	Ponoare Cave	0.66	3	0.40	3	0.23	4	0.30	7
6	Băluța Gorges	0.33	6	0.12	7	0.33	3	0.33	6
7	The sinkholes field	0.25	7	0.25	6	0.33	3	0.25	8
8	Ponoare Natural Bridge (God's Bridge)	0.84	1	0.75	1	0.5	1	0.78	1
Nr. crt	Name	Valladolid	Rank	Minho	Rank	Greek	Rank	Slavonian	Rank
1	Băluța Cave	0.45	4	10.50	4	56	3	0.25	5
2	Zătonul Mare Depression	0.25	6	10.05	5	46	6	0.31	4
3	Zătonul Mic Depression	0.35	5	9.85	6	50	5	0.20	6
4	The field of limestones- karrenfield from Ponoare	0.50	3	11.44	2	64	2	0.55	2
5	Ponoare Cave	0.66	2	10.85	3	52	4	0.40	3
6	Băluța Gorges	0.20	7	9.71	7	35	8	0.12	7
7	The sinkholes field	0.15	8	9.45	8	38	7	0.10	8
8	Ponoare Natural Bridge (God's Bridge)	0.75	1	12.30	1	85	1	0.66	1

Table 4 The sum of geomorphosites' ranks from Ponoarele protected area

Nr.crt	Name	Rank
1	BăluțaCave	32
2	Zătonul Mare Depression	35
3	Zătonul Mic Depression	37
4	The field of limestones-karrenfield from Ponoare	17
5	Ponoare Cave	29
6	Băluța Gorges	53
7	The sinkholes field	55
8	Ponoare Natural Bridge (God's Bridge)	8

When evaluating the scientific value (the method from the University of Modena and Reggio Emilia) the deviation between the values is the most reduced (0.27), existing geomorphosites which have the same value due to the smaller number of criteria taken into consideration, but also due to the genetical-evolutive and morphological homogeneity of the analysed geomorphosites. Thus, the geomorphosite no. ,7 which in all evaluations has low ranks (6-8) presents rank 3 due to its special educational and research value.

The method referring to the evaluation of touristic value of geomorphosites presents the highest amplitude of the values (0, 49), amplitude which is given to the different aesthetic value of geomorphosites, but also to the absence of cultural elements.

According to the Swiss method, where management and use of geomorphosites are not taken into account, the lowest values are obtained (0.75 maximum and 0.12 minimum), a thing which is due to the high weight of additional values which do not represent the strong point of the selected geomorphosites.

The amplitude between values is pretty high (0.58), due to the introducing of the weight given to criteria.

The method from the University of Valladolid gives, as well as the Swiss method, a great importance to additional values, leading to values relatively low for geomorphosites (0.75 maximum and 0.15 minimum), but with a high weight, 70 per cent, of the values between 0.2 and 0.4.

The Slavonian method was applied only for geomorphosites of waterfall type and this is the reason why we consider it presents some lacks in order to be possible to be applied to different types of geomorphosites, determining relatively low amplitudes and an equalization of values.

Table 5 The evaluation of geomorphosites' value from Ponoarele protected area by the proposed method

Nr. crt	Name	Scientific value	Aesthetic value	Cultural value	Economic value	Management and use	Total points	Total evaluation	Rank
1	Băluța Cave	12	8	2	6	8	36	0.36	6
2	Zătonul Mare Depression	12	10	2	6	9	39	0.39	4
3	Zătonul Mic Depression	12	10	2	6	9	39	0.39	4
4	The field of limestones-karrenfield from Ponoare	18	14	4	8	10	54	0,54	2
5	Ponoare Cave	12	8	2	8	10	40	0.40	3
6	Băluța Gorges	10	10	2	7	8	37	0.37	5
7	The sinkholes field	11	9	2	7	6	35	0.35	7
8	Ponoare Natural Bridge Ponoare (God's Bridge)	19	16	8	14	18	75	0.75	1

We considered very purposefully the evaluation by the method from the University of Minho and we applied in this demarche the method of ranks. The values thus obtained also differ from the others, and they keep the classification established by the other methods.

The method applied by Zouros resembles the method proposed by us, both having a maximum score of 100 and being applied in case of some protected areas, at different scales. The maximum value is higher (85) in case of the Greek method compared to the value obtained by applying the proposed method (75), but the minimum value is the same (35), due to the higher weight in the evaluation of scientific, ecological values or of geodiversity.

The method we propose gives an equal importance to all the values of geomorphosites (scientific – where we also enclosed ecological, aesthetic, cultural and economic value), but also to the management and use of geomorphosites. The results obtained are presented in fig. 4 and except geomorphosite no. 8 it shows that it is not compulsory that geomorphosites with the highest scientific value must also have high values for additional criteria. The amplitude between the values obtained is 0.39, the majority of geomorphosites being enclosed between the values 0.3 – 0.4 (80 per cent).
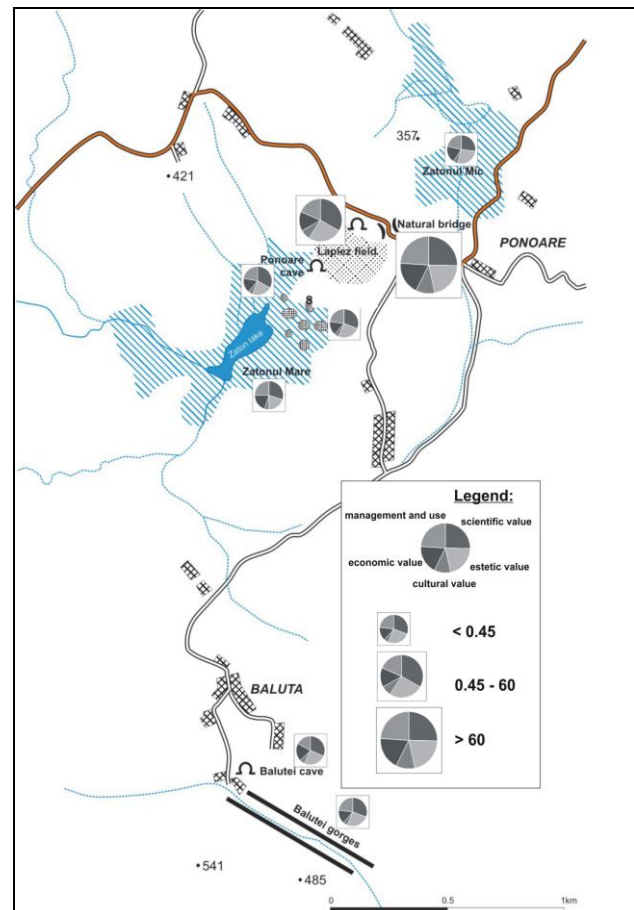

Fig. 4: Geomorphosites from Ponoare protected area - the evaluation of their value according to the proposed method

Conclusions

The method proposed was applied within Ponoare natural protected area, with the aim of increasing the role of geomorphology in the territorial management, in order to find the most adequate ways and modalities of introduction in the policies of local development. Only those geomorphosites which also present a touristic importance were evaluated. The results are useful for inventorying and classifying the geomorphosites from the analysed space.

Acknowledgements

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