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INVENTORY CARDS FOR REGIONALLY RELEVANT GEOMORPHOSITES[1]

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ABSTRACT – When analyzing inventory or evaluation cards for geomorphosites, one can notice that sometimes the elaboration of such cards is not supported by an articulated method of inventory and assessment, whereas some cards developed together with such methods do not in fact take up the criteria used in the assessment. In addition, not all methods used contain such cards. Thus, we identified the need for a new method of assessment that materializes in the development of a synthetic sheet that captures the criteria and rates noted in the evaluative process. The originality of the method emerges from de separation of the structural and functional values of geomorphosites, for which new or improved criteria and ranking are used. The restrictive attributes are also evaluated, in order to obtain a complete view upon the possibilities of conservation and exploitation of the geomorphosite. All scores obtained by a geomorphosite will be reflected in the inventory card. This card will also include general information about the landform, a brief description of the type of geomorphosite and justification for rates given in the evaluative process.

Keywords: geomorphosites, inventory card, assessment method, structural value, functional value, restrictive value

INTRODUCTION

In the elaboration of inventories of geomorphosites in different regions, an emphasis was placed on the assessment, selection, and evaluation methods as well as on cartographic representations. Only some of these methods also include an evaluation or inventory card or sheet, some just aiming a quantitative evaluation of the sites. However, not all of the cards used together with the assessment methods actually reflect the criteria or even the conclusions of the evaluative process, basically starting a new assessment approach. There are, however, some other cards purely descriptive, not based on a valuation method, while other cards are in themselves a method, containing a great number of criteria that allow the detailed evaluation of geomorphosites.

EXISTING METHODS

Among the five methods developed by the members of the Geosites working group from the IAG, that have been intensively promoted, all of the above situations can be noticed. The method elaborated by Coratza (2003), further explained by Coratza and Giusti (2005), for the assessment of geosites aims at their selection, the quantitative assessment of the scientific quality of geomorphological sites and their representations using GIS, rather than the generation of such a sheet.

Similarly, the method developed by Bruschi şi Cendrero (2005) focuses on the selection of geomorphosites and the identification of criteria for the analysis of intrinsic qualities, use, potential threats and necessary protection of such landforms. This method remains to date the most complex and widely applicable method, having good indicators and ranks for each criterion, but it is however not sustained by a type of card for the inventory of geomorphosites.

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The method used by Pereira et all. (2007) for the geomorphological heritage assessment of Montesinho Natural Park also focuses on the identification of potential geosites, their assessment, selection and description, but the authors do not actually bring in an inventory sheet that might contain the geomorphological value (scientific and additional) and the management value (use and protection) that are being assessed.

There are however two methods that actually have such a card: the method elaborated by Serrano and Trueba Gonzalez (2005) and the one developed by Reynard (2006). The first method contains a *Geomorphosite description card* that has four sections. The first two contain data used for the identification of the site (name, number) and its location (administrative unit, coordinates and altitude). The third part is more descriptive and it refers both to the geomorphological aspects: type of landform, description, morphostructure, erosion, dynamic, chronology, and to the geosites' attributes, main and secondary interests. The last section analyzes the uses of the geomorphosite: cultural content, accessibility, level of interest, state of conservation, current uses, communications, infrastructures, impacts and legal status. We can easily note that this description card does not use the criteria organization of the method that consists of three parts dedicated to scientific value, additional value and value for use and management. Still, the evaluation card covers most of the aspects analyzed throughout the assessment. However, the criteria used do not cover all the aspects we believe to be relevant for the geomorphosite assessment, whilst the card remains descriptive, with no support for quantitative evaluation.

The method developed by Reynard is in itself an evaluation card, more complex than the previous one, consisting of six parts. The first one contains general data (identification code, name, place, coordinates, minimum and maximum altitude, type of site, size, type of property, maps, photographs and bibliographical references). The second part is the description of geomorphological features, genesis and active processes, and also of archaeological elements, modern infrastructures, biotopes, etc. The next two parts contain the actual assessment process, the third analyzing the scientific value using four criteria, often found in bibliography: rareness, integrity, exemplarity, and paleogeographic value, whilst the forth one assesses the additional values (ecological, aesthetic, cultural, and economic). These values will be subsequently used in the calculation of the global value and educational value in the next section, together with risk and management measures. The final part contains the list of references. The method is indeed correct and widely applicable, but it sometimes appears to be too simple and descriptive, especially in regard to the scientific value of the site.

In general, the above mentioned methods sometimes use criteria that might be considered too subjective or might be too vaguely expressed. They also have limitations due to the omission of some criteria that we consider very relevant from the numerical quantification, as well as from the descriptive card.

A NEW APPROACH

We have therefore developed a new method with its own inventory card that has been applied for the inventory and assessment of the geomorphosites from the Trascău Mountains. In designing this new method, the following aspects were taken into consideration: the type of elements that can be considered geomorphosites are landforms with special geomorphological features. Of course, these landforms often have secondary values, represented by certain geological aspects, or the presence of certain hydrological elements, vegetation or fauna, but these aspects are not defining, and shall be marked as such. The geomorphosite quality is also dependent on the way in which such landforms are perceived by humans, and the function they are assigned. In the absence of such a function, of any scientific, cultural or economic interest, the landform can not be considered a geomorphosite. However, if the landform is interesting in itself, it could be regarded as a potential geomorphosite. Thus, geomorphosites are *landforms that have at least one functional value added to the primary geomorphological one and that are found suitable for conservation and/or sustainable exploitation.*

As one can note from the above, this new assessment method is based on the detachment of structural values, such as geomorphological, aesthetic and ecological, from the functional ones, attributes given after human perception or exploitation, derived from the first ones (cultural, scientific and economic) .

The geomorphologic value is assessed using the following criteria: genesis (considering the number of factors involved), dynamics, complexity (given by the number of geomorphological elements of interest), size (reported to an area), conservation status, rarity (on different areas of reference) and type of structure.

The aesthetic value can only be estimated rating: physiognomy (the assessment of the forms' appearance), colour, display (the possibility for observation), elevation or configuration (criterion with a differential use for evaluating surface landforms or underground forms, caves, pit caves or salt mines, for which layout is just as relevant as dimensions).

The ecological value is represented by flora and fauna (the relevance of the species and associations present in the area), as well as the current state and form of protection.

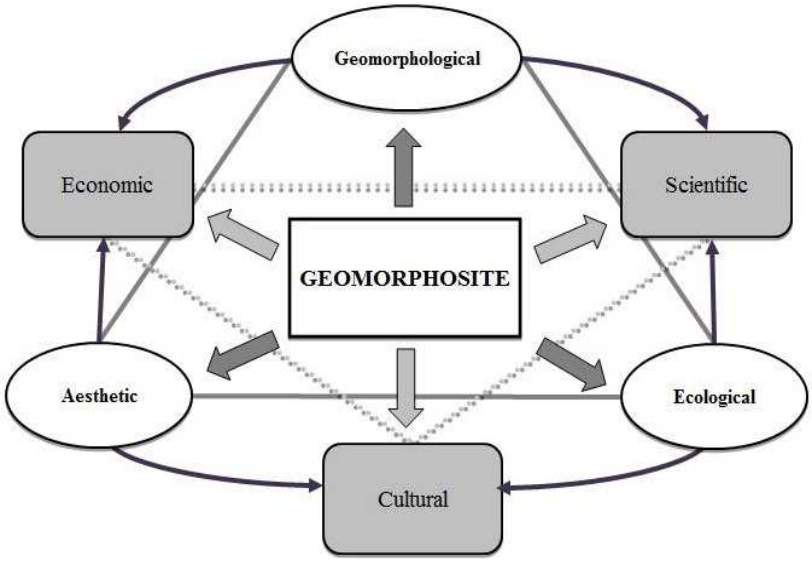

Figure 1. *Values of geomorphosites*

The cultural value sums up the historical quality (relevance of remains on different levels), archaeological importance (age of historical sites within perimeter), religious significance (the presence of monasteries or churches), the type of association of the site with different symbols, the artistic value (number of representations in literature, paintings, graphics and photography), the frequency of associated cultural events and the architectural features.

The scientific value is quantified using the following criteria: scientific significance (measuring the importance of references), scientific resource (estimation of the survey potential), formative significance (wideness of target group), usefulness as a model (relevance), representativeness (on different levels), paleontological value (abundance and conservation of paleontological remains). In quantifying the scientific value, the separation of the criteria strictly related to this value from the ones evaluating the geomorphologic value, avoiding therefore duplication, is very important.

For the estimation of the economic value, some indicators of tourism potential and exploitation are taken into account: the number of possible recreational activities, the site's tourist potential on various levels, accessibility (type of transport and distance), type of accommodation infrastructure and the distance from the geosite, present arrangement and services, distance from modern centres with complex services (in km), socio-economic features of the region (considering the size of urban centres located within 25 km), status of current tourism exploitation (complexity and seasonality), level of site promotion and frequency of sport competitions.

Besides the new approach and the original organization of criteria, new features were introduced for a better assessment of both intrinsic or derived values (physiognomy, caves

configuration or colour), others that may have been mentioned in different methods, were reconsidered and strictly rated, assessing scores according to their true significance, whilst some have been avoided, such as form of land ownership, which we consider irrelevant, as a private or nationalized form does not have an impact upon the structure and the function of the geomorphosite.

For each of the used criteria, there have been established five categories of indices designed to weigh the attributes of each feature on a numerical scale from 0 to 1. The overwhelming majority of the analysed traits are positive, therefore, they participate in shaping the geomorphosites' strengths.

There are, however, some characteristics with the opposite effect, negative attributes, which reduce the value of the site: natural and anthropogenic hazards, vulnerability, the presence of factors that could decrease the attractiveness of the site, as well as the presence of unsightly elements.

The numerical values for structural, functional, and restrictive attributes are all sums of the scores of the criteria, whilst the total value of the geomorphosite in the sum of functional and structural values, from which the value of restrictive attributes is deducted.

THE INVENTORY CARD FOR GEOMORPHOSITES

The card that we propose reflects with exemplary fidelity the criteria used in the assessment method in estimating the different values (geomorphological, aesthetic, ecological, cultural, scientific, and economic) that have been evaluated. We will analyze one such card, elaborated in the assessment and inventory of the geomorphosites in the Trascău Mountains, the inventory card for Turda Gorge, the geomorphosite with the highest score in the region, and a very important geomorphosite in the Apuseni Mountains.

The inventory card consists of two parts: one related to the identification and designation of the geomorphosite, and a second, analytical part.

The first one includes basic information about the geomorphosite, the official name and other denominations (it is not the case for the Turda Gorge, however, it was used for other geomorphosites, for example, Pietrele Ampoiței – Ampoița Limestones, or Ponorul Vanatara - Vanatarele Ponorului), and the record indicative, that consists of the letter T, indicative standing for the Trascău Mountains, and a number, representing the place it occupies in the hierarchy of the region's geomorphosites, for example T1 for Turda Gorge, the geomorphosite with the highest rating in the Trascău Mountains, T2 for Colții Trascăului, T3 for Râmeț Gorge, etc. Basic information about the general location within the region and the territorial-administrative units are also mentioned here, as well as other data such as coordinates can be added if necessary.

Afterwards, the main features of the geomorphosite, typology and spatial extension (punctual, linear or areal) will be noted, features which are essential for a brief characterization of the geomorphosite and are also a starting point for the further analysis of more specific characteristics. The geomorphosites were classified using complexity as a criterion: simple geomorphosites (e.g. Șipote Waterfall, Sfredelaşu), complex geomorphosites, which group up a series of valuable elements and that can not, however, be considered geosites (e.g. Ampoița, Tureni Gorges, Huda lui Papară Cave) and systematic geomorphosites, geomorphosites of greater dimensions that contain smaller geomorpsosites (e.g. Turda Gorges, Râmeț Gorges, Ciumerna Plateau). The generic type of landform represented by the site should also be mentioned (isolated massifs, gorges, plateaus, caves, etc).

The general value, structural and functional values, as well as the restrictive attributes are indicated in this part, in order to create a first insight on the relevance of the analyzed geomorphosite. A representative photograph or map of the area must also be attached.

The second part covers the criteria used in the evaluation and it is an opportunity for the assessor to explain the rates given for different criteria. Although many of the proposed criteria are objective, using quantitative scales, however, subjectivity can always occur. Thus, the justification of the rates is an effective way to minimize it.

This second part consists of three distinct sections, reflecting the three aspects evaluated in the assessment method: structural and functional values and restrictive attributes. For each of them, every criterion will be explained, every positive score will be justified (considerations will not be made when a criterion value is zero). Where the case, relevant examples should be provided.

Table 1. *Inventory card for geomorphosites*

INVENTORY CARD FOR GEOMORPHOSITES		
Name	TURDA GORGE	
Indicative	T1	
Location	Hăşdatelor Valley, central part of the Petreşti Range	
UAT	Cheia, Mihai Viteazu commune, Petreştii de Jos, Petreştii de Jos commune, Sănduleşti	
Typology	Systemic geomorphosite Gorges	
Extension	Linear	
General value	25	
Structural value	10.75	
Functional value	15.5	
Restrictive attributes	1.25	

STRUCTURAL VALUE		
Value	Pt	Justification
Geomorphologic	4.75	- its genesis involves at least two morphogenetic factors: tectonics, lithology and epigenetic processes (0.5) - slow dynamics (0.5) - in terms of complexity, there are more than five elements of interest: impressive slopes (Peretele Uriaş, Suurimea, etc.), ridges (Creasta Sură, Creasta Colțului Crăpat, etc), arches, pillars, 22 caves, among which four of them were identified as singular geomorphosites: Binder, Cetățeaua Mare, Cetățeaua Mică and Ungurească (1 pt.) - it is among the most relevant gorges on a regional level (0.75) - slightly affected geomorphosite (0.75) - unique site in the region especially due to the number of attractive elements and their association (0.5) - particular structure, visible in the structural surface in the upper part of the left slope (0.75)
Aesthetic	3.25	- particular physiognomy due to the association of the above elements (0.75) - 300-500m elevation (0.75) - chromatic puzzle constituted by the variety of colours (0.75) - panoramic perceived element (1pt)
Ecologic	2.75	- presence of relict or endemic plants: *Allium obliquum*, *Sorbus dacica*, *Ferula sadleriana*, *Ephedra dystachia* (1 pt.) - regionally unique biotope with rich fauna (0.75) - fully protected area, Turda Gorge Reserve, one of the oldest nature reserves in the country, established in 1938 (1 pt.)
FUNCTIONAL VALUE		
Type	Pt	Justification
Cultural	3.25	- regionally defining artefacts, civil housing site in caves: Ungurească and Peştera lui Binder (0.75) - prehistoric sites in the Călăştur Cave (0.75) - symbolic relevance discreetly associated with the site, derived from the legend of Balica and his hideouts, Cetățeaua Mare and Cetățeaua Mică caves (0.75) -more than 50 representations in art, mostly photographs (1 pt)

Scientific	4.75	- major scientific significance, at least one scientific theory related to the genesis and evolution of the landform (1 pt); - recognised survey potential – numerous bibliographic citations in relevant papers about the Trascău and the Apuseni Mountains (1 pt.) - wide target group (1 pt.) - national representativeness (0.75) - model of maximum relevance (0.75)
Economic	7.50	- 4-5 types of recreational tourist activities possible in the perimeter: climbing, hiking, paragliding, geotourism, speleotourism (0.75) - regional landmark (0.75) - vehicle access up to 500 m from the site (0.75) - modest lodgings in the perimeter or a modern one within 5 km –Cheile Turzii Cabin, Laura B&B (0.75) - equipment and modern facilities and services outside the perimeter (0.75) - Turda, centre of over 25 000 inhabitants nearby (0.5), within 10 km (0.75) - complex seasonal exploitation, during summer time (0.75) - national complex promotion, as one of the main tourist attractions of the Apuseni Mountains (0.75 pt.) - hosts one major sport competition ATTA Climbing Competition (1 pt.)
RESTRICTIVE ATTRIBUTES		
Score		Justification
1.25		- the presence of factors that could affect the site: farming and grazing (0.5) - controllable risks, flooding and rock fall (0.5) - the site is vulnerable but cannot be strongly affected (0.25)

It is obvious that such an inventory card is dependent on the achievement of assessment and ranking of regional relevant geomorphosites. Thus, the evaluation, ranking, and inventory of geomorphosites come together in a fluent and articulate approach of high objectivity and applicability.

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