Mendel University in Brno
Czech Society of Landscape Engineers – ČSSI, z.s.

Public recreation and landscape protection – with environment hand in hand?

Proceedings of the 14th Conference

Editor: Jitka Fialová

9th–11th May 2023, Křtiny

MENDEL UNIVERSITY IN BRNO

Czech Society of Landscape Engineers – ČSSI, z. s.,

and

Department of Landscape Management
Faculty of Forestry and Wood Technology
Mendel University in Brno

Public recreation and landscape protection – with environment hand in hand?

Proceedings of the 14th Conference

Editor: associate Professor Ing. Jitka Fialová, MSc., Ph.D.

9–11 May 2023
Křtiny

Under the auspices
of prof. Dr. Ing. Jan Mareš, the Rector of Mendel University in Brno,
of prof. Dr. Ing. Libor Jankovský, the Dean of the Faculty of Forestry and Wood Technology, Mendel University in Brno,
of doc. Ing. Tomáš Vrška, Dr., the Director of Training Forest Enterprise Masaryk Forest Křtiny, Mendel University in Brno,
of Ing. Dalibor Šafařík, Ph.D., the Chief Executive Office, Forests of the Czech Republic,

of JUDr. Markéta Vaňková, the Mayor of the City of Brno,

and of Mgr. Jan Grolich, the Governor of South Moravia,

south moravian region

in cooperation with Czech Bioclimatological Society, Nature Conservation Agency of the Czech Republic) and Partnerství, o.p.s.,

with the financial support of FS Bohemia Ltd.

The authors are responsible for the content of the article, publication ethics and the citation form.
All the articles were peer-reviewed.

ISBN 978-80-7509-905-1 (print)
ISBN 978-80-7509-904-4 (online ; pdf)
ISSN 2336-6311 (print)
ISSN 2336-632X (online ; pdf)
https://doi.org/10.11118/978-80-7509-904-4

Contents

RISK ASSESSMENT ON GEODIVERSITY SITES

Lucie Kubalíková[1,2], Eva Nováková[1], František Kuda[1], Karel Kirchner[1], Aleš Bajer[2], Marie Balková [2]

[1] Department of Environmental Geography, Institute of Geonics of the Czech Academy of Sciences, Drobného 28, 602 00 Brno, Czechia

[2] Department of Geology and Soil Science, Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemědělská 3, 613 00 Brno, Czechia

https://doi.org/10.11118/978-80-7509-904-4-0258

Abstract

Geoconservation is an action of conserving and enhancing geological, geomorphological, hydrological and soil features and processes. Particular geoconservation measures are very often applied on the site-level to protect important geodiversity sites. Nevertheless, despite established legal protection and related geoconservation activities, threats to geodiversity sites related to the multiple use and human society demands can arise and reaching a compromise can be difficult. In this contribution, a two-level threat assessment is applied and discussed. The first level of threat assessment is based on the already used criteria within geosite/geomorphosite concept. The second level of threat assessment is represented by Risk Assessment Matrix, which may be considered a useful tool providing a complex view on the threats to geodiversity sites. The methods are applied on two different sites and their advantages and limits are discussed. Based on the assessment, specific management proposals may be implemented in order to balance conservation needs and demands resulting from human activities related to the sites.

Key words: geoconservation, risk assessment matrix, degradation risk, geosites, geomorphosites

Introduction

Currently, declaring a natural site or area as legally protected is considered as one of the effective tools of how to protect valuable geodiversity phenomena from negative impacts. However, despite the existing and established legal protection, there is still a range of possible threats to geodiversity and geoheritage, both of natural and anthropogenic origin (Gray 2013, García-Ortiz et al. 2014, Fuertes-Guttiérez et al. 2016, Crofts et al. 2020). Thus, the identification, assessment and management of these threats, risks and conflicts of interests should become an integral part of every geoconservation effort which can contribute to the balance of all the needs and demands on the site or area. In our case study, we use a two-level methodological approach to risk assessment: the first one is represented by assessing degradation risk based on geosite/geomorphosite approach (Selmi et al. 2022) and the second level is represented by assessment of identified threats by using the Risk Assessment Matrix (Kubalíková and Balková 2023). These methods are applied on two different sites situated in the South Moravian Region: Ledové sluje in Podyjí National Park and Rudice-Seč Natural Monument. Based on the results, specific management measures can be proposed and the advantages and limits of both approaches are discussed.

Methods

The method used for this case study consists of the following steps:

1) Description of geodiversity phenomena on the site including the identification of threats (especially based on the fieldwork);
2) Assessment of the degradation risk by using the criteria based on the geosite/geomorphosite concept (Kubalíková and Balková 2023, Table 1);
3) Assessment of the threats to geodiversity by using the Risk Assessment Matrix (Figure 1);
4) Interpretation of the results, proposals for risk treatment, further management and monitoring.

Study areas

The proposed methodological approach is applied on two different legally protected geodiversity sites (Figure 2): Ledové sluje (a site with limited anthropic influence) and Rudice-Seč (a site intensively used by public).

Ledové sluje (“Ice caves”) are situated in the heart of Podyjí National Park (NP) declared in 1991. The site is formed by Bíteš orthogneiss of the Dyje Massive and it is shaped as a rocky spur. On the slopes, numerous cryogenic landforms (frost cliffs, debris fields) can be found. The meandering Dyje River has influenced the static of the slopes and the sequence of subsidence movements occurred

during Late Pleistocene creating numerous cavities and pseudokarst phenomena. Generally, the biodiversity (resp. species diversity) is very high thanks to the diversity of the geomorphological and specific microclimatic conditions: 159 species of lichens, 133 species of moss, 28 species of liverworts, 502 species of vascular plants, 58 species of spiders and 39 species of mammals. The occurrence of 21 relic species of *Araneae* (spiders) and specific case of vegetative reproduction of spruce (*Picea abies*) make the site unique from the biodiversity point of view. Although the site is still affected by active geomorphological processes (e.g. slow slope movements or occasional rock fall; last one in February 2021), they do not disturb the site in general. Currently, the site is not accessible for tourists (Nováková et al. 2018, Reiterová et al. 2022), however it is visited illegally by an average of 50 visitors per month, in exposed months (summer) it is more than double. An interesting fact is that there are some visits even during winter season. The only accessible place within the site is the upper part with a marked path and a viewpoint.

Rudice-Seč is an abandoned sandstone and caoline pit declared as Nature Monument in 2022. So called Rudice Beds lie on an undulating relief with deep karst depressions which are supposed to originate during Lower Creatceous (one of the oldest known period of karstification within the Bohemian Massive). The Rudice Beds consist of remains of laterite-kaolinite weathering products, forming limonite layers at the base which were extracted by prehistoric people already in Halstat period. The layers of kaolinic quartz sands, reddish coloured ferruginous sandstones and colourful kaolinic clays contain numerous flints, hornblende concretions and quartz geodes (so called Rudice balls) which are attractive for mineral hunters. On the upper part, lenticular layers of quartz pebble gravels and loess clays of variable strength appear. The site is important from stratigraphical, paleontological and mineralogical point of view (Czech Geological Survey 2023, AOPK 2022). The bottom of the pit is flooded, creating a specific ecosystem important for protected species (*Bombina bombina*) and suitable for the reproduction of amphibians. The unstable slopes are covered by pioneer vegetation (birches, aspens, pines) and protected *Lycopodium clavatum* can be found here. The site is very well accessible and very often visited by tourists.

Tab. 1: Degradation Risk assessment criteria: each criterion is evaluated on the scale from 0 to 1, a total sum then represents a degree of risk degradation; if the sum exceeds 4.5 points, the site is considered endangered

criterion	scoring
Integrity	0 – excellent conditions; 0.25 – good conditions; 0.5 – medium, average conditions; 0.75 – bad conditions, but with a possibility to recover; 1 – bad conditions, site is damaged
Accessibility	0 – more than 1 km both from a parking place and stop of public transport; 0.5 – the stop and/or parking in the distance 0.2 and 1 km; 1 – the stop and/or parking place no more than 0.2 km from the site
Current threats and their management	0 – site practically not endangered; 0.25 – low anthropic and natural threats; 0.5 – potential threats, but managed well or possible to decrease; 0.75 – current anthropogenic threats but existing plans how to decrease them; 1 – existing and ongoing processes leading to the destruction of the site with no plans to recover
Legal protection	0 – protected on national level; 0.25 – protected on regional level; 0.5 – protected on municipal level; 0.75 – ongoing monitoring of the site; 1 – no legal protection
Proximity to problematic areas	0 – site located less than 1 km of a potential degrading area/activity; 0.5 – site located less than 0.5 km of a potential degrading area/activity; 1 – site located less than 0.2 km of a potential degrading area/activity
Current use	0 – 1 activity; 0.5 – 2 different activities; 1 – 3 and more different activities
Visitation	0 – low; 0.5 – medium; 1 – high
Number of threats	0 – no threat; 0.25 – 1 threat; 0.5 – 2 threats; 0.75 – 3 threats; 1 – 4 and more different threats
Use limitations	0 – the use is very hard due to limitations difficult to overcome (legal, permissions, safety etc.); 0.5 – the site can be used occasionally after overcoming limitations; 1 – no limitations for public use

PROBABILITY					
Highly probable	5 Moderate	10 Major	15 Major	20 Severe	25 Severe
Probable	4 Moderate	8 Moderate	12 Major	16 Major	20 Severe
Possible	3 Minor	6 Moderate	9 Moderate	12 Major	15 Major
Unlikely	2 Minor	4 Moderate	6 Moderate	8 Moderate	10 Major
Rare	1 Minor	2 Minor	3 Minor	4 Moderate	5 Moderate
	Very low	Low	Medium	High	Very high
			IMPACT		

Fig. 1: Risk Assessment Matrix: for every identified threat, the probability and impact is established, the product then indicates the level of risk

Fig. 2: Geodiversity sites: Ledové sluje in Podyjí NP (pseudokarst phenomena), Rudice-Seč NM (kaolinic clays and sands)

Results

For both sites, existing and potential threats have been identified based on the fieldwork and literature review (e.g. Crofts et al. 2020, Kubalíková and Balková 2023 and references therein). The results of the degradation risk assessment and evaluation of particular threats are presented in Table 2 and 3.

The site Ledové sluje has reached a relatively low degree of degradation risk, main identified threats are represented by current use and a number of different threats. However, when looking at Table 3, it is evident that the site is very vulnerable – some potential threats (construction, landuse change) would generate rather higher impact even if their probability is low. In such cases, these threats have to be considered and taken into account. Nevertheless, mainly thanks to the existence of legal protection and official limited accessibility, the risks are on moderate level. The possible solutions can be the fostering nature guides that would give penalties to the illegal entries to the site. Perhaps it would be appropriate to define dangerous and critical places within the site of interest with regard to the stability of rock blocks and walls. Other threats are difficult to influence (e.g. change of mesoclimatic conditions).

Tab. 2: The assessment of the total level of degradation risk (using the concept of geosites)

Criterion:	Int	Acc	Thr	Leg	Prob	Use	Vis	Num	Lim	**Sum**
Ledové sluje	0	0	0.5	0	0	0.5	0.5	0.75	0	**2.25**
Rudice-Seč	0.5	1	0.75	0.25	0.5	1	1	1	1	**7**

Tab. 3: Risk assessment of identified threats (using the Risk Assessment Matrix)

Threat to geodiversity	Prob	Imp	**Sum**	Prob	Imp	**Sum**
	Ledové sluje			***Rudice-Seč***		
Urbanisation, construction	1	5	**5**	2	5	**15**
Mining, re-opening the quarry or pit	n/a	n/a	**n/a**	1	5	**5**
Changes in land use management on site and in close proximity	2	5	**10**	3	5	**15**
Recreation, tourism (littering, breaking the rules)	3	5	**15**	5	5	**25**
Change of mesoclimatic conditions	3	5	**15**	3	5	**15**
Geomorph. processes: erosion, accumulation	4	1	**4**	5	1	**5**
Restoration of pit (landfill, restoration of agriculture or forest land)	n/a	n/a	**n/a**	1	5	**5**
Collecting fossils and rock specimens.	n/a	n/a	**n/a**	3	3	**9**
Confusion in legal protection (different types and authorities)	n/a	n/a	**n/a**	2	4	**8**
Vegetation overgrowth	n/a	n/a	**n/a**	5	5	**25**

The site Rudice-Seč is quite different. Although enjoying the legal protection, there is a very high total sum of degradation risk and two threats may be considered as severe (visitation and vegetation growth). In this case, the urgent action is needed to resolve the possible negative impacts. At first, the visitation needs to be managed well and it is necessary to ensure following the rules (including the entries outside the marked paths or prohibition of bathing in the pond, which disturb the amphibians and other species). The natural erosion is not considered an important threat here as it enable the renovation of the Earth Science phenomena. However, the vegetation growth can obscure the phenomena and contribute to disappear it. The possible solution is to regularly cut the overgrowing trees and maintain the good visibility of the Earth Sciences phenomena. Other threats are represented by urbanisation and changes in landuse in the surrounding area which may generate higher pressure on the site (both resulting from the higher visitation and changes of natural conditions). Mesoclimatic conditions may change as well, especially due to the long lasting droughts – this does not endanger the Earth Science phenomena so much, but the fragile ecosystems and protected species may suffer. Mining or re-opening the quarry may be considered a moderate threat – although the site is protected according to Nature conservation Act (114/1992 Coll.), the protected deposit area according to the Mining Law (44/1988 Coll.) is still valid. There is a very low probability of this threat, but in the case of its realization, the site would be heavily damaged. The same apply for restoration and landfill. A related threat is represented by confusion of different types of protection and de facto two different authorities that somehow manage the site (Nature Conservation Agency and Mining Office).

Discussion and conclusions

The assessment of risk degradation based on geosite concept represents a quite useful tool which enable to evaluate the total degree of risk on the site, but it does not allow to prioritize the particular threats. For this purpose, it is suitable to use the risk assessment matrix where we can simply evaluate the degree of particular threats; it allows to see which threat is urgent and may have significant impact on the site's geodiversity. The method also allows to estimate the degree of vulnerability of the site which may be less obvious when applying just geosite approach. Thus, when assessing the degradation risk on sites, a traditional geosite approach should be complemented by the risk assessment matrix.

In this preliminary study, both approaches have been applied on two different geodiversity sites. The main threats have been identified and prioritized and possible solutions have been proposed. Ledové sluje (Ice Caves) are less endangered, however, it is suitable to continue watching the illegal visitations and follow some recommendations (e.g. fostering nature guides) taking into account a very high vulnerability of this site. Rudice-Seč NM is more endangered and some of the threats are necessary to resolve as soon as possible (especially vegetation overgrowth or high visitation and related pressure on site). However, to effectively manage the threats, it is suitable that all the stakeholders involved in this site cooperate, be they nature conservation institutions, universities, owners, municipalities and local public. Also, environmentally educative activities (information panels, geoeducation programmes) may contribute to the better acceptation of the proposed measures and to balance conservation needs and human activities on site.

References
AOPK – Nature Conservation Agency of the Czech Republic (2022). Plán péče o přírodní památku Rudice – Seč na období 2022–2032. AOPK ČR.
Crofts R, Gordon JE, Brilha J, Gray M, Gunn J, Larwood J, Santucci VL, Tormey D, Worboys GL (2020) Guidelines for geoconservation in protected and conserved areas. Best Practice Protected Area Guidelines Series No. 31. Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2020.PAG.31.en
Czech Geological Survey (2023) Significant geological localities of the Czech Republic. http://lokality.geology.cz. Accessed 26th March 2023
Fuertes-Gutiérrez I, García-Ortiz E, Fernández-Martínez E (2016). Anthropic Threats to Geological Heritage: Characterization and Management: A Case Study in the Dinosaur Tracksites of La Rioja (Spain). Geoheritage 8, 135–153. https://doi.org/10.1007/s12371-015-0142-3
García-Ortiz E, Fuertes-Gutiérrez I, Fernández-Martínez E (2014). Concepts and terminology for the risk of degradation of geological heritage sites: fragility and natural vulnerability, a case study. Proc Geol Assoc 125:463–479. doi:10.1016/j.pgeola.2014.06.003
Gray M (2013). Geodiversity: Valuing and Conserving Abiotic Nature. Second Edition. Chichester: Wiley-Blackwell.
Kubalíková L, Balková M (2023). Two-level assessment of threats to geodiversity and geoheritage: A case study from Hády quarries (Brno, Czech Republic), Environmental Impact Assessment Review 99, 107024, https://doi.org/10.1016/j.eiar.2022.107024
Nováková E, Kuda F, Kubalíková L (2018). Tourist interest in illicit zone of Ice Caves. In Public recreation and landscape protection – with nature hand in hand! Conference proceeding, Mendel University in Brno, pp 408-413.
Reiterová L ed. (2022). Zásady péče o Národní park Podyjí a jeho ochranné pásmo. Správa Národního parku Podyjí, Znojmo, 2022.
Selmi L, Canesin TS, Gauci R, Pereira P, Coratza P (2022). Degradation Risk Assessment: Understanding the Impacts of Climate Change on Geoheritage. Sustainability 14(7):4262. https://doi.org/10.3390/su14074262

Acknowledgement
This work was supported by the programme “Dynamic Planet Earth” of the Czech Academy of Sciences – Strategy AV21.

Souhrn
Příspěvek se zabývá hodnocením hrozeb a rizik na geolokalitách. Prvním krokem je podrobný terénní průzkum včetně identifikace možných hrozeb, následuje zhodnocení pomocí vybraných kritérií (vycházejících z metodiky geomorphosites), rizika a hrozby jsou také analyzována pomocí matice rizik (pravděpodobnost a dopad hrozby). Metodický přístup je aplikován na Ledových slujích v NP Podyjí a v rámci nově vyhlášené PP Rudice-Seč. Na základě hodnocení jsou navržena opatření, která mohou přispět ke zmírnění dopadů hrozeb, případně rovnou k jejich eliminaci.

Contact:
RNDr. Lucie Kubalíková, Ph.D. et Ph.D.
E-mail: Lucie.Kubalikova@ugn.cas.cz

Title: **Public recreation and landscape protection – with environment hand in hand?**
Proceedings of the 14th Conference
Editor of the proceeding: associate Professor Ing. Jitka Fialová, MSc., Ph.D.
Publisher: Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czechia
Print: Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czechia
Edition: 1st Edition, 2023
No. of pages: 392
No. of copies: 75
ISBN 978-80-7509-905-1 (print)
ISBN 978-80-7509-904-4 (online ; pdf)
ISSN 2336-6311 (print)
ISSN 2336-632X (online ; pdf)
https://doi.org/10.11118/978-80-7509-904-4