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Șos. Panduri, 90-92, București – 050663; Telefon/Fax: 021.410.23.84

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Evaluation of geoheritage in the Western part of Podyjí National Park, Czech Republic

Karel KIRCHNER¹, Lucie KUBALÍKOVÁ²

Abstract: The evaluation of geoheritage is one of the tools of geoconservation. For the geomorphological assessment it is possible to use the concept "geomorphosites" which includes both inventorying and evaluation and proposals for management and rational use of the sites. This concept was used for evaluating selected geomorphological sites in the western part of Podyjí National Park. Although the area is protected and conserved, geoheritage is not well promoted and managed. The results of the assessment can serve as a base for proposals for rational use and management. Other perspectives of the use of the geomorphologic assessment are outlined too.

Keywords: geoconservation, geoheritage, geomorphosites, Podyjí National Park, Czech Republic

1. Introduction

Evaluation and inventorying of geoheritage can serve as a tool for geoconservation and management of geoheritage and geodiversity. The concept of geodiversity was for the first time developed in Australian Natural Heritage Charter (2002) and the principles of geoconservation were defined in the same document. In general, we can define the geoconservation as an activity of humans that is oriented to the conservation of geoheritage. We consider geoheritage as a term which includes geological, geomorphological and pedological elements, landforms and processes worth of protection (SHARPLES, 2002). Conservation of geoheritage or geoconservation includes both management and strategies for rational use of this heritage.

The evaluation of geoheritage and geo(morpho)logic sites can be used for comparison between geo(morpho)logic sites themselves, for classification of the sites and also can be applied for management measurements and rational use for the sites.

The concept of "geomorphosites" seems to be an applicable tool for the evaluation of geoheritage. This concept was presented by PANIZZA (2001) and it is developed in various research institutions especially in Western and Southern Europe (for example Université de Lausanne, Switzerland, Università di Modena, Italy, Universidade do Minho, Portugal). Within the International

Association of Geomorphologists (IAG), the working group Geomorphosites exists and it is oriented on the development of methods of geomorphologic assessment, educational activities and geoconservation.

Under the geomorphosites concept, various methods of geomorphologic assessment exist. For the evaluation of geoheritage of the sites in western part of Podyjí National Park a modified method was proposed; this method comes out from methods that have already been used.

2. Methodological approach

Geomorphosites can be defined as landforms that have acquired a scientific, cultural/ historical, aesthetic and/or social/economic value due to human perception. Geomorphosites can be single geomorphologic objects or wider landscapes. These geomorphosites can be modified, damaged, and even destroyed by the impacts of human activities (PANIZZA, REYNARD, 2005).

The geomorphosites are classified by different points of view: 1) activity (in relation to presence or absence of current process): active or passive 2) dimensions: simple geoforms or geomorphologic landscapes or geomorphologic systems (REYNARD, E. (ed.), 2009).

As mentioned above, the geomorphosites can acquire different values. REYNARD et al. (2007) divide these values into two groups: 1) scientific

values that present an importance for understanding of a landform, a process or an evolution. Within the geomorphologic sites, the processes are considered one of the most important scientific values together with representativeness of the landform and process, uniqueness and palaeogeographical significance of the site, 2) additional values include cultural, aesthetic, economic/social and ecological values. Cultural value is represented by the archaeological or historical significance of the site and can both be influenced by the geomorphology of the site and can have an influence on the site. The perception of the aesthetic value is based on the colour contrast, structure of the space or heterogeneity of the site. For these reasons it is the most problematic value to describe. Economic or social value is related to the potential for use of the site especially for the geotourism. The ecological value of the site expresses the relation between geomorphologic elements of the site and biota and as well as cultural value can both be influenced by geomorphology of the site and can have an influence on the site.

Various methods are used for evaluation of geoheritage. PANIZZA (2001), CORATZA, GIUSTI (2005) proposed a method for geomorphologic assessment where especially scientific value is accented. Besides the scientific values (integrity, uniqueness and representativeness) the evaluation of some additional values is proposed. The methodology of GONZALES-TRUEBA (2006) comes out from the geomorphologic mapping and covers both scientific values and additional values. He also mentions the use of site for education and vulnerability. Universidade do Minho in Portugal uses the method of PEREIRA (2006). This method is based on the assessment of scientific and additional values and

takes into account the potential for use and protection of the locality. The method of REYNARD et al. (2007) comprises the assessment of scientific values (representativeness, integrity, palaeogeographical significance), additional values (historic, cultural, religious or symbolic values) and tries to evaluate the existence of the products that support the sites. Submitted methods of evaluation were particularly discussed and compared by KUBALÍKOVÁ, KIRCHNER (2010).

The above methods use different means of evaluation, both direct and indirect, for example expert's estimate or numerical evaluation. The majority of the methods are numerical which have an advantage of relative objectivity, but there are certain parameters that can be measured with difficulties and could be the source of disagreements. Another problem of the assessment process is subjectivity, especially in the evaluation of aesthetic and cultural aspects of the site, but also in evaluation of the scientific significance of the site.

The presented methodology for Podyjí National park (see Table 1) is based on the above-mentioned methods and keeps this procedure: 1) the identification of significant geomorphologic sites (based on the literature, maps and field survey), 2) a detailed inventory of selected sites (general information, geology, geomorphologic data – morphology and genesis, environmental conditions, a description of the cultural components of the site, aesthetic aspect, availability, background, presence services, current status of the site, potential threats and risks), 3) numerical evaluation of sites, 4) synthesis (classification of the sites, management proposals, possible use of the site, proposed legislative protection).

Table 1 The proposed methodology for evaluation of geoheritage in Podyjí National park

1. Scientific value		
number	criteria	score
1.a	Representativeness	0-1
0 – low representativeness of the form and process, 0,5 – medium representativeness, especially for scientists, 1 – high representativeness of the form and process, also for the laic public		
1.b	Integrity	0-1
0 – totally destroyed site, 0,25 – destroyed site but with the rests of geomorphologic features, 0,5 – disturbed site, but with the main geomorphologic features, 0,75 – only low destruction of the site, 1 – site without any destruction		
1.c	Exemplarity, pedagogical use	0-1
0 – very low exemplarity and pedagogical use of the form and process, 0,5 – existing exemplarity, but with limited pedagogical use, 1 – high exemplarity and high potential for pedagogical use, goeidactics and geotourism		
1.d	Number of similar sites in the area of interest	0-0,5
0 – more than 3, 0,25 – less than 3, 0,5 – unique site		

1.e	Number of similar sites in the country	0-1
	0 – more than 5, 0,5 – less than 5, 1 – unique site	
1.f	Mezofoms, microforms	0-1
	0 – no important or missing, 0,5 – presence of some mezo- and microforms, 1 – presence of some mezo- and microforms which are important for representativeness and exemplarity of the site	
1.g	Presence of geologic and pedological features	0-1
	0 – no important or missing features, 0,5 – presence of geological and pedological features, 1 – presence and existing protection of the geological and pedological features	
1.h	Knowledge of the site, scientific articles	0-1
	0 – unknown site, 0,5 – some articles in the literature, 1 – high knowledge of the site, monographic studies about the site	
1.i	Importance for understanding to geological evolution	0-1
	0 – no important or missing, 0,5 – existing importance	
1.j	Paleogeographic importance (possibility of reconstruction of landscape, climate etc.)	0-1
	0 – no important, 0,5 – possibility for reconstructions but only at local scale, 1 – high paleogeographic importance	
1.k	Existing protection of the geo(morpho)logic features	0-1
	0 – no existing, 0,5 – existing protection, but not of the geo(morpho)logic features, 1 – existing protection of the geo(morpho)logic features	
Scientific value total score		max. 10
2. Additional values		
2.a	Aesthetic value	
	The number of colors	0-0,5
	0 – one color, 0,25 – two or three colors, 0,5 – more than 3 colors	
	Structure of the space	0-0,5
	0 – only one pattern, 0,25 – two or three patterns clearly distinguishable, 0,5 – more than 3 patterns	
	Global aesthetic value	0-1
	0 - low, 0,5 - medium, 1 - high	
2.b	Ecologic value	
	The influence of the geomorphologic feature on the ecologic feature	0-1
	0 – no important, 0,5 – existing influence but not so important, 1 – important influence of the geomorphologic feature on the ecologic feature	
	Presence of the protected species	0-0,5
	0 – missing, 0,5 - present	
	Existing protection of the ecologic features	0-0,5
	0 – no protection, 0,5 – existing protection	
2.c	Cultural value	
	Historical and archaeological importance	0-1
	0 – no historic and archaeological features, 0,5 – existing historic and archaeological features but without any relation to the geomorphology, 1 - existing historic and archaeological features with the strong relations to geomorphology	
	Religious and symbolical importance	0-1
	0 no religious and symbolical importance, 0,5 - existing religious and symbolical importance but without any relation to the geomorphology, 1 – existing religious and symbolical importance with the strong relations to the geomorphology	
	Literal and artistic importance	0-1
	0 - no literal and artistic importance, 0,5 - existing literal and artistic importance (paintings, legends etc.), 1 – site as strong inspiration of the artists	
2.d	Knowledge of the site due to its additional values	0-1
	0 – unknown site, 0,5 – local or regional knowledge, 1 – national or international knowledge of the additional values of the site	
Additional values total score		max. 8

3. Potential for the use		
3.a	Visibility	0-1
0 – only with special equipment (light, rope), 0,5 – good visibility, but necessity of walk around to see all, presence of the trees etc., 1 – very good visibility		
3.b	Accessibility	0-1
0 – more than 1000 m from the parking place, 0,5 - less than 1000 m from the parking place, 1 - more than 1000 m from the stop of public transport		
3.c	Infrastructure (tourist facilities)	0-1
0 - more than 10 km from the site existing tourist facilities, 0,5 – 5 – 10 km tourist facilities, 1 – less than 5 km tourist facilities		
3.d	Attendance, number of visitors	0-1
Depends on the data acquired. For example the rating: well attended, medium-attended, low attended.		
3.e	Current use of the geo(morpho)logic features of the site	0-1
0 – no use, 0,5 – existing use but not so important, 1 – existing and important use of the geo(morpho)logic features of the site		
3.f	Current use of the additional values of the site	0-1
0 - no use, 0,5 - existing use but not so important, 1 - existing and important use of the additional values of the site		
3.g	Total number of the possibility of the uses	0-1
0 – no use, 0,5 – 1 – 3 possibilities of the use, 1 – more than 3 possibilities of the use		
3.h	Limits of the use	0-1
0 – no accessible site, 0,25 – accessible only with guide, 0,5 – considerable limits, but good accessibility, 0,75 – good accessibility with small limits, 1 – no limits for the use		
3.i	Existing promotion of the site	0-1
0 – no promotion, 0,5 – postcards, leaflets etc., 1 – emblematic site for the region or town		
Potential for use total score		max. 8
4. Threats and vulnerability		
4.a	Existing and current threats	0-1,5
0 – high both natural and atrophic risks, 0,5 – existing risks that can disturb the site, 1 - existing risks that can disturb the geo(morpho)logic features of the site, 1,5 – practically no vulnerability of the site		
4.b	Potential threats (in the case of the more intensive use of the site)	0-1,5
0 – high both natural and atrophic risks, 0,5 – existing risks that can disturb the site, 1 - existing risks that can disturb the geo(morpho)logic features of the site, 1,5 – practically no vulnerability of the site		
4.c	Existence of the legal protection	0-1
0 – no protection, 0,5 – existence of the status of the site as Natural monument, Natural reservation or protected landscape area, 1 – existence of National Park		
Threats and vulnerability total score		max. 4
TOTAL SCORE		MAX. 30

This methodology was used for the assessment of selected geomorphosites in the western part of the NP Podyjí. The final part of the assessment was to present proposals for rational use of sites for their conservation and management.

3. Study area

National Park Podyjí is situated in the SW part of South-Moravian Region in Czech Republic (see Fig. 1). The deep incised, canyon-like valley of the Dyje River forms the axis of the National park between the towns of Znojmo in the East and the

town of Vranov nad Dyjí in the West. The relief strongly influenced the human activities in this particular area since the Neolithic. During the medieval time there were border castles built on steep slopes of the Dyje River (Hardegg in Austria, Vranov, Nový Hrádek in Czech Republic). On some slopes, the terraced crop fields and vineyards were situated. In the modern time several mills and paper mills used the waterpower of the Dyje River. Due to Iron Curtain established after World War II, the economic activities in the area were very limited, so the natural values of this area were protected and now the landscape is less damaged than in the other cultural landscapes of the Central Europe.

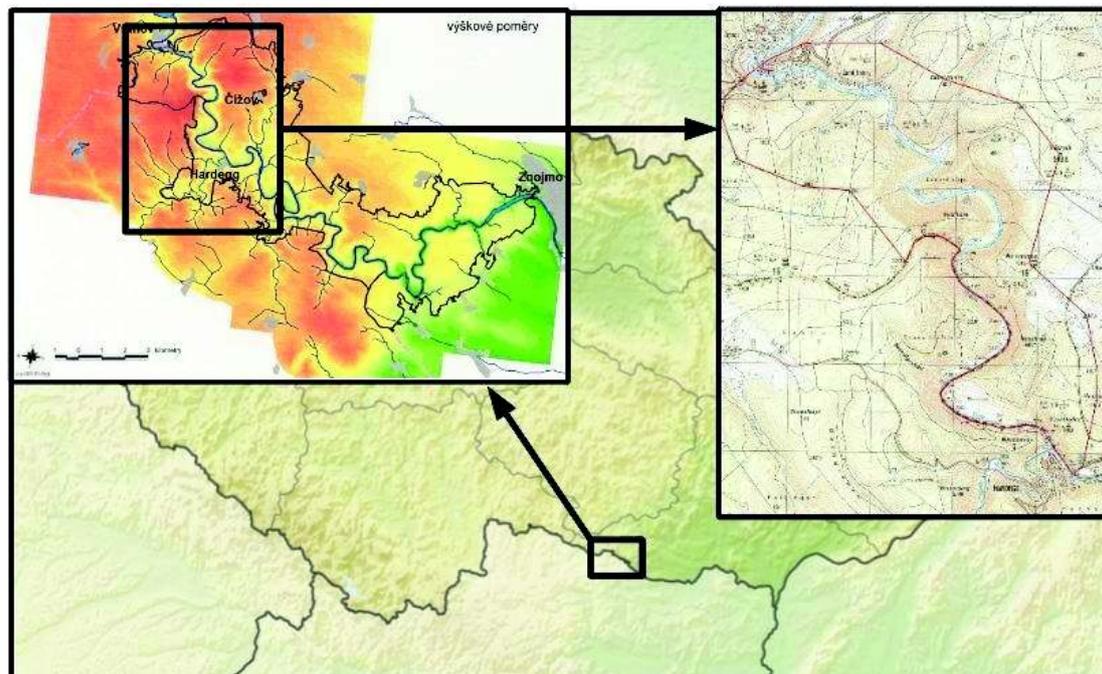


Fig. 1 The localization of study area (source: Administration of Podyjí NP, author)

Political changes in Europe since 1989 have brought the possibility of the evaluation of this area, so the National Park Podyjí was declared in 1991. The protected area of the NP Podyjí reaches 63 km². Natural forests cover about 84 % of the area. The high geodiversity and biodiversity (especially concerning plants and invertebrates) ranges the area among the most naturally valuable territories in the Central Europe.

Geologically, there are three main units in wider area. The Eastern part is created by the core of the Dyje dome, mainly of granite. The division between eastern and western parts makes the Lukov group formed by phylit and mica schist and in the Western part gneiss type Bíteš dominates (BATÍK, 2004).

The deep incised, canyon-like valley of the Dyje valley is the main and unique landscape feature of the National Park. The river enters the Podyjí NP close to the town of Vranov nad Dyjí in Czechia, flows through the town of Hardegg in Thayatal NP in Austria and it leaves the Podyjí NP close to the town of Znojmo in Czechia. The actual length of the Dyje valley on the territory of both Parks is 41.6 km. Three parts with different morphology were distinguished (IVAN, KIRCHNER 1994, KIRCHNER, IVAN, 1998):

- i) The W part incised in the Bíteš orthogneiss between the towns of Vranov nad Dyjí and Hardegg; it is the most incised part of the valley up to 235 m deep;
- ii) The central part which is incised in less resistant two-mica schist of the Lukov unit

(with the important intercalations of marbles); the valley is 120 to 150 m deep, but some slopes are less inclined in comparison with the first part;

- iii) The E part incised into granite of the Dyje Massif is almost 20 km long and the valley depth does not surpass 160 m; steep slopes with many tors and exfoliation forms are accompanied by large block fields, block streams and screes.

The study area itself corresponds with i). The main landformforms in the Western part of Dyje valley are incised meanders, alluvial plains and others typical fluvial landforms, the important feature of relief is also cryogenic relief with forms like large block fields, block streams and screes, rock towers and others. Important features of the relief are also the anthropogenic forms like water-gangs, vineyards, anthropogenic terraces etc. (KUBALÍKOVÁ, 2009).

Selection of significant geomorphologic sites was based on field survey and study of relevant literature. Seven geomorphologic sites were chosen: 1) Ice Caves, 2) Hardegg Lookout, 3) Rock City, 4) Hamry Folds, 5) Castle Rock, 6) Abandoned Meander, 7) Block accumulation at Braitava.

Site No. 1, Ice Caves is important especially for the occurrence of pseudokarst phenomena and extensive block accumulations, so it has a high scientific potential. The aesthetic value is represented by viewpoint near Obelisk that has certain cultural significance as well.

Hardegg Lookout, site No. 2, represents a site with high aesthetic and scenic value thanks to the existence of the valuable overview. It has also a very high potential for tourism because it is one of the best known sites of the western part of the National park.

On the contrary, the site No. 3, Rock City is known only within the researchers; it is situated out of the tourist paths and in fact the access is prohibited. The site is important due to existence of the range of cryogenic, pseudokarst and gravitational forms (torrs, block accumulations, rock towers).

Site No. 4 Hamry Folds is rather geological than geomorphologic site. The main reasons of protection are ptygmatic folds of different scale.

Castle Rock, locality n. 5, is particularly significant because of its high aesthetic and cultural value. The castle situated on the rock is closely related to the geomorphologic form and in the past, its construction was conditioned by the existence of this landform.

Abandoned Meander, locality n. 6, represents fluvial landform that has a very high potential for pedagogic and educational activities. There is a risk of spreading of vegetation that can lead to a degradation of the site.

As the site No. 3, the site No. 7, Block accumulation at Braitava, is situated out of tourist paths, so it is practically unknown and non-visited. It has a high educational and scientific potential.

4. Results

The above-mentioned sites were evaluated, the final results shows Table 2. As can be seen, the Ice Caves (L1) reached a very high score both in scientific and additional values, so it became the most evaluated site within the area. The sites n. 4 and 6 also have an important scientific value, mainly due to its representativity and rarity. On the other side, the locality n. 5 (Castle Rock) does not have so high scientific value, but it has an important additional

value thanks to its historical and cultural importance and high potential for the use thanks to its accessibility. High potential for the use has also site n. 4 (Folds of Hamry) and Ice caves (L1) owing to the proximity of the tourist infrastructure. The less vulnerable are the localities n. 3 and 7 because they are situated out of the reach of the tourist path in the first zone of National Park.

The most evaluated geomorphological localities are L1 – Ice Caves and L4 – Folds of Hamry thanks to the high score of scientific and additional values and L5 – Castle rock thanks to its high potential for the use and high additional value.

On the basis of the inventorying, detailed description and assessment we can do a synthesis: alert to risks or threats, estimate the potential for use and present some proposals for management of the sites:

L1 – Ice Caves are very well preserved especially thanks to the fact that caves themselves are not accessible by public. This site has an extraordinary scientific and pedagogical potential, but in the case of possibility of access to the Caves, significant threats would appear. High potential for educational use can be employed during the organised excursion with a guide.

Aesthetically very valuable locality No. 2 Hardegg Lookout principally suffers from the movement of the tourists out of the marked path and from consecutive degradation of the soil and vegetation cover. This unwelcome phenomenon could be reduced for example by higher frequency of checks guard nature; however, the problem could be the financial possibilities of the National Park Administration.

Site No. 3, Rock City is probably one of the most preserved sites in the western part of the National Park thanks to its inaccessibility. The site has a high potential for educational activities and high scientific and cultural value, but it is relatively remote, so the design and creation of hiking trails would probably need certain financial resource.

Table 2. The evaluation of geoheritage in the Western part of Podyjí NP

Ranking	Scientific value	Additional values	Potential for the use	Threats and vulnerability	Total score
1	L1 (8,5)	L5 (7)	L5 (6,25)	L3 (4)	L1 (21,5)
2	L4 (8,5)	L1 (5,25)	L4 (5,75)	L7 (4)	L4 (20,75)
3	L6 (5,75)	L2 (4,5)	L1 (4,5)	L1 (3,5)	L5 (19)
4	L3 (5,25)	L4 (4)	L2 (4)	L2 (3)	L2 (16)
5	L7 (5,25)	L3 (3)	L6 (4)	L4 (2,5)	L6 (15,25)
6	L2 (4,5)	L6 (3)	L7 (2,25)	L6 (2,5)	L7 (14,25)
7	L5 (3,75)	L7 (2,75)	L3 (1,5)	L5 (2)	L3 (13,75)

The current usage of the site No. 4 (Hamry Folds) is sustainable, even if the existence of the road above the site may cause some problems. Another source of problems can be ingrowth vegetation, according to the Administration of NP this problem is already treated by elimination of undesirable vegetation. The pedagogical potential is supported by information panel so the locality can be used for the education of the public.

Castle Rock (site No. 5) is particularly important in terms of culture. That is why it is mainly used for these reasons (the visit of the Vranov castle). The scientific values of the site are not employed so much. Despite the situation of the site in the first zone of the national park there can be observed camping activities in this area. The solution could be similar as in the case of the site No. 2.

Despite its strong scientific and pedagogical potential value, the Abandoned Meander, site No. 6, is neglected and remains only a short stop on the way from Vranov to the Ice Caves. The reason may be, for example, that the geomorphologic features of the site are partially wiped and distinguished shape gradually overgrows with vegetation.

The locality No. 7, Block accumulation at Braitava offers a considerable educational potential, although it is one of many similar accumulations in the area of interest. It is situated in the inaccessible part of the first zone of the national park as well as Rock City. Given the relative proximity of these sites, there is a possibility to introduce a tourist path (see Fig. 2), or to use both sites for organized geomorphologic aimed guided tours.

In general, from a scientific perspective, the sites have been appreciated for its live component, non-living elements of nature in the context of conservation have not had such attention (there are no care plans for the geologic and geomorphologic sites, these sites are included in the management and care plan of the first zone of National Park). The above mentioned facts propose the question

whether the wider attention should be offered to the geo(morpho)logic components of the sites of interest. After all, it is the geomorphologic and geological component of the landscape, which usually determines all the other components of the landscape.

5. Discussion and conclusion

The proposed methodology for evaluation of geoheritage tried to assess the sites of a geo(morpho)logical interest. In the Western part of the Podyjí NP, the main objective of the inventorying and assessment itself was to evaluate the scientific and added values of the selected sites, to identify potential for use and to propose possible management of these sites. This synthesis was done and some proposals for rational use were presented, although these proposals may not meet with the understanding both the Administration of Podyjí NP and other researchers engaged in this area.

Despite the fact that it would be probably possible to use the proposed methodology to other territories, it should be noted, that in some respects there are some imperfections and defects (for example evaluation of aesthetic sites or objectivity in evaluating the scientific parameters of the site). Consequently, this methodology will be further refined and developed.

As mentioned above, the geomorphologic and geological components usually determines all the other components of the landscape, so they are very important and worthy of protection. Inventory and evaluation of geomorphosites and geoheritage in general may help identify these elements and appreciate its importance for both wildlife and the activities of human society and may thus significantly contribute to the understanding of the need to protect geoheritage.

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¹**Institute of Geonics, Academy of Sciences of the Czech Republic, Branch Brno, Drobného 28, 602 00 Brno, Czech Republic, e-mail: kirchner@geonika.cz**

²**Institute of Geography, Faculty of Science, Masaryk University, Kotlářská 2, 637 11 Brno, Czech Republic, e-mail: LucieKubalikova@seznam.cz**