Department of Landscape Management FFWT
Mendel University in Brno

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

Conference proceeding

5th – 6th May 2014
Křtiny

Under the auspices
of Petr Horáček, the Dean of the FFWT Mendel University in Brno,
of Richard Brabec, the Minister of the Environment,
of Michal Hašek, the Governor of the South Moravia Region,
and
of Roman Onderka, the Mayor of the City of Brno.

in cooperation with Czech Bioclimatological Society, AOPK ČR (Agency for Nature Conservation and Landscape Protection of the Czech Republic) – Administration of the Moravian Karst Protected Landscape Area, Training Forest Enterprise Masaryk Forest Křtiny, Administration of Caves of the Czech Republic, Czech Society of Landscape Engineers and Czech Environmental Inspectorate

with the financial support of the City of Brno

B R N O

and FS Bohemia Ltd.,

FS Bohemia, s.r.o.

The conference is included in the Continuing Professional Education in Czech Chamber of Architects and is rated with 3 credit points.

The authors are responsible for the content of the article and the citation form.

Editors of the proceeding: Ing. Jitka Fialová, MSc., Ph.D.; Dana Pernicová
ISBN 978-80-7375-952-0

Contents

A NATURE PARK "THE MEANDER OF THE OHŘE RIVER" AN EXAMPLE OF CONNECTION BETWEEN RECREATION AND NATURE PROTECTION

Pavla Pilařová, Kristýna Bláhová
Mendel University in Brno

Abstract
Revitalisation of watercourses flowing through towns and cities is a relatively complicated issue, which requires cooperation of experts from different fields of specialization. Watercourses revitalisation in urban areas is still a long term commitment in the Czech Republic, although examples of restoration practice in urban areas in our country are gradually appearing nowadays. Successfully established projects can be found, followed by other watercourse revitalisations in preparatory process. A nature park "The meander of the river Ohře" is an example of established urban riverine area revitalisation in the town Karlovy Vary. Following article describes the revitalisation project and approach to integrate urban riverine area revitalisation principles.

Key words: watercourses, urban areas, revitalisation, restoration

Introduction

During the past years our cities have been increasingly fragmented by motorways, which results in diversion of the city into partially enclosed segments. Rivers, which were due to practise in former times, isolated from their sorroundings by steep slopes or abutment walls, play important role in the fragmentation of the urban environment. Therefore the main focus of revitalization of watercourses in the urban point of view is to restore the urban continuum along the river as well as across the river and its floodplain. Integration of the river into the urban structure of a town helps to restore functions of the river and the riverine areas in order to create major green element of a town. Connection of the two banks of the river including public areas secures continuous urban territory. Such concept requires respecting the usual structure of a town, where the build up area in the center is more dense than in the suburbs. Therefore the aspiration in the center of a city is to create riverine zones of urbanized character – embankment, further from the center towards the suburbs transgress to establishment of nature-like character of the river and to restore nature character of watercourses with respect of the landscape character of the whole floodplain of the riverine areas outside the urban areas. The river and the riverine area should therefore become a significant part of a city, which has a positive effect on the character of a city and increases the functional potential of the area for recreation, sport and social life.
The realization of the project called „Meander of the river Ohře in Karlovy Vary" commenced in 2010. The aim was to establish a nature park in the biocenter of the local ecological stability network of the landscape called „Tuhnický meander". The location and area of the Tuhnický meander premised establishment of nature-like revitalization with emphasis on the recreation potential of the locality. Presented article provides information about limitations and requirements, which were superimposed on the design of the nature park, states how were the requirements dealt with and reports whether the declared ecological/recreational function of the design was fulfilled.

Materials and methods

Tuhnický meander is located at the cadastral area of Tuhnice within the district of administration of the town Karlovy Vary. It is a meander of the Ohře river under the weir of Tuhnice of the fluvial chainage of 178,3 km west of central part of the town Karlovy Vary. The area of the meander used to serve as horticulture, later when the horticulture production terminated, ruderal brushwood and herbage with agressive spreading started to grow on the location (Hogweed *Heracleum mantegazzianum*, *Reynoutria*). Illegal dumping ground was also found there.

The investor – „Správy lázeňských parků Města Karlovy Vary" was concerned to establish a multifunctional area with ecological as well as recreational function.

Territorial, technical and legislative limits:

- The water supply from the river Ohře is possible only through pumping due to heights of the terrain and reduction of the volume of groundwork.

- Aerial piping of VHV 110 kV and HV 22 kV crosses the location, present are: telecommunication cable, gas conduit, territorial reserve of railway and extension of the motorway I/6 along the area – it is required to respect the conditions of each administrator of traffic and technical infrastructure and administrators of engineering networks.
- The locality is situated in protected area IIA natural healing resources – under obedience of the law No. 164/2001 Sb., Lázeňský zákon (Health resort law).
- Integration of local biocenter No. 11 „Tuhnický meander" into biocorridor of superior denotation K 108 „Ohře" – under obedience of the law No. 114/1992 Sb., o ochraně přírody a krajiny (Nature and landscape protection).
- The entire meander is located in the active flooding zone of the river Ohře and inundation occurs already at Q_{10} „decennial runoff flow" – under obedience of the law No. 254/2001 Sb., o vodách (Waters).

Perspective of the territory:
- The lands are mostly owned by the town of Karlovy Vary – easier enforcement of the project and cost reduction on the purchase of the lands.
- Major cycleway of the Karlovy Vary region – extension.
- Water tourism – the river area becomes more attractive as path for paddlers.
- Stream territory for high number of residents of the town Karlovy Vary – predisposition of recreational potential.
- Accessibility from the spa center of the town – attraction for tourists.
- Educational and instructional function – creation of educative footpath.

It was necessary to create a design, that will meet all the requirements and conditions resulting from the territorial, technical and legislative limitations and will make use of the potential of the area. Therefore such design has to be a compromise between all desired functions of the locality (water management, ecological, recreational, aesthetical and urban).

Results

The most complicated problem was to develop a design, that would respect the flood protection (improvement or preservation leastwise) and nature protection (area marked out for integrated local biocenter (LBC)) as well as the condition of the recreational potential of the locality. This fact played major role in the schedule of the preparation and realization of the project, as preparation part of the project commenced in the year 2006, while the contractor was chosen in the year 2009 and the nature park was realized and open for public during the year 2010.
The areas determined for the localization of the outplanting in range of the design of the local biocenter LBC 11 „Tuhnický meandr" were found with difficulties. The areas were a result of intersection between each technical limitation (protection areas of traffic and technical infrastructure and engineering networks) and areas marked out for recreation and water components. The outplanting of tree species, shrubby species and herbaceous species were proposed in respect of the character of the locality in order to support development of nature-like biotops specific for the particular locality.

The final design of the nature park „Meander of the river Ohře" (Fig. 1) occupies area of 8,65 ha and combines following components:
- 2 water sheets and Artificial watercourse called Oharecký (the aim is to establish components of standing waters and flowing waters) – water is being pumped from the river Ohře
- Sport and Cycleway, Central path and Riverbank footpath.
- Playground and Sportground
- Sunbathing moles
- Willow arbours
- Educational footpath
- Vegetation components (outplanting and grassing)

Total cost of realization was set at 22,9 mil. CZK, from which 92,5 % of eligible costs was reimbursed by the Europian union (Integrated town development plan).

Conclusion

Revitalization of rivers and streams in towns comprises of wider range of activities and goals, than revitalization of watercourses in open landscape, where the main focus is ecological and biological restoration of the watercourse. Revitalization measures of watercourses in town environment require balance between variety of factors. Generally such projects comprise of:

- Partial naturalization of the river or stream according to local conditions and possibilities,
- Improvement or respect of flood protection of the build up area,
- Accesing of the watercourse and waterside zone for the residents and its integration into the urban structure.

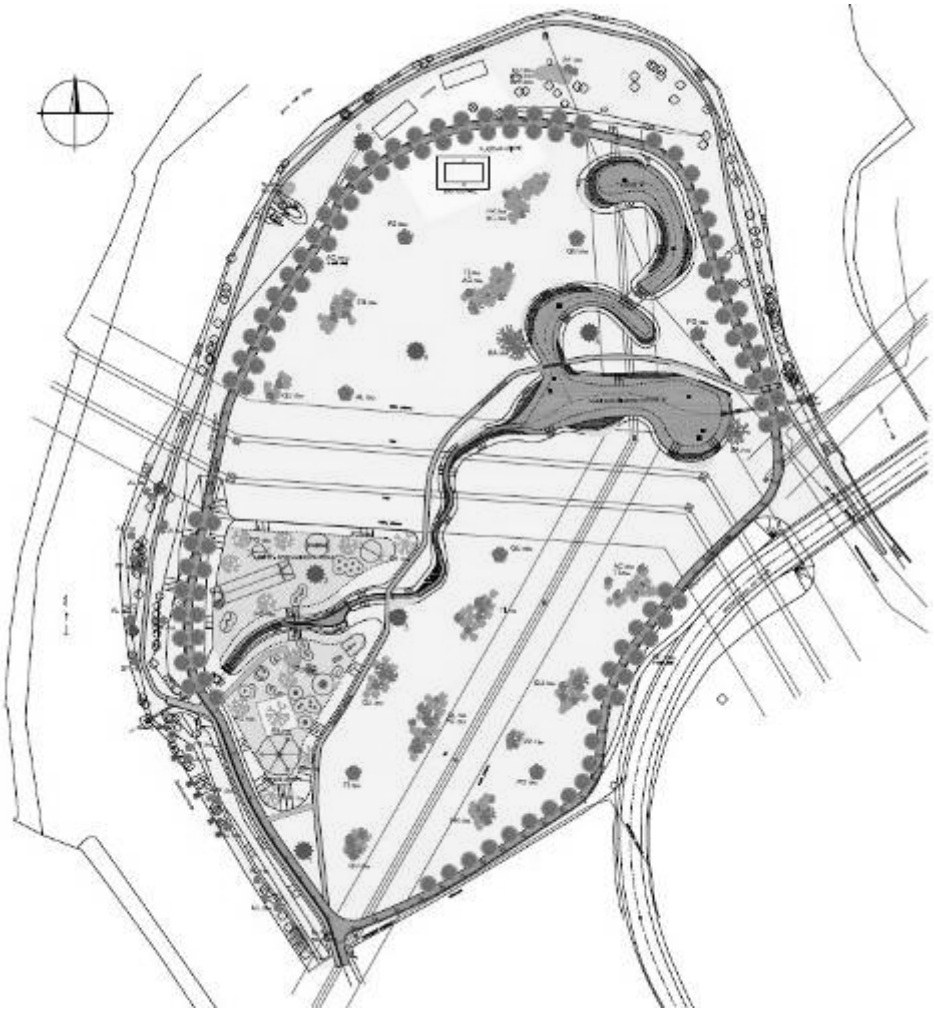


Fig. 1: The proposal of a nature park „The meander of the river Ohře“ (Ekologická dílna Brno)

Implementation of the principles of revitalization modifications of watercourses in urban area in range of nature park „Meander of the river Ohře“

Unfortunately the project did not deal with the revitalization of the meander of the river Ohře alongside the nature park (as it was not part of the project), in spite of the fact that there is a need to revitalize the watercourses in urban areas. The question of revitalization of the watercourses in urban areas still requires a long-term commitment in the Czech Republic. Although realized revitalizations abroad can serve as good experience, the administrators of watercourses prefer technically modified river basins with reference to secure flood protection of the build up area and simplicity of maintanance. Sunbathing moles were installed on the west side of the park to support approximation of the visitors to the river Ohře.

The entire area of the park is located in the active flooding zone of the river Ohře and already Q_{10} „decennial runoff flow“ floodes out the area. The possibility of using the area of the meander for retention of flood flow rates would be completely ineffective and would not meet the requirements of the nature protection and recreational function of the nature park. Terrain

arrangements were designed in order to preserve the current flood protection measures. Thanks to the creation of the Artificial watercourse and the two water sheets, two components of standing and flowing water were implemented into the nature park, which supports empowerment of natural (creation of water biotops) and recreational function. The active flooding zone also defines the territorial limitation of the vegetation outplanting and the character of it (reduction of shrubby vegetation and localization of the tree vegetation out of the flood water direction). It is necessary to state, that due to current legislation it is not possible to establish parallel woody growth within the active flooding zone. Proposed outplanting emulated the condition of establishing local biocenter LBC 11 „Tuhnický meandr". Benches, dustbins etc. are absent within the entire area of the nature park and all the constructions were designed in a way, that they can be carried by the flood water without worsening the volume of the flood water.
The installation of the educational footpath provides the educational and instructional function of the nature park „Meander of the river Ohře". The visitors get to know the phenomenon occuring in the park during the year within few stops in comprehensible manner.

Although the options were limited by numerous factors, it was possible to create a revitalization of the river Ohře floodplain in a nature-like character with combination of nature protection and recreation. Realized nature park can serve as inspiration for future projects in major towns.

Nature protection vs. Recreation in nature park „Meander of the river Ohře" in time
The nature park fulfilled all the recreational expectations. Landscaping made good use of the recreational potential of the area and provided a ground for leisure activities and increased attractivity of the area for everyday tourism not only for the local residents but also for visitors of the town Karlovy Vary.
The proposal of the design did not introduce the possibility to install benches, dustbins etc. (due to the fact that the area is in the active flooding zone and also to create an impression of free landscape inside town to support the role of nature protection). Unfortunately during the year 2011, were the contractors informed about negative public acceptance and so for the summer season 2013 mobile shop and mobile toilets were placed in the park. The visitors were not satisfied with the fact, that the footpath from nearby parking lot is not passable with roller skates and that the parking lot itself does not have strenghtened cover. Also these complaints were complied with and during the year 2014 the current stage will be modified.
Concerning the fact that the nature park „Meander of the river Ohře" is located in the urban area relatively close to the spa center of the town and it is easilly accesible by bike and car, the pressure on recreation function will always be greater than that of nature protection.Though the aim should be to situate the recreation components into areas marked out for it in order to preserve the nature.

To evaluate the effect of the nature park „Meander of the river Ohře" on the nature protection and fulfilment of the local biocenter after 3,5 years is not possible. The only possible evaluation can be done on the state of the outplanted vegetation and grassing. The realization seems to be successful and though in 2011 the area was affected by flood, the vegetation nor the grass was destroyed. During summer period the water sheets suffer from outgrowth of algae and water bloom. Such phenomenon was expected and i tis supposed to stop once the water biotops are stabilized.

References
ATELIER FONTES, s.r.o., 2008. Meandr Ohře v Karlových Varech – project documentation
Ekologická dílna Brno, 2006. Meandr Ohře v Karlových Varech – nature park study

Acknowledgement
Presented paper was ensued mainly thanks to support of the company ATELIER FONTES, s.r.o., which also provided part of the documentation.

Souhrn
Revitalizace řek a potoků ve městech zahrnují širší okruh činností a cílů, než je tomu u revitalizací vodních toků ve volné krajině, kde převládá biologická či ekologická obnova toku. Revitalizační úpravy vodních toků v městském prostředí by měly sledovat více složek, které by měly být vzájemně vyváženy, obecně by pak měly zahrnovat:

- dílčí zpřírodnění řeky či potoka dle místních podmínek a možností,
- zvýšení či respektování protipovodňové ochrany sídla,
- zpřístupnění toku a pobřežní zóny pro obyvatele a jeho začlenění do urbanistické struktury.

Zahrnutí principů revitalizačních úprav vodních toků v městském prostředí v rámci přírodního parku „Meandr Ohře

Samotná revitalizace meandru řeky Ohře podél přírodního parku nebyla projektem řešena (nebylo to součástí zadání projektu), což můžeme vnímat záporně (z pohledu snahy revitalizovat vodní toky v rámci urbanizovaného území). Otázka revitalizace vodních toků v urbanizovaném prostředí je stále během na dlouhou trať na území České republiky. Správci vodních toků i nadále preferují technicky upravená koryta s odkazem na zaručení protipovodňové ochrany zastavěného území a jednoduchosti údržby, i přes zkušenosti z realizovaných revitalizací, které mají jejich zahraniční kolegové. Pro přiblížení návštěvníků se samotnou řekou Ohře byly alespoň nainstalovány v západní části přírodního parku dřevěná opalovací mola.

Celá plocha přírodního parku se nachází v aktivní zóně záplavového území řeky Ohře a již při Q_{10} „desetileté vodě“ dochází k zaplavení celého území. Případné využití plochy meandru pro retenci povodňových průtoků by bylo vzhledem k ploše meandru naprosto neefektivní a dále by nebyly splněny požadavky na ochranu přírody ani na rekreační funkci přírodního parku. Terénní úpravy byly navrženy tak, aby stávající protipovodňová ochrana byla zachována. Díky vytvoření umělého Ohareckého náhonu a 2 vodních ploch byly do přírodního parku začleněny vodní prvky stojatých i tekoucích vod, což vede k posílení přírodní (tvorba vodních biotopů) i rekreační funkce. S aktivní zónou záplavového území souvisí i prostorové omezení vegetačních výsadeb a volba jejich charakteru (omezení keřů a rozmístění stromů tak, aby nebránily průtoku povodňové vlny). Je nutné konstatovat, že právě díky stávající legislativě není možné v aktivní zóně záplavového území vytvořit zapojený dřevinný porost. Navržené výsadby se tak snažily maximálně naplnit podmínku tvorby lokálního biocentra LBC 11 „Tuhnický meandr“. V celé ploše přírodního parku nebyl osazen městský mobiliář (lavičky, odpadkové koše, atd.) a veškeré konstrukce byly navrženy tak, aby byly odplavitelné nebo nezhoršovaly průtok povodňové vlny.

Díky instalování naučné stezky, plní přírodní park „Meandr Ohře“ i výchovnou a vzdělávací funkci. Návštěvníci přírodního parku se během několika zastavení dozvědí srozumitelnou formou vlastnosti a děje, které lze na území meandru během roku pozorovat.

I přes všechny limity, které musely být v návrhu přírodního praku „Meandr Ohře“ respektovány, byla vytvořena revitalizace poříční nivy Ohře přírodě blízkého charakteru s vhodným propojením ochrany přírody a rekreace. Realizovaný přírodní park může být inspirací pro budoucí revitalizace vodních toků a jejich okolí na území našich ostatních větších měst.

Ochrana přírody vs. rekreace v přírodním parku „Meandr Ohře“ s odstupem času

Z rekreačního pohledu splnil přírodní park všechna očekávání. Krajinářská úprava využila rekreačního potenciálu území a svým charakterem poskytla zázemí pro nenáročné pobytové a herní aktivity a zvýšila atraktivitu území pro každodenní rekreaci a volnočasové aktivity nejen místních obyvatel, ale i návštěvníků města Karlovy Vary.

V návrhu přírodního parku nebylo počítáno s instalací městského mobiliáře (z důvodu umístění plochy v aktivní zóně záplavového území a také aby i v městském prostředí si návštěvníci uvědomovali, že jsou v přírodním parku, kde ochrana přírody hraje také svou roli). Bohužel již během roku 2011 zaznívaly negativní ohlasy z řad návštěvníků. Proto byl na letní sezónu v roce 2013 do přírodního parku umístěn mobilní kiosek společně s mobilními toaletami. Dále se návštěvníkům nelíbilo, že s přilehlého parkoviště nemohou na kolečkových bruslích sjet přímo na sportovní stezku a že parkovací plocha nemá zpevněný povrch. I v tomto případě se návštěvníkům a rekreačnímu využití přírodního parku vyšlo vstříc a během roku 2014 dojde k úpravě stávajícího stavu.

Vzhledem k tomu, že se přírodní park „Meandr Ohře“ nachází v urbárnním prostředí, v relativní blízkosti vlastního lázeňského centra města a je lehce dostupný na kole i autem, bude tlak na rekreační funkci vždy převládat nad ochranou přírody. I přesto by mělo být snahou, všechny ústupky vůči přírodě situovat do ploch, které pro rekreaci byly vyčleněny (a tomu se tak i děje).

Vyhodnotit efekt přírodního parku „Meandr Ohře“ na ochranu přírody a plnění funkce lokálního biocentra již po 3,5 letech od realizace celého záměru nelze. Lze pouze vyhodnotit, v jakém stavu jsou provedené výsadby a zatravněné plochy. Z prvních náznaků lze realizaci hodnotit pozitivně a i přes povodeň, která v lednu 2011 územím prošla, nedošlo k poškození výsadeb ani zatravnění. Vodní plochy trpí v letním období zarůstáním řasami a vodním květem. Tento jev se dal očekávat a předpokládá se, že až dojde k ustálení vodních biotopů, zarůstání přestane.

Contact:
Ing. Pavla Pilařová
Mendel University in Brno
Faculty of Forestry and Wood Technology
Department of Landscape Management
Zemědělská 3, 613 00 Brno
pilarova.pavla@gmail.com

Ing. Kristýna Bláhová
Mendel University in Brno
Faculty of Forestry and Wood Technology
Department of Landscape Management
Zemědělská 3, 613 00 Brno
kristynablahova1@gmail.com

A PROPOSAL FOR THE TOURISM ATTRACTION IN THE SOUTH-WEST PART OF SLOVAK AGRICULTURAL LANDSCAPE

Andrea Jakubcová, Henrich Grežo, František Petrovič
Constantine the Philosopher University in Nitra

Abstract
The term of tourism contents many approaches and interdisciplinary scientific points of view. In the frame of multi-dimensional conception it is necessary to set apart more dimensions of studying. In our article we aim to show, which physical - geographical (PG) factors and landscape features impact to the possibilityof a country to perform tourism in Slovak rural space. On the example of chosen cadastral territory of the Kamenica and Hronom and Chľaba villages, we tried (with special methods of graphical and geographical visualization) to make a proposal how to improve such kind of rural space and make it more attractive for potential tourism. We explored, whichPG parameters are related to the level of space attraction in specific part of the agricultural landscape in the SW Slovakia, and how they are related spatially to each other. From these graphical results we tried to make some new proposal of two operating version of nature trail in two mentioned cadastral territories, which would be situated in "Burda" national natural reserve. Finally in the frame of this trail proposal, we created some factual arrangements,which could be necessary as for practicingpotential forms of tourism in this part of rural space.

Key words: tourism, slovak rural space, physical-geographical parameters, nature trail, national natural reserve of Burdov

Introduction
A solution of problems resulting from the anthropogenic pressure on the country requires itself a complex and integrate (geosystemic) approach. In the last years uprises an endeavour to solve this problem by means of complex assessment and evaluation of landscape changes, its reasons and consequences. One of the targets of this approach is to set apart the limiting, inhibiting, but also potentially stimulating factors for sustainable development of tourism in researched territories.
In our paper we proposed 2 alternatives of educational trail, which could mean an attraction improvement of rural SW part of Slovakia. This region is typical of dominant features of agricultural landscape. The nature of this territory (highlands), in otherwise lowland Slovak area, would so be kept. The territory of volcanic mountains of Burda (National Natural Reserve Burda) on the close interface between the Danube and Ipeľ rivers is typical on a relative small cross-sectional area with a big landscape types and structures diversities, included the specificity of its natural features. These factors of this original territory we tried to emphasize in this paper.

Territory deffinition
The object of our research is territorially defined by the National Natural Reserve Burda (NNR Burda), which extends in cadastral territories (c.t.) of Chľaba and KamenicanadHronom villages and gradually passes in the north of c.t. Chľaba with oak and hornbeam forests biotopes into the NNR Leliansky forest in the c.t. of Leľa. The researched territory covers a part of SW Slovakia (in the SE outshoot of NovéZámky district) (Fig. 1).
Region is typical with 3 basic features creating its significant specificity:
- It is surrounded from the Slovak side with an agricultural land (Danubian lowland, parts of Danubian plains and Danubian uplands).
- It is a border and rural territory on the south of Slovakia, bordered with Hungary, and a border line creates 2 important rivers Danube and Ipeľ and their confluence. The east border line passes as the continuation of the Burda Mts. in the Hungarian side.
- Physical-geographical (PG) conditions of the region are on the small space very diverse and contrastive. This fact corresponds also an appearance of forests biotopes(forest steppe and xeroterm (dry) steppe vegetation).

Fromlitogeographical point of view, our territory of Burda belongs between the voulcano Mts. As for the geomorphological classification one part of our region belongs to the Alppine Himalayan System, within it a smaller part to the subsystem of Pannonia basin, West - Pannonia basin province, subprovince Small Danube Plain, Danubian land territory, Danubian uplands unit, part Ipeľ (Mazúr, Lukniš, 1980). NNR Burdov itself belongs to the Carpathian subsystem, West-Carpathia province, Matransko-slanská territory, unit of Burda, part Visegrad gate (Mazúr,

Lukniš, 1980, with AKSR 2002verifikation).Burda creates one gemophological - phytogeographical unit with the volcanic Mts. Börzsöny in Hungary, which is the continuation of Burda Mts. in Slovak territory. Burda also creates a small but important geomorphological floe, separated with riverIpeľ from Danubian lowlands in the form of volcanic Mts. The highest point of Burdais Burdov hill (388 m.a.s.).
According to the climatic-geographical types (Tarábek, 1980, modified with AKSR, 2002)we include smaller part of the region to the type of lowland clima (dry or gently dry), subtype of warm and predominantly warm clima, with the annual rainfall 550 - 700 mm in higher uplands, or lower submountain areas of Burda Mts. Larger part of Burda Mts. belongs to the type of mountain clima, its warm subtype, with relatively dry features and with the average annual rainfall 600 - 800 mm (taking into the account the microclima of particular localities). A significant climatical phenomenon in S-SW part of Slovakia is the draught. This represents a phenomenon, which appears in different climatical zones, in different time and with different duration. The aridity is in unregular periods 3 - 5 years changed with the extreme floods phenomenons. Similarly, insufficiency of snowpack in winters 2011/2012and 2013/2014in the SW Slovakia and only sporadical appearance of atmospheric precipitation in summer time also provoke the strong drying of the natural environment (Annual report of Slovak hydrometeorological institute, 2012, Annual report from Agrometeorology, 2008).
Biogeographical term conditionresult from the fact,that the whole territory belongs surfacely to the Pannonian flora *(Pannonicum)*, the Europannonianxeroterm flora *(Eupannonicum)* (Futák, Čepelák, 1980), Danubian lowland flora district. The whole part of NNR Burdov belongs to the *Matricum*flora zone, district of Burda(Futák, 1980, Maglocký, 2002). Many plant species appearing here are typical with the feature, that vegetation in this region reaches the northest border its Pannonian expansion. An inclusion of fauna according to the territorial classification roughly follows the two upmentionedfytogeographical regions and it is substancially identical with them. We can observe, that our region is located in terrestrial steppe biocycle, in its pannonian sector and to this fact relates also an appearance of fauna and flora species (Jedlička, Kalivodová, 2002).Small and large protected areas in this space according to the actual evidence of Slovak environmental agency and territorial environment protection portal in Slovakia, are as follows:Burdov is a national nature reserve launched in year 1966 still entitled "Kováčovskékopce – south", actually with validity in 5th degree of territorial protection. The administration of assets is State nature protection of Slovakia, affiliation of Danubian floodplains protected area (CHKO Dunajskéluhy), in total acreage 364,14 hectares (http://uzemia.enviroportal.sk/, 2014, www.soprsr.sk, 2014). As for Natura 2000 protection sites system, Spetial protection areas (SPA) don't cover territorially any part of our region. According to the Regulation of Ministry of Environment of SR No. 3/2004-5.1 on National list of proposed Sites of Community Importance, Annex No. 1,are also some of these Burda habitats protected. There occur Pannonian rocky steppes and salt marshes, natura eutrophic and mesotrophic waters, Pannonian grasslands - loess grasslands, thermophilousPannonian oak and oak - Quercuscerris forests, floodplain willow - poplar and alder forests, floodplain forests of oak and elm ash and pannonian oak and hornbeam forests. On the researched territory appear also protected species of plants and animals according to the Decree of Ministry of Environment SR No. 24/2003 implementing Act No. 543/2002 on Nature and Landscape Protection in the last years.

Hypothesis and research objectives
Physical-geographical parameters of a given territory may the potential of tourism either develop, sustain, or thynaturaly develop as unsufficient. From this assumption we have set a hypothesis, that:
"Physical-geographical parameters of the territory significantly affect the tourism possibilities. Human-geographical structure (tertial structure included), tourism market requirements and environmental awareness either stimulates, or inhibatesthem".
The hypothesis we tried during the terrain research either confirm, or neglect. As case region we chose 2 different (as or the diversity, status of municipality and its administrative machinery importance) ecotops: Burda Mts. and Danube and Ipeľ rivers confluence, which cover a part of the cadatral territories KamenicanadHronom and the whole c.t. Chľaba (Fig. 1, Fig.4a/).This region we tried to make more attractive with a proposal of a new educational-scientific trail as the special research site in the Burda Mts. and also the second alternative - continual transitionthrough the meadows (grassland formations) till to floodplain forest by the Danube - Ipeľ confluence.

Materials and methods

The approaches to scientific tourismstudies focusing on PG features, size and quality of environment, are different. The reason of this fact isa necessity of interdisciplinary way of studying closely connected with a different understanding of the term “good terms for tourism development”. This topic is therefore multidimensional. An initial methodical step was to take into the theoretical account the general conceptual structure to the tourism studies, modify it and create similar, but on our regional condition set up model of tourism examination, on the case of 2 chosen upmentioned c.t. We tried also to focus on such tourism exploring, which doesn’t forget the basic and important principles of positive agro-environmental government policy, with an active participation of local inhabitants and existing action groups(Bezák a Petrovič 2006). The relation between the area acreage and the environmental quality may have several levels of research. We based our on assumptions, that in case, that PG factors are not satisfactory, or occur the space overcrowding, this reduces also the possibility of better quality of life with sustainable development principles. For that reason we chose components, which partially or totally entering the tourism potential relevance:

- Natural resources, that we were able to identify in the territory (water, energy, nutrients, some part of mass circulation,
- Natural environment factors: attractiveness of the environment, suitable/unsuitable for tourism, biotic and abiotic formations, microclimatical specificity, traditional landscape types, protected areas.

In the case of ecological and environmental aspect of tourism research, we followed such indicators, which might have an influence to the right environmental quality, to the human behaviour and relation to their natural environment.In the paper we try by means of the terrain research to refer if/how these phenomenonsand trends (processes) relate to each other.In the conclusion we made a synthesis of the results and we determine a key factor and landscape arrangements as for influencing and directing the tourism potential in this region.

Mapping and results

Preliminary outputs, which we had with the studies after 3 years of the terrain research, we verified and updated again and add them into the regional geodatabasis. Each obtained data and information we then synthetically evaluated with using GIS environment and graphical software and finally we proposed some key factors and steps with dominant importance for the sustainable regional tourism. In graphic representations we used a method of superposition and overlaying of map data layers.As a result, we can constate, that there is one dominant feature last years in territory - increase of regional hunting. In the village of Chľaba contemporary exists a hunting association, which is devoted to forest in Burda Mts. This subject regulates wild animals shooting(mainly deers and hoofed game) with the strict rules of regulation. Hunting is repeatidly an increasing trend of sustenance and hobby in the region and a good mean of animal regulation at the same time. For this purpose we can find in the terrain a big amount of hunting hides (many privat included) and adapted to this fact also areas for animal feeding, mires for wild boars etc. directly on the forest paths and trails (Fig. 4b/).The hunters prepares themselves the standposts for shooting thus producing on many places of Mts. terrain illumination (forest glades), where is beast shooted. The problem connected with is an amount of new “black” paths and roads and also some original trails became to be very opaque and useless. This can be also very confusing for potential visitors, tourism and wildlife lovers. In Burda Mt. and in adjacent Leliansky forest, there is actualy a big amount of wild boars, contemporary flooded, but with no significant problems, without any compromising security causing for local people (Fig. 4 c/,d/).In Burda currently there is the amount of deers and hoofed games (deer, does, musmons and fallow deers (Fig. 4 e/;f/).

By means of the terrain research we also recorded the occurrence the amount of forest and cart-ways with very different importance, length and utilization, most of them actualy new, without any cartographical designation, without sufficient marking (except to the west part of the blue marked trail to the KamenicanadHronom direction). This fact is caused due to an increase of hunting and therefore cars and motor vehicles increase in Burda protection area(Fig.4g/;h/).On the existing blue marked trail is in the section of crossroads at the Ipeľ cottage by the ridge to the Kamenica outlook uselessly very broad, even it is more spread with using of forestry equipment and heavy machinery. This part is also destructed a lot. In mentioned section with the length of more than 1 km there were changed intensive forest felling and clearcutswide from 30 up to 50 metres and passing to the valley 100 - 150 m down the contour line. On this section this phenomenon was visible in the number of 6 such fellings and

on the other forest trail side in the number of 3 fellings.According to the actual information we found out, that this forest felling is in the responsibity of Forests of the Slovak Republic, affiliation of Kamenín (with the seat in the neighbouring village).However we didn't find out exactly, how much of the wood in this part and what purposes will be this wood use for. However it is notably, that somebody could so vigorously strikes into the acreage and composition of forest cover. Here were clearly visible, that not onlydiseased trees and the young forest, mostly resulting by self-seeding, were felled. Lots of felled trees wereold and healthy forest cover (oak and hornbeam), which form the basis of the ancient forest and his sustainability as functioning ecosystem(Fig.4i/;j/).
In Burda Mts. is except to the part to Kamenica - oulook (blue markings) is bad or no labelling of the forest trails, roads and path. From the side of KamenicanadHronom finishes red marking of an existing nature trail, and this trail is on many places in poor physical condition, overgrown with self-seeding plants and scrubs. This red mark is connected to the blue one, however the blue brand is in many places losing as well, what is also caused by felled trees. Similarly the physical condition of trails and pavements is not continual and many of them begin and end without any purpose to be further connected to others.
A current phenomenon in the region is an increasing amount of cars and terrain vehicles, even on same places of forestry equipment as weel. This phenomenon also contributes to a poor physical condition of trails and pavements and to their discontinuality. We thus have been mapping a current state of trails and forest roads in Burda and their utilization and we created a proposal of their actual hierarchy (Fig. 2, see legend and table to fig. 2 below).
Some of the roads are blind and som of them loose nowhere or at least the actual state of forest roads and pavements changes very often. Directly in Burda Mts. is also a big amount of old unused fragments of fencing, as a relic of the intensive historical management in Burda (former vineyards, orchards, narrow strip rolls, some of them still used). Other current phenomenon, which we found on the southern slope of Burda, is the removal of bushy vegetation and thus the emergence of a bare slope, probably for the purpose of emergence of a large block arable land, which was planned to use as for the establishment of new vineyards and orchards. After the removal of young bushy vegetation cover, is this woody waste stacked on the edges of this plot. The waste will be probably used for local heating in the villages(Fig.4k/;l/).

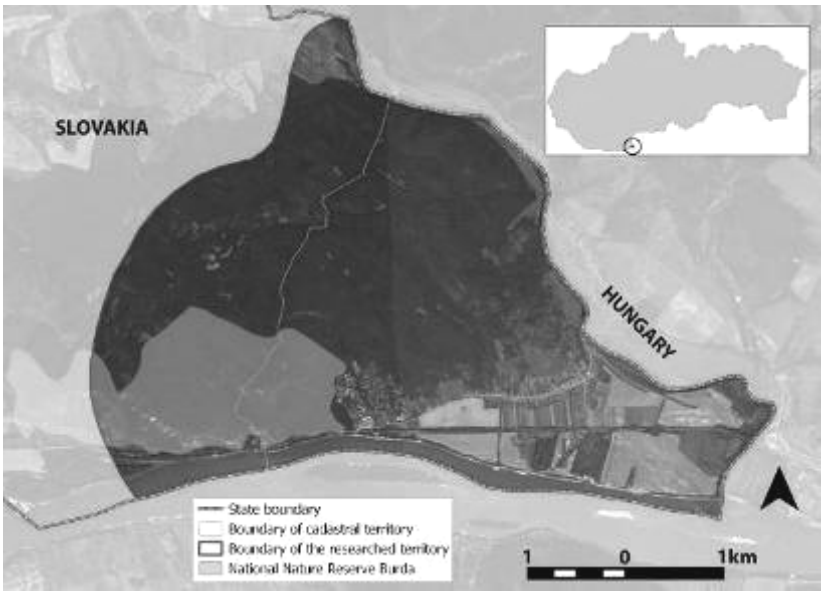


Fig. 1: Territory definition of the researched region

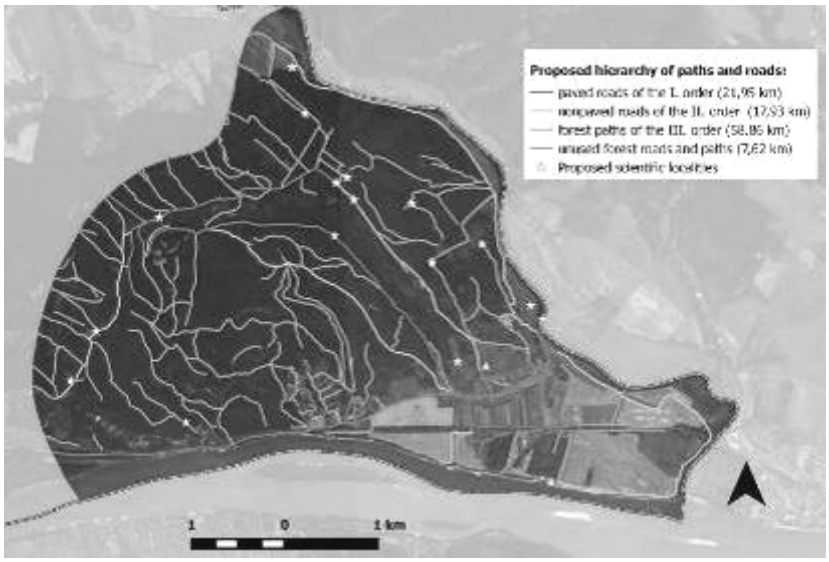


Fig. 2: Hierarchy of paths, trails and roads in the region

Proposed arrangements for the tourism attraction within the landscape management

On the basis of research results and mapping synthesis we propose:

- Better designation of forest paths and tracks, re-determination of their hierarchy and casting marks, so that they would be more durable.
- On the contrary, as a result of paths overgrowing (mainly of their input parts towards the hills), we propose the foothills gradually clean the slopes and this wood matter subsequently utilize for heating and local economic effect.
- Setting limits and controls for forest roads using of motor vehicles, and the privat using of parts of roads limit to a minimum and only on the basis by the competent authority conservation.
- The useless paths, not leading anywhere, to stop using, let them become natural part of ancient forest.
- A coherent interconnection of roads through the whole mountain range, the unnecessary ones to stop use. Similarly to improve orientation in the terrain by correct road labelling (especially intersections)(Fig.2).
- The installation of new educational boards we don't suggest. It would be enough to label new trail proposal for the educational purposes (Fig. 3).
  The first forest trail (blue color in fig. 3) begins in the village Chľaba and its length is 7,9 km. This involves the whole diversity attractiveness of mountain part. The second one (yellow color in fig. 3 has 2 alternatives, the shorter and the longer).
- Continuously to develop under specified conditions the scientific and research activities and try to propose new research points and stations.
- Bigger areas in Burda, but also other valuable habitats, it is necessary to let without human intervention. So, it will be retained the representativeness of rare habitat localities and examples of successional stages of forest development for some coherent areas. These should be a right pattern of natural form of self-regulation, nutrient cycling and energy (Fig.4. m/; n/).
- For sustainable way of living in this rural region and keeping their quality of lifewe suggest (in harmony with the nature and with the respecting of the regional necessities) a form of educational discovery tourism, agrotourism (hippotourism) for the purposes of better natural conginition and understanding of ecosystems functioning.

The hypothesis of a new nature trail necessity wasn't explicitly confirmed. Nevertheless,there is a natural inflow of visitors anyway. Big inflow of visitorscould be at this stage for the village unsustainable. The inhabitants themselves appreciate the intimity and silency of their space, the "genius loci" of their living place. To the natural inflow of individual visitors and individual tourism forms they don't prevent, but a radical form of tourism expansion, they don't wish. An appropriate form of regional propagation and the emphasis of indiviual (walking) tourism forms, however, could have for the region a positive sustainable effect.

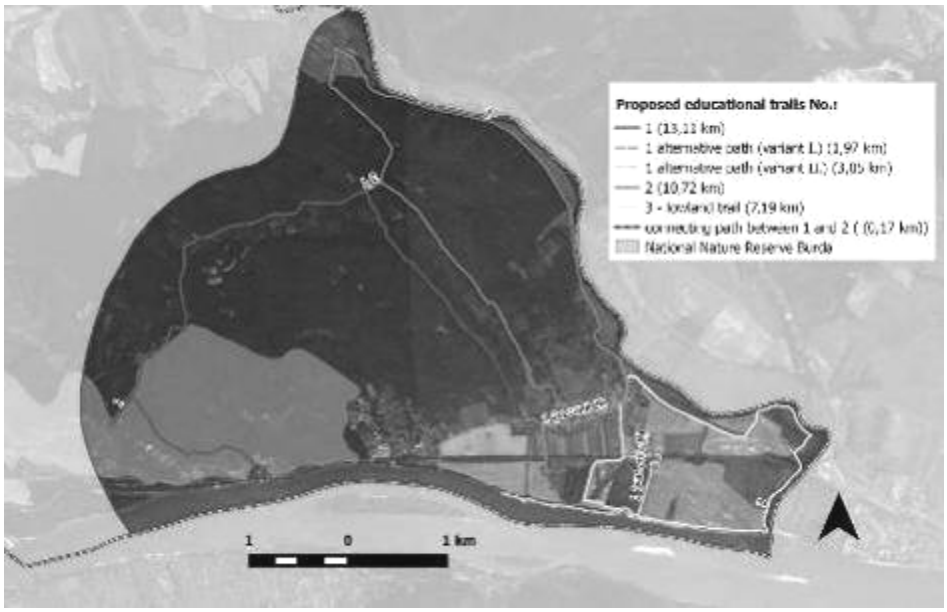


Fig. 3: Proposal of the educational and scientific trails in the region

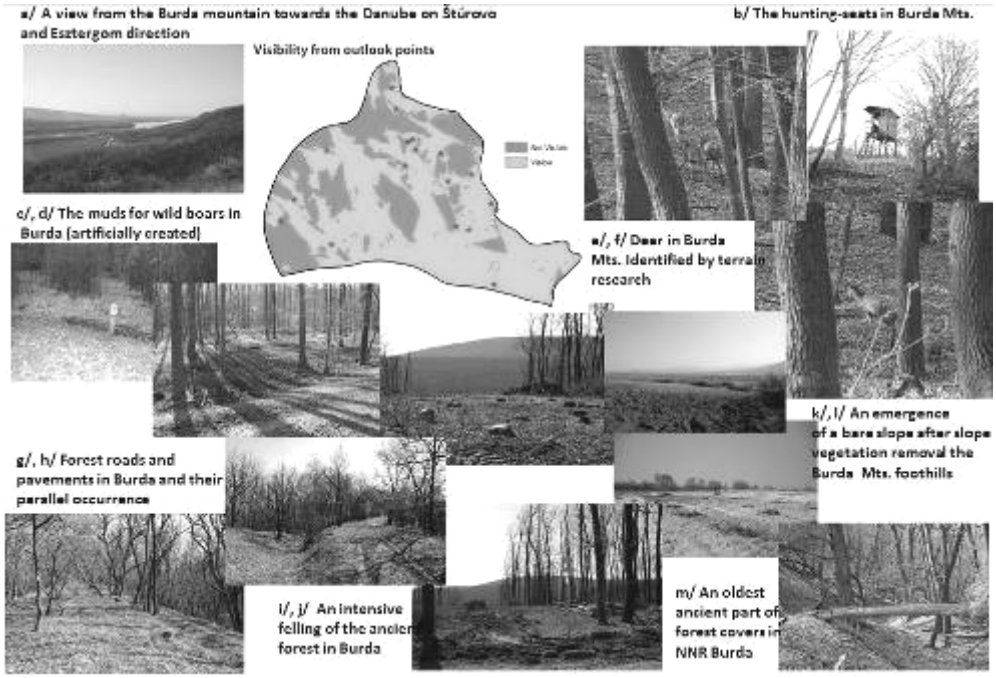


Fig. 4: Proposed destinations of the educational trail with the mission “Know, protect and create

Discussion

Civilization and its modern progress is a buffer, which inbibates the thorough natural cognition and its intuitiveunderstanding. We have often to face a conflicting issue, whether it is better to have more wild life space, or to have more space for vacation and tourism (Leopold, 1988, 2008). In the frame of „Land Ethic“ conception, there is important to set the question, whether it is better to have and to conserve the forests, steppes, natural, or semi-natural places of meadows, parks, protected areas and species.At the same time, there would be good to come into the stage, if we could answer this as well as the question “how we can have also the wild or protected natural places and also the modern development” (Maser, 2003, 2009).

In Slovakia dealt with the research of disperty settlement Petrovič (2006). According to his research results there can be assert a parallelism in some sustainable trends with our results. If it would have the tourism potential of some areas inhere only on impulses and innovative processes, there is absolutely necessary to realize the fact, that not every rural marginal area is suitable for such development and, that this delopment alternative is only one of its possibilities. Rural regions are still typical with predominance of agricultural tendency. In the last years there

is visible to see some changes in development trends of these territories partially towards the rural tourism (agrotourism). One of the prevailing features is a transition from mass tourism forms to individual ones, in the traditional landscape with conserving its natural, historical and folklore - cultural elements(Petrovič 2006).Tourism and recreational facilities are simply associated with easy economic benefit. Therefore, investment pressure focused on valuable natural areas, can be a serious threat to their values and integrity. The survey results may indicate a different approach to this issue in different countries (Gałaś et al., 2013).A contradictory aspect in chosen region appears the development of motor transport in the villages. To such kind of rapid development there aren't adapted spaces connected with parking, but on the other hand motor vehicles facilitate an access to these villages f.e. for emergency needs, by flooding etc. An emphasis should be placed in the future on the promotion of natural flows between neighbouring villages and regions, asthe resultant of regional necessities and "where" the region focuses. Every rural space is the unique one, thus it isn't our intention to force some activites and sources into the region withno assumptions, or which are for these villages unnecessary or unsustainable.

Conclusion

In the introduction set up the hypothesis was confirmed only partially. One of the striking aspects of the tourism attraction,is the state of forest roads, pavements and their labelling. PG parameters although have an initial influence on territory attraction for potential tourism development, but the significant impact has also the infrastructure, services equipment, possibilities of drawing financial resources, tradition and also appropriate form of promotion. An important practical output of the terrain research in Chľaba and KamenicanadHronom, is finding of knowledge, that the artificially raising of the regional attractiveness is not required. The opposite, its excessive intensity could lead to loss of that, what we in that region want to have and what to protect (relatively conserved natural environment, peace, silence and the amount of interesting aesthetically rare vegetation and fauna). Rather, we want to highlight the need to preserve natural habitats and biodiversity, so necessary and typical for this country. This step we propose through its inclusion among the research sites and educational localities. There is our endeavour in the village of Chľaba to create a center of education in the field of natural environment learning. We are planninghereto create an educational project, which might lead to better knowledge of natural geoecosystemknowledges. The reason is the unique biodiversity of many habbitats on the relative small territory, which is specifical with:

1/ exceptional PG conditions in the area, its geographical position;

2/ a coherence, relation and feedback with the natural condition, the intensity of land utilization and also with natural impact of geobarriers (Burda Mts. rivers Danube and Ipeľ and the state border);

It would be good, if the regional development could lead hand in hand with possibilities and regional specifics of secondary and tertiary landscape structure, even if because of the regional marginality.A zoning draftfor this territory in the future by means of concrete projects would allow on one side better access to the area (creation of the possibility of "see, know and to enjoy the natural beauties"), and on the other side to regulate flows of movement in the region there, where that is for the landscape desirable. This approach would join the classical environment protection (conservation) with the hand of regional sustainability ("to see" but from a reasonable distance and certain conditions) and the modern approach to keep in the region that, what we there want to see in the future.

In the frame of general conclusions of our research, there is important for such rural territories a partial return to self - supply ability and economicalself-sufficiency, with forms of relative closed managementcycles.The outputs of our research in Slovak rural regions could lead to the realistic assessment of the regional possibilities (trends) and to the identification of appropriate/inappropriate activities for these landscape types and their biodiversity conservation.

References

ATLAS COUNTRY OF THE SLOVAK REPUBLIC, (2002).elektronical version 2.0a/ (AKSR 2002).

BEZÁK, P., PETROVIČ, F. (2006). Agriculture, landscape, biodiversity: Scenarios and Stakeholder Perceptions in The Poloniny National park (NE Slovakia). ed. Bratislava. *Ekológia, 25,* (1), pp. 82 – 93.

FUTÁK, ČEPELÁK, 1980, MAGLOCKÝ,Š. (2002).Mapa fytogeografických regiónov Slovenska. In: Atlas country of Slovakia, 1980, 2002.
GAŁAŚ, S., GAŁAŚ, A., ZVIJÁKOVÁ, L., ZELEŇÁKOVÁ, M., FIALOVÁ, J., KUBÍČKOVÁ, H., ŠLEZINGR, M., HÁZI, J., PENKSZA, K. (2013).Environmental impact assessment process in the field of recreation in the V4 countries. In: *Journal of Landscape Management* (2013) Vol.: 4 / No. 1. Brno.
JEDLIČKA, KALIVODOVÁ, (2002).Územná klasifikácia fauny na území Slovenska. In: Atlas country of Slovakia, 2002.
LEOPOLD, A. (1949). The Land Ethic from A Sand County Almanac, Oxford University Press, New York, 1966. 1.ed. Abies. 1999. ISBN 80-88699-13-4.p. 233-255.
MASER, CH. (1996).Premenený les. 1. vyd. Abies.Praha. 1996. ISBN 9788-088-699-088.
MAZÚR, LUKNIŠ, (1980).Atlas country of Slovakia 1980, Mapa Geomorfologického členenia.
PETROVIČ, F. (2006).Changes of the Landscape with Dispersed Settlement.ed.
Bratislava. *Ekológia, 25,* (1),pp.201 – 211.
ANNUAL REPORT FROM AGROMETEOROLOGY, (2008).
REGULATION OF MINISTRY OF ENVIRONMENTOF SR NO. 3/2004-5.1 on National list of proposed Sites of Community Importance, Annex No. 1.
TARÁBEK,A.(1980).Atlas country of Slovakia.MapaklimatogeografickýchtypovSlovenska.
ANNUAL REPORT OF SLOVAK HYDROMETEOROLOGICAL INSTITUTE, (2012).
http://www.uzemneplany.sk/upn/chlaba/uzemny-plan-obce/
http://www.sazp.sk/public/index/go.php?id=1004
http://www.kamenicanadhronom.sk/
http://www.chlaba.sk/
http://uzemia.enviroportal.sk/, 2014
www.soprsr.sk, 2014

Acknowledgement
The contribution was created with help of the project VEGA No. 1/0232/12 and with support of the project APVV-0669-11 Atlas of Landscape Archetypes of Slovakia and the cooperation of the Department of Ecology and Environmental Science, Faculty of Natural Science in Nitra.

Souhrn
Jedním z cílů integrovaného přístupu ke studiu krajiny je stanovit limitující, inhibující, i potenciálně stimulující faktorypro únosný (udržitelný) rozvoj podmínek rekreace v cílových územích. V našem příspěvku jsme navrhli 2 alternativy poznávacího a výzkumného chodníku, který by znamenal zatraktivnění rurálního území JZ části Slovenska, jinak typického převládajícím rázem zemědělské krajiny. Ráz vrchovinnékrajiny, která je zde ojedinělým přírodním úkazem, by se tím zachoval. Území sopečného pohoří Burda (Národní přírodní rezervace Burda) na těsném rozhraní mezi řekou Dunaj a soutokem Dunaje s řekou Ipeľ, je typické na malém průřezu územím velkou rozmanitostí krajinných typů a struktur, včetně zvláštností přírodních rysů teritoria. Tento fakt území se snažíme vyzvednout tímto příspěvkem. Jedním z důležitých praktických závěrů výzkumu v obci Chľaba a Kamenica nad Hronom (zaměřeného na pohoří Burda a přilehlou oblast spádující k soutoku Dunaje s řekou Ipeľ) je konstatování, že zatraktivnění území musí stavět na zachování přirozeného prostředí a biodiverzity charakteristické pro tuto část krajiny. Proto jsme navrhli území zařadit mezi vědecko-výzkumné a edukační lokality a v obci Chľaba vytvořit středisko edukace a vzdělávání. Tímto způsobem by se skloubila klasická ochrana přírody s udržitelností pro region částečně zvýšením jeho atraktivity.

Contact:
Andrea Jakubcová, RNDr.
Department of Ecology and Environmental Science,Faculty of Natural Science, Constantine the Philosopher University in Nitra
Tr. A. Hlinku No. 1, 949 74 NITRA
+421907 760 918, andrea.jakubcova@ukf.sk

ACTIVE PROTECTIVE STRUCTURE ON THE BANKS OF RECREATIONALLY USED DAM

Miloslav Šlezingr, Lenka Gernešoválˇ, Pavla Pilařová
Mendel University in Brno

Abstract
The stability of the banks provide means of active or passive stabiliozačních structures. Most often used stone, wood, gabions, piles (wood and metal), parts of trees - trunks, stumps, as well as various types of precast concrete structures. In this paper we present some of the proposals.

Key words: bank stabilization, stone, wood, reservoir, erosion wall,

Introduction

In this paper we present proposals of several types of active stabilization antiabrasion structures.
Bank stabilization is an issue in a large amount of reservoirs. It should be implemented when the hydraulic structure is being put into operation; however, for economic, time and other reasons this is not usually the case. The following remedy measures are then little efficient, insufficient and mainly very costly.

Abrasion (Erosion) of banks

The Brno Reservoir is one of those with the highest erosion walls in the Czech Republic. Unfortunately, they occur in areas which are very popular for outdoor activities. This is mainly dangerous when the water level drops while an abrasion platform is used for leisure (sunbathing, fishing, etc.).
The most vulnerable part of the banks has been declared a natural formation. We can not here use passive stabilization Fig 1,2 (which is constructed directly on the slope). Therefore, we propose to stabilization active – breakwater Fig. 3,4.

Fig. 1: Passive stabilization, Brno reservoir, „OSADA“ area, foto M.Šlezingr, 2011

We propose the following example, the stabilization of the structure. Figure 3 - construction cylinders made of twigs (branches) - Salix fluviatilis, Salix purpura, or such as Salix triandra. Branches are bound with wire.
Figure 4 tree trunk lying on the bottom of the lake about 10 m from the shore. It ensures the stability of wooden piles.
Another option is for example the use of stone - stone is often used material. We use local stone or stones taken from the quarry.
Height stone serifs is about 1 m, the width at the bottom is about 1.5 m Size (approximate diameter) of the stone is 0,4 - 0,5 m.
U všech stabilizačních prvků dosahuje hladina asi do jedné poloviny, až dvou třetin výšky construction.

Fig. 2: Passive stabilization, Brno reservoir, „SOKOLSKÉ KOUPALIŠTĚ“ area, foto M.Šlezingr, 2012

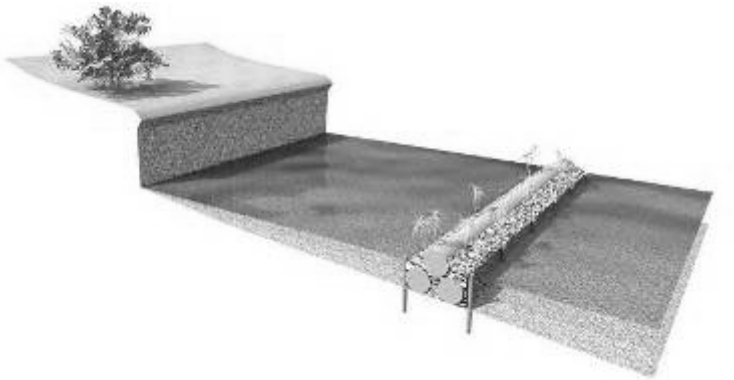


Fig. 3: Construction cylinders made of twigs (branches) - Salix fluviatilis, Salix purpura, or such as Salix triandra. Branches are bound with wire. Monhart, Brno 2012

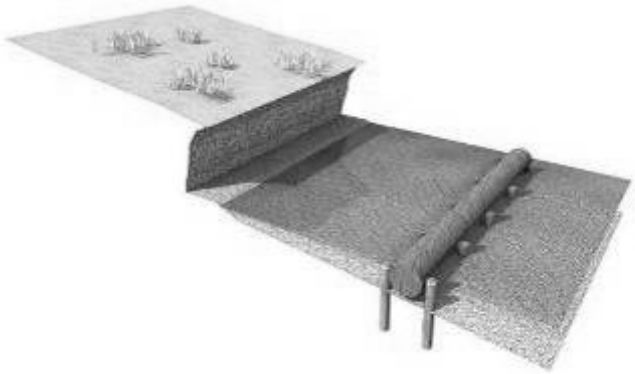


Fig. 4: Tree trunk lying on the bottom of the lake about 10 m from the shore. It ensures the stability of wooden piles. Monhart, Brno 2012

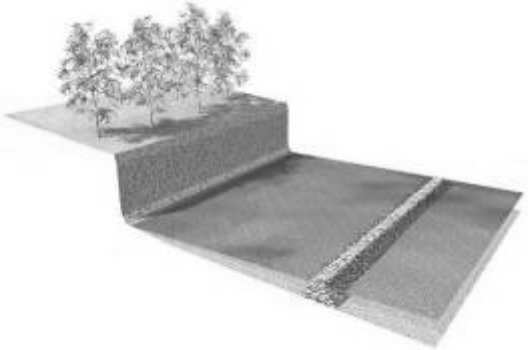


Fig. 5: Stone serifs - Height is about 1 m, the width at the bottom is about 1.5 m. Size (approximate diameter) of the stone is 0,4 - 0,5 m. Monhart, Brno 2012

Conclusion - Discusion

Currently, we are selecting possible designs and verifying them. We assume these will be implemented after professional consultations with the representatives of the stream management institution in the places of the highest risk. The wave which is “held back” does not carry away the material fallen to the toe of an eroded bank and thus a new bank slope is spontaneously created.

References

BAROKOVÁ, D.: Určenie vplyvu vodnej stavby na hladinový režim podzemných vôd a možnosti jeho regulácie. - Bratislava : STU v Bratislave SvF, 2006. - 152 s.; (Edícia vedeckých prác; Zošit č.33). - ISBN 80-227-2367-3

BAROKOVÁ, D., ŠOLTÉZS, A.: Groundwater modelling for improving groundwater-surface water regime in Slovak part of the Medzibodrožie region. In: HydroPredict 2008 : International interdisciplinary conference on Predictions for Hydrology,Ecology and Water Resources Management.Prague,CR,15.-18.9.2008. - Praha : Česká asociace hydrogeologů, 2008. - ISBN 978-80-903635-3-3. - S. 375-379

GAŁAŚ, S.; ZELEŇÁKOVÁ, M.The complex evaluation of the development potential of the area - case study in the village Dedinky in the Spis county (Slovakia) Public recreation and landscape protection - hand in hand?: Conference proceeding pages: 142-147, 2011

GAŁAŚ, S., GAŁAŚ, A., ZVIJÁKOVÁ, L., ZELEŇÁKOVÁ, M., ŠLEZINGR,M., FIALOVÁ, J. Environmental impact assessment process in the v4 countries in the field of recreation and tourism. Public recreation and landscape protection - with man hand in hand: Conference proceedings pages: 45-50, 2013

LUPTAKOVA, A; HARBULAKOVA, V.; STEVULOVA, N.; ET Al.Biocorrosion of concrete catch basins and pillars in old mining loads By: Conference: 14th International Biotechnology Symposium and Exhibition (IBS-2008) Location: Rimini, ITALY Date: SEP 14-18, 2010 JOURNAL OF BIOTECHNOLOGY Volume: 150 Supplement: 1 Pages: S253-S254 Published: NOV 2

JUNÁKOVÁ, N., BÁLINTOVÁ, M. Predicting Nutrient Loads in Chosen Catchment, Chemical Engineering Transactions. Vol. 26, no. 1 (2012), p. 591-596. - ISSN 1974-9791

JUNÁKOVÁ, N., BÁLINTOVÁ, M. Evaluation of small water reservoir use through its quantitative and qualitative characteristics, In: Public recreation and landscape protection - with man hand in hand... : Conference proceeding : 1st - 3rd May 2013, Brno. - Brno : Mendel University Brno, 2013 P. 56-60. - ISBN 978-80-7375-746-5

KOLEM, M. REJEC, A. CETINA, M. Sanitation of the left bank in Doblar reservoir – Soča Riever, XIX kongres ICOLD – přehledná informace In: Priehradné dni Košice 1998, str.58

KORYTÁROVÁ, J., ŠLEZINGR, M., UHMANNOVÁ, H. Determination of potential damage to representatives of real estate property in areas afflicted by flooding (2007) Journal of Hydrology and Hydromechanics, 55 (4), pp. 282-285.

Soldo, B., Oreskovič, M., Anioskin, A. An example of examination of the bank slope and water wavering contact, Journal of Landscape Management, No 2, 1, 41 – 44 p 2010

SLEZINGR M.; JEDLICKA L., 2010 Accompanying vegetation – grassland In: Colloquium on Landscape Management, No 1, pages: 28-30

Šlezingr, M. Stabilisation of reservoir banks using an "armoured earth structure" (2007) Journal of Hydrology and Hydromechanics, 55 (1), pp. 64-69.

ZELENAKOVA, M.; CARNOGURSKA, M.; SLEZINGR, M..; ET AL. A model based on dimensional analysis for prediction of nitrogen and phosphorus concentrations at the river station Izkovce, Slovakia HYDROLOGY AND EARTH SYSTEM SCIENCES Volume: 17 Issue: 1 Pages: 201-209 Published: 2013

ZELENAKOVA, M.,; PETRILAKOVA, A.,; GALAS, S.,Evaluation of the development potential of the village Spisske Bystre, Slovakia Conference: Conference on Public Recreation and Landscape Protection - Hand in Hand Location: Mendel Univ, Fac Forestry & Wood Technol, Dept Landscape Management, Brno, CZECH REPUBLIC Date: MAY 04-06, 2011 Pages: 45-50

Acknowledgement

We used the partial results of the project “Optimalizace vodního režimu na modelovém území pomoravské nivy” QJ1220033 LUH12-15

Souhrn
Na údolní nádrži Brno jsou jedny z nejvyšších abrazních srubů ze všech nádrží v ČR. Bohužel se vyskytují v rekreačně výrazně využívaných oblastech. Hlavní nebezpečí hrozí při snížení hladiny a při využívání abrazní plošiny k rekreaci (slunění, rybaření, aj.).
Na obrázcích 1 a 2 jsou prezentovány ukázky pasivní stabilizace břehu – tedy konstrukce přímo zasahující do břehu – břehová patka či betonová konstrukce opěrné zídky. Tyto konstrukce byly realizovány na poškozené části břehů nádrže Brno v minulých letech.
V současné době jsme se zaměřili na maximální využití aktivní stabilizace. Ta je v tomto příspěvku prezentována ve formě návrhů zpracovaných ve 3D (Monhart, Šlezingr 2012).

Contact:
Miloslav Šlezingr; Lenka Gernešovál ;Pavla Pilařová
Ústav inženýrských staveb, tvorby a ochrany krajiny,
Mendelova univerzita v Brně Zemědělská 3, 613 00 Brno

AIR TEMPERATURES AND CONDITIONS FOR RECREATION

Jaroslav Rožnovský; Pavel Zahradníček
Czech Hydrometeorological Institute

Abstract
The extent of recreation spent in nature is influenced also by the course of the weather, which is expressed by evaluating the dynamics of selected air temperatures, i. e. the number of tropical days, summer days and days with average day-time air temperature above 15 °C. The number of days with temperatures above 15 °C increases, as well as the number of summer and tropical days. This positive trend in number of days is statistically significant. Tropical days, however, are unfavorable for staying outside in nature.

Key words: bioclimate, air temperature, tropical day, summer day, recreation

Introduction

The time spent in nature is significantly influenced by the course of the weather. The potential of a landscape for this form of recreation is determined by long-term regime of the weather, in other words the climate. Our region is significantly affected by circulation and geographical conditions, so our climate, including the air temperature, varies a lot throughout the year. The average annual air temperatures range from -1 °C up to 10 °C in the Prague city center. The warmest region of our country is south Moravia (Climate Atlas of Czechia, 2007). In terms of the air temperature variation during the year, on average the coldest month is January, the warmest one being July.

During the year, after the winter minimum, the temperature gradually increases. The largest increase occurs in March and April. The highest temperatures are reached in July and a substantial decrease is observed in September and October. The temperatures then decrease further at the end of October and beginning of November. The winter culminates in the second ten-day period of January. The so-called Indian summer, a sort of extension of the summer, occurs mostly in September. It is difficult to give one specific value in terms of the air temperature that would describe the suitability of staying in nature. Surely, for example the annual average is not appropriate.

Materials and methods

For the purposes of this analysis of temperature characteristics, 10 climatological stations representing the area of the entire CzechRepublic were chosen, with emphasis on popular recreational areas. Each time series contains errors in measurements, non-homogeneity and also missing values. This could lead to biased results of the analysis, therefore data quality control of the selected time series was performed, non-homogeneity tested and possible breaks in the time series repaired. Finally, interpolation methods were used to fill in all the missing values in daily intervals (Štěpánek et al. 2011 a,b, Štěpánek et al. 2013, Zahradníček et al. 2014).

The following day types were chosen for the evaluation of temperature conditions: Summer day, during which the measured maximum air temperature reached 25 °C or more and minimum air temperature did not fall below 0.0 °C. Tropical day, during which the measured maximum air temperature reached 30 °C or more and minimum air temperature did not fall below 0.0 °C, and day with average temperature above 15 °C. Standard statistical methods were used for their analysis.

Results

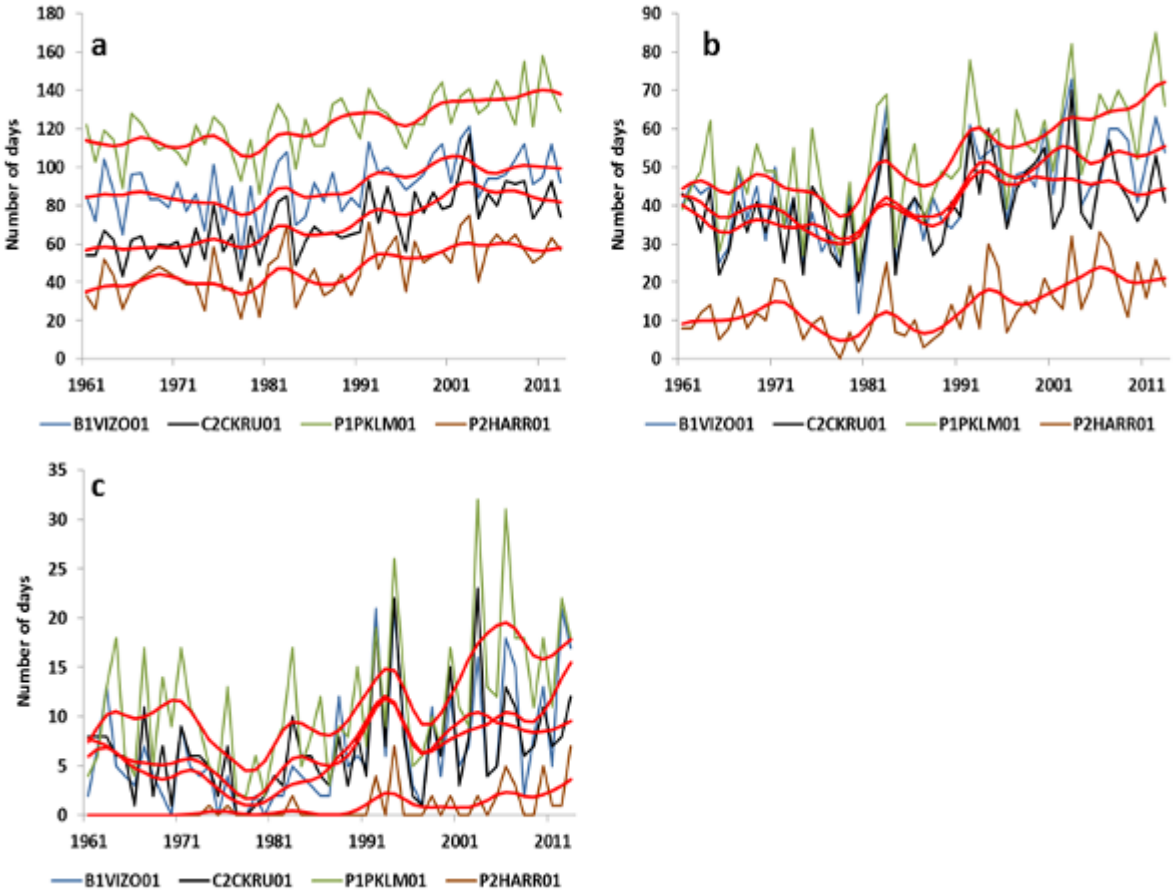


Fig. 1: Number of days with temperature above 15 °C (a) summer days (b) and tropical days (c) for the stations Vizovice (B1VIZO01), Český Krumlov (C2CKRUM01), Prague-Klementinum (P1PKLM01) and Harrachov (P2HARR01) for the period between 1961 and 2013, red line represents the 10-year low-frequency filter

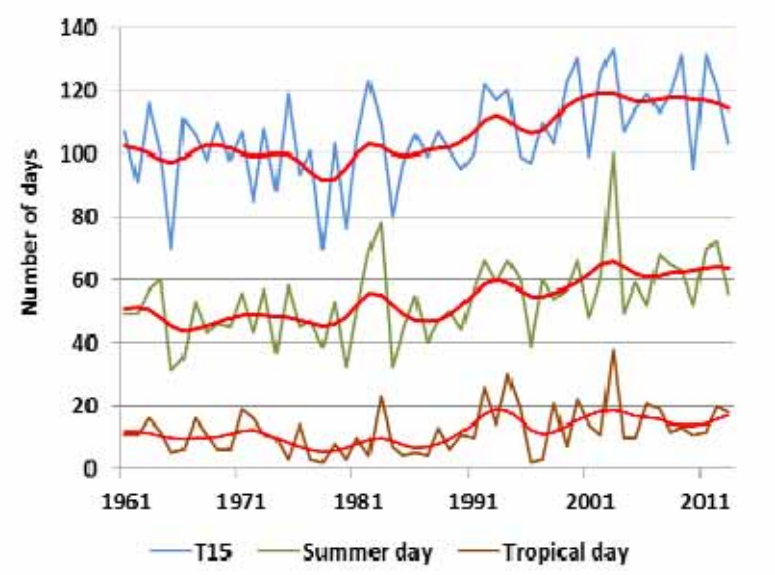


Fig. 2: Selected temperature characteristics for the Kuchařovice station in the period between 1961-2013

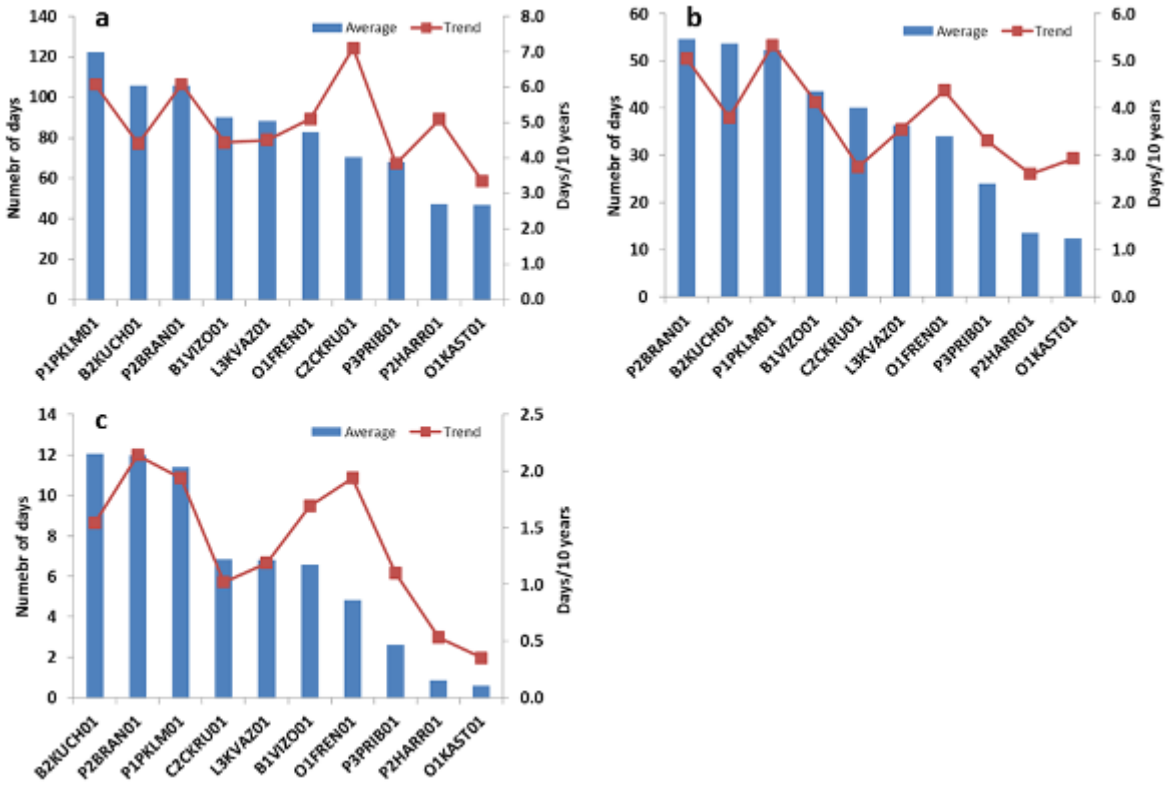


Fig. 3: Average number of days and linear trend (number of days / 10 years) of days with temperature above 15 °C (a) summer days (b) and tropical days (c) in the period between 1961 and 2013 at the selected stations

For the individual selected stations, the linear trend in temperature characteristics was determined. The increase in the number of days with average temperature higher than 15 °C in the analyzed period is statistically significant (p=0.05). The largest increase was observed at the station in Český Krumlov, where it was more than 7 days in 10 years. The smallest increase, on the other hand, was found to be at the station in Karlova Studánka (3.3 days/ 10 years). The number of summer days also statistically significantly increases at all the stations. The largest increase was recorded at the Prague-Klementinum station (5.3 days/10 years) and the smallest increase at the Harrachov station (2.6 days/10 years). If, however, we look at this number in relation to the average number of days, then there is in fact 20 % more of these days every 10 years, which is more than in Prague-Klementinum, where the converted increase is only 10 %. The number of tropical days is smallest from the studied characteristics. Statistically significant positive trend was again observed at all the stations. The largest increase was at the station in Brandýs nad Labem, where the number increased by 2.1 days in 10 years.

Discussion

The relationship between weather and climate is the subject of study of biometeorology, which has many ways to evaluate this relationship. In the recent years, the knowledge of bioclimate began to be used also in evaluating the suitability of conditions for staying in nature. This analysis shows that the generally stated warming is also proven when evaluating the frequency of the selected days. This fact leads to the conclusion that the time periods during the year that are suitable for staying in nature gradually change. Average day-time air temperatures above 15 °C are observed earlier than stated in available literature (Atlas of climate, Climate of Czechoslovakia – Tables), so in this perspective, there are longer periods suitable for staying in nature during spring and autumn months. The summer, however, traditionally considered to be the besttime of the year, is characterized by more and more tropical days, which are for humans not suitable for staying in nature.

Conclusion

Air temperatures in the region of the Czech Republic are highly variable. This means that conditions for humans to stay in nature vary throughout the year and also depend on the particular location. The presented analysis of the number of days with day-time air temperature above 15 °C, summer days and tropical days, shows that there is a general warming and the number of these days increases. This fact, however, cannot be taken as something positive, because the temperatures during tropical days are very exhausting for a human body.

The obtained results prove that it is necessary to monitor the current trends in air temperature and that when evaluating the landscape potential for staying in nature, also the announced possible climate changes must be taken into account.

References

ŠTĚPÁNEK P, ZAHRADNÍČEK P, BRÁZDIL R, TOLASZ R. 2011a. Metodologie kontroly a homogenizace časových řad v klimatologii (Methodology of Data Quality Control and Homogenization of Time Series in Climatology). Czech Hydrometeorological Institute, Prague, 118 pp.

ŠTĚPÁNEK, P., ZAHRADNÍČEK, P., HUTH, R. (2011b): Interpolation techniques used for data quality control and calculation of technical series: an example of Central European daily time series. Idöjárás, 115, 1-2, pp. 87-98.

ŠTĚPÁNEK P, ZAHRADNÍČEK P, FARDA A. 2013. Experiences with data quality control and homogenization of daily records of various meteorological elements in the Czech Republic in the period 1961–2010. *Idöjárás* 117: 123–141.

ZAHRADNÍČEK P., RASOL D., CINDRIČ K., ŠTĚPÁNEK P. 2014: Homogenisation of monthly precipitation time series in Croatia. International Journal of Climatology. DOI: 10.1002/joc.3934

Acknowledgement

P. Zahradníček was supported by the "Hydrometeorological extremes in Southern Moravia derived from documentary evidence" (Czech Science Foundation, no. 13-19831S)

Souhrn

Rozsah rekreace v přírodě je ovlivněn také průběhem počasí, které je vyjádřeno hodnocením dynamiky vybraných teplot vzduchu, a to počtem dnů tropických, letních a s průměrnou denní teplotou vzduchu nad 15 °C. Teploty vzduchu na území České republiky jsou velmi proměnlivé. Pro jsou na našem území pro pobyt člověka v přírodě různé podmínky jak v průběhu roku, tak v jednotlivých místech republiky. Z předložené analýzy počtů dnů s průměrnou denní teplotou vzduchu nad 15 °C, dnů letních a tropických vyplynulo, že dochází k oteplování a jejich počet roste. Tento poznatek však nelze brát jen v kladném smyslu, protože teploty vzduchu v tropických dnech jsou pro lidský organizmus zatěžující. Získané výsledky dokládají, že je nutné sledovat aktuálně průběhy teplot vzduchu a v hodnocení potenciálu krajiny pro pobyt lidí pamatovat na avizované možné změny klimatu.

Contact:

Jaroslav Rožnovský
Czech Hydrometeorological Institute, Brno regional office,
Kroftova 43, 616 67 Brno
00420 724185617,
e-mail. roznovsky@chmi.cz

AN OUTLINE OF ECONOMIC IMPACT OF MANAGEMENT OPTIONS FOR ŠUMAVA NP

Ian Dickie[1], Pavel Kindlmann[2], Zdenka Křenová[2]
Economics for the Environment Consultancy Ltd.,London[1]; Charles University, [2]

Abstract

This analysis briefly compares the economic impacts of three potential future management scenarios for Šumava National Park (NP) in the Czech Republic: (1) continuation of current management; (2) the adoption of draft Bills that would declassify protected areas and enable developments within some of the Park's most valuable habitats for wildlife; (3) the adoption of proposals to expand the wilderness area in the Park's core with associated tourism opportunities. Our preliminary results indicate that the pro-wilderness scenario offers a more economically and environmentally sustainable development plan for the Šumava NP than either the current situation or the plans proposed in draft Bills. It is recommended that proposals in draft Bills should not be pursued at least until a fuller economic evaluation of options has been undertaken.

Key words: Sumava NP, management, proposed bill

Introduction

Šumava National Park (NP) was established in 1991. Its status as an area of high conservation importance is reflected in several international designations: Šumava's peat bogs are designated Ramsar sites (which are wetlands of international importance); and the Šumava NP is part of the EU's Natura 2000 network due to both Special Protected Area and Special Area of Conservation designations (under the Birds and Habitats Directives respectively).

Šumava harbours important populations of many species including capercaillie (*Tetrao urogallus*), Ural owl (*Strix uralensis*), three-toed woodpecker (*Picoides tridactylus*), lynx (*Lynx lynx*), moose (*Alces alces*), peregrine falcon (*Falco peregrinus*) and freshwater pearl mussel (*Margaritifera margaritifera*) (Bláha et al., 2013).

The management of Šumava NP is a politically sensitive issue, attempting to strike a balance between promoting local economic wellbeing and protecting the area's ecological importance. Reflecting the political uncertainties and complexities of the management of the area, Šumava NP has had nine directors in its 22 year history, in contrast to the Bavarian Forest NP (in the region adjacent to Šumava on the German side) which has had 3 directors in its 43 years. Recent debate surrounding the management of the NP, in which the international scientific community and NGOs discussed the future of the Šumava NP with the current NP director, local politicians, and developers, has attracted significant media interest in the Czech Republic. The NP has also attracted international attention criticising current management practices and plans for the future.

The Park's management is based on management zones with different levels of access and resource use, and allowing interventions against bark beetle. It is apparent that the scientific community support non-interventionist management of bark beetle. However, intervention management practises bring revenue for the NP Authority in the form of timber, and create employment. These direct market returns can mean that intervention management practises are favoured by decision-makers. This view does not take into account the wider economic benefits that biodiversity can bring through indirect support for market activity (e.g. tourism), and non-market benefits (i.e. the value people place on maintaining a healthy ecosystem within the National Park).

The purpose of this report is to briefly compare the economic impacts value arising from three management scenarios for the Šumava NP: firstly if the current status of the park continues; secondly if the Bill drafted for the Czech parliament earlier this year is adopted, enabling declassification and development of areas of the Park; and thirdly if the management of the NP adopted a 'Pro-Wilderness' approach.

The park is currently split into three zones: Zone I is the most valuable and strictly protected part of the NP (which should be equivalent to the core zone under Czech legislation), Zone II includes the natural ecosystems that in the past were variously influenced by human activities, and Zone III has areas which allow a wide variety of activities on them. More details on the zonation and intervention strategies in the NP are contained in the sections below. The issue of the management of the NP is currently under discussion due to the drafting, earlier this year, of

a Bill to the Czech Parliament that has proposed a change to the zonation of the NP. This is intended to promote interventionist bark beetle management and encourage economic development, but is seen by many conservation organisations as a threat to the habitats within it.
This report does not undertake primary assessment of the ecological damage or benefits that will occur under any of the three scenarios. It instead relies on existing scientific and economic evidence from Šumava itself, evidence from a fact finding trip in July 2013 and comparable regions including the Bavarian Forest in Germany which borders the NP, to assess the economic potential of different development options.

Results

Current Status

This scenario assumes that current management approaches continue without significant change into the future. The current areas of zones are maintained. Šumava NP has several designations as it is of international conservation importance for several species and habitats. However, the most ecologically valuable areas of habitat are highly fragmented: there are 135 Zone I segments in the Park.
Since the Šumava NP was established in 1991, zonation was used to define protection (Bláha et al, 2013). Zone I is the most strictly protected part of the national park. These are areas which are considered to be natural or semi-natural ecosystems of greatest conservation value. Zone II is managed actively to increase its ecological value, generally in preparation of some parts for inclusion in Zone I prior to 2030 (Křenová and Hruška, 2012). Zone III areas are villages and areas of significant human impact. After the windstorm Kyrill in 2007 the fragmented zonation was partly consolidated by NP management. The non-intervention regime was extended from Zone I to some parts of Zone II.
Under the current zoning, only 13% of land is classified as Zone I and the designation is split into 135 fragmented areas. This arrangement has been in place since 1995, when a change in leadership favoured active management of areas infested with bark beetle – an approach that has been criticised by a range of experts, including IUCN and the Ramsar Committee (Bláha et al., 2013). The current non-intervention area (Zone I plus part of Zone II with non-intervention against bark beetle from 2007) is much smaller than that proposed by scientists, based on GIS analyses of the actual extent of Natura 2000 habitats (52.2% for Zone I, out of which 49.8% should be non-intervention - Bláha et al., 2013).
Compared to other national parks in this region of Europe, non-intervention core areas of Šumava NP form a much smaller proportion of the NP and are much more highly fragmented. The fragmentation of habitat within the management zones in Šumava NP reduces the nature conservation benefits of the most highly protected areas – with related implications for ecotourism potential. In response to the current status of the NP, the European Commission have been in contact with the Czech Government to raise concerns about the current management of the NP, and its impact on Natura 2000 sites. There are also clear recommendations from IUCN and the European Council to change the zonation in the current management strategy and implement a clear and long term strategy for management of Šumava NP.

Draft Bill Adoption

There are two drafts of the Bill recently developed for submission to the Czech Parliament: one by the Pilsen local government and one by the government (prepared by the Ministry of Environment) .
The most advanced one in terms of preparation is the Bill drafted by the Ministry of Environment (the current director of the Šumava NP was substantially involved in its preparation) and therefore we will use it in the following assessment. However, as these two proposals do not differ substantially in matters analyzed here, so conclusions and recommendations hold also for the second proposal.
The plans in the Bills drafted for Parliament propose changes to the areas and definitions of the three types of Zone in the NP. Zone I is again comprised of those areas with significant biodiversity values. Zone II is comprised of those areas that have natural value, but are again compromised in some way by human activity. Zone II areas are split into Zone IIA and Zone IIB. Zone IIA areas are those that are suitable for ecological recovery within 15, 30 or 45 years, but logging will be allowed in them within these timescales. Zones IIB are those areas permanently

designated as ‘nature friendly management’. Zone III are those areas that are mainly used for business, tourism, sport and recreation, and are also potential areas for development.
Zone I designation prohibits all intervention management activities. But according to Annex 4, Part A of the Bill exceptions to these rules exist in certain territories in the NP. The Bills nominally propose increasing the Zone I area to 26.53%, but in practice it will comprise 22% non-intervention zones and 4% ‘intervention zones’ in which felling will be allowed (meaning it is not actually a non-intervention Zone). These proposals would increase the total size of Zone I areas and reduce fragmentation of the core areas from 135 segments to 37. However, the current non-intervention area of the NP will actually be reduced.
A variety of management interventions are allowed in the Zone II and Zone III areas. Zone IIB designation allows significant interventions on the land, including timber production for the local population, clearing of brushwood, establishing tourist infrastructure. Zone III allows timber management interventions and economic development opportunities. This includes a proposed ski lift and run. Zone IIA will be 8.49%, Zone IIB will be 59.87%, Zone III 5.12%.
Under drafts of the Bill, a significant part of the existing core areas will be de-classified from their present strictly protected status and logged, in many cases based on arguments for interventionist bark beetle management. Extensive areas of the Park would be opened up to a variety of high impact activities, such as building and infrastructure development. These are proposed to include development of ski-lifts, and an expansion of the touristic road network, which may affect survival of some species (e.g. capercaillie).
It is concluded that under the drafted Bills habitats in Šumava NP will remain fragmented, although fragmentation will be reduced, and zone 1 areas will cover a lower proportion (only ~44%) of the highest-value habitats. Combined with increased development pressures, this means the ecological value of the NP will fall.

Pro-Wilderness Development
The natural ecosystem (pro-wilderness) scenario is based on an ecological optimum size of Zone I, as defined in Bláha et al. (2013). This was calculated by defining a merged area using a GIS-based mapping of the most important features characterising the Natura 2000 status of the NP. The proposal is that 52.2% of the Šumava national park is defined as Zone I of which 49.8% is defined as non-intervention.
This pro-wilderness scenario also involves investment in the promotion of nature-based tourism (with marketing based on the ‘wilderness experience’), and in the local economy’s ability and infrastructure for supplying these services for this market. There are numerous locations and opportunities to invest in small-scale infrastructure and low-impact access to Zone II areas. These developments would be based around current paths with the NP. They would not take place in locations where they would damage the ecological value of the NP (e.g. they would not increase fragmentation of habitats).
The zoning under this proposal, including the larger non-intervention area, is also intended to provide a more coherent large scale approach to bark beetle management. There would be a defined NP perimeter beyond which interventionist management, including felling to control the spread of bark beetle, could be employed.
It is concluded that under pro-wilderness proposals the ecological integrity of the NP will be assured and improved, with accompanying sustainable economic potential.

Discussion
Currently, there exists a significant amount of nature-based tourism in and around the national park, connected to its large wilderness core. The 2 million visitors to Šumava NP each year bring an estimated €68 million of spending to the local area, where unemployment is below the national average. Key sources of employment are in nature-based tourism and forestry. The high imported element of forestry labour means that nature-based tourism activity is likely to result in a greater proportion of income remaining within the local economy, and as a result higher tax revenues to local Government.
The proposals in the draft Bills have the potential to generate employment through ski lift development, but much of this activity will use imported labour and/or be short-term (e.g. associated with construction work). The financial viability of this development is uncertain for a number of reasons, including: likely requirements to compensate for damage to protected habitats; reduced future snow cover due to climate change, and competition to attract sufficient visitors to use the ski lift.

The economic impacts of the adoption of the draft Bills (and, to a lesser extent, of continuing with current management) would also include negative effects on current nature tourism activity and on its long term potential to expand. Currently, and certainly if the proposed plans in the draft Bill are adopted, the value of the NP as an area of wilderness and high-quality ecosystems will be reduced. This would weaken one of its key selling points as a tourism and recreation destination. The opportunity for international branding of the national park based on these ecosystems would be diminished. This damage to ecosystems would go against the views of the 75% of the Czech population who agree that it is important to halt the loss of biodiversity because we have a moral obligation to look after nature.

Pro-wilderness development offers an alternative scenario. It would allow economic opportunities to be pursued to promote nature-based tourism at new locations and activities around an expanded non-intervention zone, while not undermining the ecological integrity of the NP. The Šumava NP is a unique area which supports a wide variety of habitats and species and has the potential to form one of the largest areas of natural forest and wetland habitat in Central Europe. This tourism offer is in keeping with visitor's preferences (identified in a 2010 survey), and can exploit global growth in ecotourism activity. The best access points to the Šumava NP's wilderness are currently regarded as being 'full' in that further increases in visitors would damage the wilderness experience which draws visitors. Therefore, there is perceived to be demand for a larger number of carefully managed access points to a larger wilderness area.

To maximise the local economic benefits of this tourism development around the park, appropriate training for the local workforce is required. Local benefits could be enhanced through nature-based tourism development that is spread throughout the communities in and around the park. This would not conflict with the park's wild image that attracts visitors, and this visitor market could grow with support from expanded marketing activity. The potential local economic benefits from the pro-wilderness development option include:

- maintaining and expanding employment in management of the National Park's habitats, visitor facilities and access points;
- increased nature-based tourism trade in the villages within and surrounding the Park;
- increased opportunities to attract financing for local economic development (e.g. training and SME support for nature-based tourism), and for the Park's management, both internationally (e.g. from EU funding sources), and locally (e.g. through fees for visitors using specific facilities);
- a greater proportion of value-added in the tourism offer being generated within the local community, meaning more income can be retained locally and support greater indirect economic activity, and
- maintaining forestry employment.

Key aspects of this analysis are the way in which tourism potential at the Park is developed, and the extent of logging as a measure to manage bark beetle. Šumava NP borders the Bayerischer Wald NP in Germany, which has developed a successful nature-based tourism industry. This offers a proven model to pursue sustainable economic development under the pro-wilderness development scenario, and a unique opportunity for complementary promotion of the two parks branded as the 'Wild Heart of Europe'.

More specific predictions of economic and employment impacts will require a full economic study. However, this initial analysis indicates that the pro-wilderness scenario offers a more economically and environmentally sustainable development plan for Šumava NP than either the current situation or the plans proposed in draft Bills. It is recommended that proposals in draft Bills should not be pursued at least until a fuller economic evaluation of options has been undertaken.

Conclusion

This preliminary analysis shows that a more detailed economic assessment is required of the Šumava NP, which includes:

- Changes to ecosystem services under the different scenarios.
- Opportunities for sustainable local economic development connected with conservation of the Park's wilderness, for example: tourism promotion and events, based around individual communities and one or more visitor centres, could be developed and expanded without damaging the area's natural assets (ecology and landscape); the tourism offer could also be enhanced through closer links (e.g. in marketing) with the adjoining Bayerischer Wald National Park, which has a core wilderness area and

attracts high numbers of visitors; there is a Šumava Region product range, but it does not appear to be marketed in connection with the existence of the national park.
- The financial viability of the ski run enabled by the drafted Bills proposals should consider vulnerability to climate change, risks of not achieving sufficient visitors, and the costs of compensatory habitat in relation to the areas of the park it would damage.

A fuller assessment of the potential costs and benefits of pro-wilderness development would allow the benefits the NP's unique image of wild natural ecosystems provides, which are currently overlooked in project and policy assessments, to be recognized. This will lead to a more informed choice on sustainable economic development for Šumava NP.

References

BLÁHA, J., ROMPORTL, D., KŘENOVÁ, Z., 2013. Can Natura 2000 mapping be used to Zone the Šumava National Park. European Journal of Environmental Sciences 3: 57–64.
KŘENOVÁ, Z., HRUŠKA, J., 2012. Proper zonation – An essential tool for the future Conservation of the Šumava National Park. European Journal of Environmental Sciences 2(1): 62–72.

Acknowledgement

This research was supported by the grant No. CZ.1.05/1.1.00/02.0073 of the Czech Ministry of Education, Youth and Sports..

Souhrn

Analýza krátce srovnává ekonomické dopady tří možných budoucích plánů hospodaření v Národním parku (NP) Šumava v České republice: (1) pokračování stávajícího hospodaření; (2) přijetí koncepce Bills což by vedlo ke zpřístupnění chráněných území a umožňující vývoj uvnitř některých nejhodnotnějších prostředí divočiny parku; (3) přijetí návrhů k rozšíření zachovalejších jádrových oblastí parku s možnostmi turistiky.
Návrhy v koncepci Bills mají předpoklady k podpoře zaměstnanosti díky rozvoji lyžařského vleku, ale mnoho takových aktivit bude využívat dováženou práci nebo budou krátkodobé. Finanční průchodnost takového rozvoje je nejistá. Ekonomické dopady přijetí koncepce Bills by také zahrnovaly negativní efekty na stávající přírodu díky turistickým aktivitám a na její dlouhodobý možný rozvoj. Současně a s určitostí můžeme konstatovat, že pokud navrhované plány v koncepci Bill budou přijaty, hodnota NP, jako divoké krajiny s významnými ekosystémy, razantně poklesne. Což můžeme považovat za jednu z klíčových slabin celého národního parku – turistika a místa s rekreačním využitím. Příležitost mezinárodního hodnocení národního parku založeného na těchto ekosystémech by byla zhoršena. Tyto škody na ekosystémech by šli proti názoru 75 % obyvatel České republiky.
Pro přírodě blízký vývoj umožní ekonomické příležitosti, které by usilovaly o provozování přírodě blízké turistiky v nových lokalitách a aktivit poblíž rozšířených bezzásahových zón, bez zhoršování ekologické integrity národního parku. Taková turistika odpovídá požadavkům návštěvníků a přispět k růstu ekoturistiky. Nejlepší přístupová místa do divočiny NP Šumava jsou v současné době „zaplněná". Tudíž je zde požadavek pro větší počet přístupových míst do divočiny.
Původní analýza naznačuje, že přírodě blízký vývoj nabízí více ekonomicky a přírodně udržitelný územní plán pro NP Šumava než stávající situace nebo plány navrhované v koncepci Bills.Je doporučeno, aby návrhy koncepce Bills nebyly vůbec uskutečněny, dokud nebude provedeno celkové ekonomické hodnocení.

Contact:
Pavel Kindlmann,
Department of Biodiversity Research, Global Change Research Centre AS CR,
Na sádkách 7, 37005 České Budějovice, Czech Republic
Telephone number: +420 604 753 397, e-mail: pavel.kindlmann@centrum.cz

ASSESSMENT OF ECOLOGICAL SITUATION IN A LANDSCAPE BASED ON CALCULATION OF ECOLOGICAL STABILITY COEFFICIENT

Jaroslav Bažík[1], Zlatica Muchová[1], František Petrovič[2]
Slovak University of Agriculture in Nitra, Slovakia[1], Constantine the Philosopher University in Nitra, Slovakia[2]

Abstract
Lužianky area (size - 1,219,820 m^2, population - 2,536, Nitra district, Nitra region, South-Western Slovakia, 90 % of the area is intensively used as agricultural land, only few elements requiring protection are located here) case study presents possible ways of determining ecological situation using coefficients of ecological stability. Several methodological procedures (e. g. coefficients of ecological stability – KES, coefficient of rural area structure – KS, coefficient of anthropic influence on landscape – KAO, method for determining cone of influence – $KES_{PÚ}$, for the purpose of land consolidation) have been used for the evaluation. This work details selected methodology, shows calculations using GIS and results with accompanying discussion related to the proper understanding/verification of facts. Possible mechanical misinterpretations of calculations which in many cases may predetermine wrong conclusions are highlighted. Assessments of ecological situation, based on calculations using the dataset for the location, can point to a new direction of development towards enhanced ecological stability of the territory with respect to the qualitative and quantitative area characteristics.

Key words: ecological stability of a landscape, coefficient of ecological stability, coefficient of anthropic influence on landscape, authenticity index of original land types, land consolidation

Introduction

Observations of changes in land use through the landscape development are becoming more important. Land use represents certain economic activities in space and time. Also information about historical, economic, social and cultural potential at the interface with natural landscape features and technical capabilities is accumulating. This synergy relates to the spatial rearrangement of the form of the land use, so called country structures. Zonneveld (1995) defines the country structure as just what the country looks like from bird's-eye view. Many authors (Buček – Lacina, 1995; Sklenička, 2003; Supuka et al., 2013) consider country structure as a basic indicator of ecological value of the country. Land use reflects functional features (land types and their uses). Anthropogenic influence usually manifests in their spatial location and representation. Changes in land use which reflect the state of the structure in different time horizons can be monitored. There are different approaches of landscape changes' evaluation in relation to the development, e.g. forest biocenosis (Faltan et al., 2008; Garzia-Ruiza et al., 1996), scattered settlements (Petrovič, 2005; Šolcová, 2013) or in relation to folk architecture (Lipský, 2001; Míchal, 1982). An interesting approach is the evaluation of landscape structure based on original historical water's evolution (Boltižiar et al., 2012), or examination of development of lakes in Tatra Mountains. So far only few Slovak authors consider the evaluation of landscape structure in relation to land consolidation, also taking into account design conditions in a landscape (Muchová – Petrovič, 2010). Efficiency evaluations of designed facilities on the basis of surface assessment of land structure in land consolidation projects are more common in foreign methodologies (Stejskalová, 2012; Konečná et al., 2012).
Monitoring and environmental assessment of a landscape structure development is commonly implemented on the basis of surface representation of the main land use forms. Several types of ecological stability coefficients are used to quantify this evaluation. Different approaches of evaluation are represented here. Some factors are based only on spatial assessment of land fund; others include also a rating of individual landscape elements.
This paper presents landscape development in the last 150 years on a case study for cadastral area of Lužianky. Monitoring and environmental assessment of landscape structure development based on some ecological stability coefficient uses the main form of land fund.

Materials and methods

Case study area

Cadastral area (c. a.) of Lužianky administratively belongs to Nitra region, Nitra district, with total area of 12,419,820 m^2. Geographically, it belongs to Danubian Lowland. Warm, dry climate with mild winters is typical for this area. Eastern part of the area is flat with a slight slope,

western part is lowland. Elevation of this location is between 139 and 233 meters above the sea level. The area is located in the Nitra river basin, river system is undeveloped. The watercourse Nitra is the supra-regional bio-corridor and watercourse Radošinka is an element of regional territorial system. A small dam (Muchová et al., 2007) is located east of the village. According to the phytogeographical division of territory of Slovakia (Atlas Krajiny SR, 2002), c. a. belongs to oak phytogeographic zone. C. a. is currently intensively used as an agricultural land. Permanent grasslands in the typical form of meadows and pastures are virtually not present in this area.

Development of land use

We present the development of land use and the intensity of changes in three time periods (three time horizons). Firs period uses maps of historical landscape (TP 1) from 2nd military mapping of 1843, second period uses maps of current land use (TP 2) based on planimetric mapping for purpose of land consolidation project from 2007 and third period uses maps of GPFOT - general principles of functional organization of the territory (TP 3) from 2011 as an output of the land consolidation project.

Individual land types for historical, current and proposed land structures were mapped. Mapped land types are based on planimetric measurement methodologies for the purpose of land consolidation (Muchová et al., 2009). They show actual conditions on the day of mapping. Proposed land types have been taken from the new state registry. Historical landscape structures have been estimated on the basis of interpretations legend for the 2nd military mapping (Špulerová et al., 2009; Zeman, 2012) and their co-verification on stable cadastre maps. In TP 1, there were totally 7 land types with 96 sites, TP 2 has 6 different land types with 1643 sites and TP 3 1655 sites in 7 different types.

Methods of assessing the landscape structure based on calculation of ecological stability coefficients

Several methods for calculating ecological stability coefficient (KES) are available. Tab. 1 summarizes the methods used in Slovakia.

Landscape changes as manifested by the ecological stability coefficients

The paper further indicates intensity of landscape development as measured by KES. Coefficients for each time period have been calculated and are shown graphically. KES values are dimensionless numbers and should be roughly comparable in the frame of their classification schemes. This argument is shared by several authors, but still it is necessary to clearly declare improvement or deterioration by landscape changes. We will try to verify this assertion.

Results and discussion

Human influence in landscape structure is represented by spatial changes in different time periods. Fig. 1 clearly shows the changes in land use which are in many cases reflected by environmental problems. The most apparent change is in the forest area. None of the forest area is preserved from the original deciduous forests covering originally 23 % of the territory. These complexes of forests were ploughed. That clearly suggests that the current frequent floods (http://www.luzianky.sk) in those areas are the result of intensive agricultural utilization during a fifty years period. In that time, more than 41% of land was used as arable land. In the area of communications, permanent grasslands were located originally. House surroundings were used as yards which accounted for about 1% of the cadastre. Vineyards (1% of territory) were also located there.

Tab. 1: Overview of ecological stability calculations

No	Year	Author	Mark	Formula	Classification
1	1982	Míchal	KES	$\frac{LP+VP+TTP+Pa+Mo+Sa+Vi}{OP+AP+Ch}$	< 0.10 – devastated landscape
					0.10 - 0.30 – above average used area
					0.30 - 1.00 – intensively used area
					1.00 - 3.00 – almost balanced landscape
					> 3.00 – balanced landscape

2	1984	Löw et al.	KES	$\frac{1,5A + B + 0,5C}{0,2D + 0,8E}$	< 1 – devastated landscape 1 – balanced landscape 1 - 10 – predominance of natural elements > 10 – natural landscape
3	1986	Mikós	Ks	$\sum_{i=1}^{n} \frac{p_i \times k_{pt}}{p}$	< 0.2 – significantly unstable landscape 0.2 - 0.4 – unstable landscape 0.4 - 0.6 – partially stable landscape 0.6 - 0.8 – stable landscape 0.8 - 1 – significantly stable landscape
4	1993	Mederly	KS	$\frac{\sum_1^n p_{pn} k_{pn}}{p_{zú}} \times k_r$	< 0.33 – unstable territory 0.34 - 0.50 – stable territory 0.51 - 0.66 – medium stable territory > 0.67 – the most stable territory
5	1995	Streďanský et al.	KES	$KES = \frac{\sum_1^n PK_{st}}{\sum_1^m PK_{nst}}$	< 0.50 - significantly unstable landscape 0.51 - 1.00 - unstable landscape 1.01 - 3.00 - partially stable landscape 3.01 - 4.50 - stable landscape > 4.51 - significantly stable landscape
6	2000	Oberholzer	KES	$\frac{(\sum_{i=1}^{n} B_i \times P_i)}{P_{ZU}}$	0 - 25 - unstable landscape 26 - 40 - partially stable landscape 41 - 100 - stable landscape
7	2001	Kupková	KAO	$\frac{(ROP + RZAP + ROsP)}{(RLo + RPa + RLP + RVP)}$	< 1 – predominance of natural elements 1 - balance > 1 – predominance of unnatural elements
8	2007	Reháčková et al.	KES	$\sum_{1}^{n} \frac{p_i \times S_i}{p}$	1.00 - 1.49 – very low eco. stability 1.50 - 2.49 – low eco. stability 2.50 - 3.49 – medium eco. stability 3.50 - 4.49 – high eco. stability 1.50 - 5.00 – very high eco. stability
9	2009	Muchová et al.	KES PÚ	$\frac{P_5 + P_4 + P_3}{P_2 + P_1 + P_0}$	< 0.40 - very low eco. stability 0.41 - 0.80 - low eco. stability 0.81 - 1.20 - medium eco. stability > 1.21 - high eco. stability

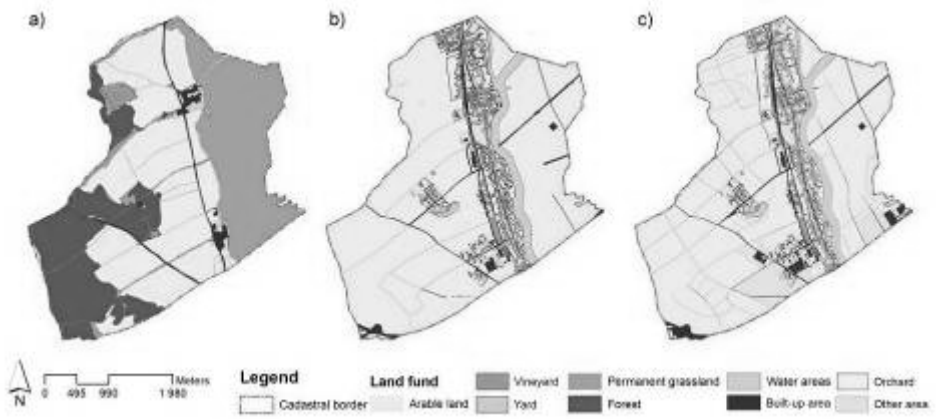


Fig. 1: Representation of land fund in different time periods: a) TP 1: Historical landscape structure; b) TP 2: current land use; c) TP 3: new proposal

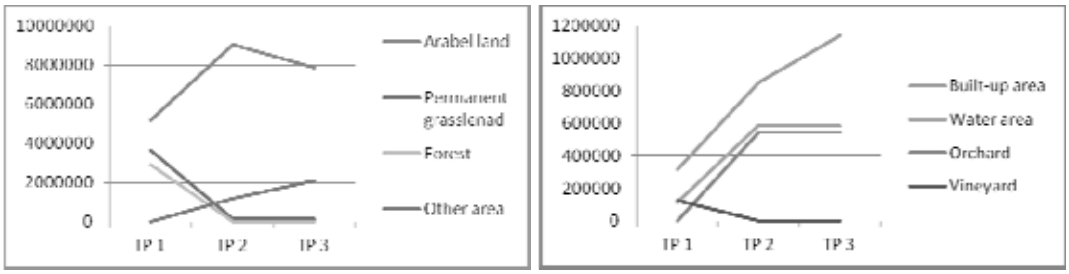


Fig. 2: Graphical representation of changes in land use in different time periods

Major current land use is arable land, up to 73% from 42%. Permanent grassland was reduced from 29% to less than 1%. Forests are currently not present in the area. Non forest vegetation occupies nearly 7% of the area. Thus, we can conclude, that the area was modified to agricultural country in the time span from historical to current period. Similar results have been also shown in case studies for other areas (Jančovič – Petrovič, 2012; Meeus, 1993; Boltižiar et al., 2012). Using land register data (http://portal.statistics.sk) for 1996–2013, we tried to visualize the changes of landscape structure. Fig. 3 shows development of each land type. From this graphs, it is possible to observe changes leading to a significant decrease in arable land. This trend started around 2007 due to a new industrial park in this area. Also, in 2011, we recorded that the area of permanent grassland was increasing due to the registration of land consolidation project in the land registry. Land consolidation project registration in the land registry reflects the area that has been proposed for measures to improve ecological stability. Increases of other areas were also documented, including all areas of existing and new proposed elements of non-forest vegetation.

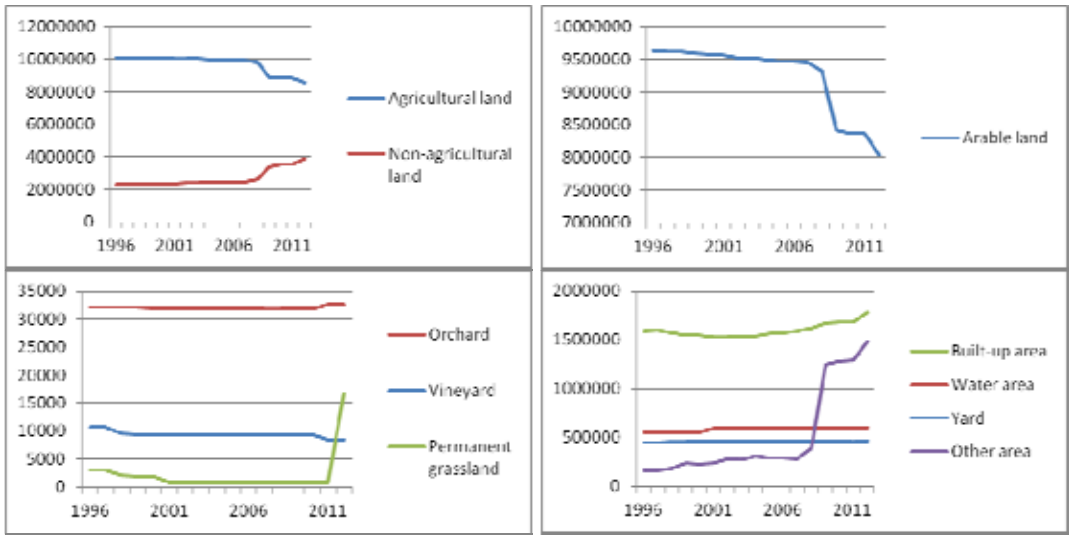


Fig. 3: Land use development in period 1996 – 2013

European trends of land use change since 1783 also show increase in the proportion of non-forest elements, which is confirmed by several authors (Pärtela et al., 1999; Olah, 2006; Špulerová et al., 2001). This is also present in the area of our case study. Trends towards the significant expansion of built-up areas are also observed. These trends are probably related to the location of the cadastre, because it's considered a suburban area of Nitra city, also an industrial park is located in this area. Landscape structure development is rather predominantly oriented to expected benefits in the economic sphere than to the preservation of "historical" landscape. Fig. 4a show unvarying area during TP 1-2. There are approximately 337 ha of unchanged area. Between TP 2-3, small changes are visible due to elements of GPFOT. Significant changes in built-up and other areas are compared. This paper takes into consideration that the new proposals will be realized. TP 3 proposes expansion of small-scale green spaces. About 7% increase of non-forest vegetation is expected. Also the continuation of the trends of gradual increase of built-up areas is to be expected. This change is contingent upon reduction of arable land. Fig. 4c shows stable surfaces for TP 1-2-3. Unchanged areas retain on 274 ha and there were changes on 967 ha.

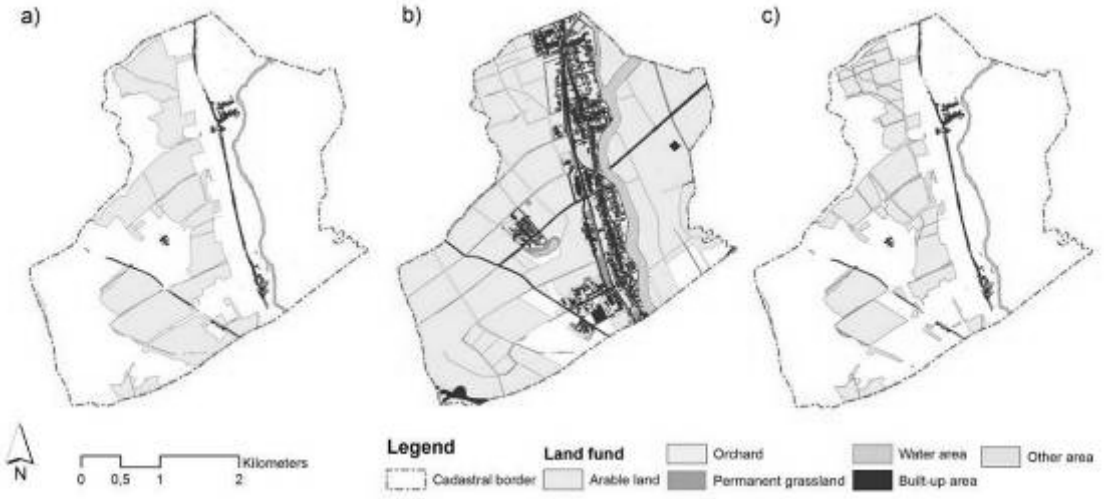


Fig. 4: a) Unvarying land use in time period TP 1 and TP 2; b) Unvarying land use in time period TP 2 and TP 3; c) Unvarying land use in time period TP 1, TP 2 and TP 3

Landscape changes as seen by some ecological stability coefficients were determined. Tab. 2 presents the calculations for different time periods and coefficients.

As it was mentioned above, several documentations are referring to ecological stability coefficients in order to express positive or negative changes in landscape development. However not all coefficients can map this change because of unsuitable rating scale, improperly defined classification, etc. As an example, we are comparing TP 2 and TP 3. After new proposal, only 19% of area has been changed. Some factors didn't record any change, although ecologically stable areas have increased.

Several possibilities can be chosen to evaluate landscape. Deficiency of some coefficients is that they don't involve enough semi-objectivity and completeness in evaluating. Landscape is usually highly diverse and often contains specific classes which are very difficult and often impossible to integrate into any of these categories. Therefore it is important to choose coefficient, which takes into account each element separately with adequate value assigned.

If we compare coefficients which take into account ecological value of individual elements (2 – Löw et al., 1984; 3 – Miklós, 1986; 4 – Mederly, 1993; 6 – Oberholzer, 2000; 8 – Reháčková et al., 2007; 9 – Muchová et al., 2009) results for TP 1 are nearly identical. All coefficients but the 3, 6 and 8 classify the case study area as very stable with dominance of natural elements. Other coefficients evaluated this area as partially or medium stable. The discrepancy lies in the way of defining a classification scheme for ecological stability. It is obvious, from the historical landscape that dominant elements are forest and permanent grassland (more than 55% of area) although mentioned coefficient considered this area as not stable. We think that coefficients 2, 4 and 9 have upper limit of stability chosen optimally. For the sake of comparisons, coefficients 2, 4, 6 and 8 didn't take into account increase of green area in the new proposals (19% of area).

Based on our calculation, we conclude that two approaches (Miklós, 1986; Muchová et al., 2009) can precisely evaluate ecological stability of the area. In approach of Miklós (1986) we recommend redefining of classification.

Tab. 2: Calculation of KES and interpretation of results for each TP

No.	KES TP 1	KES TP 2	KES TP 3	Classification
1	1.26			almost balanced landscape
		0.25	0.38	landscape used above average
2	5.11			predominance of natural elements
		0.55	0.60	devastated landscape
3	0.49			partly stable landscape
		0.17		significantly unstable landscape
			0.20	unstable landscape
4	3.63			the most stable territory
		0.16	0.17	unstable territory
5	1.26			partially stable landscape
		0.12	0.12	significantly unstable landscape
6	30.02			partially stable landscape
		18.11	19.17	unstable landscape
7	0.80			predominance of natural elements
		8.64	8.64	predominant of unnatural elements
8	2.54			medium eco. stability
		1.32	1.38	very low eco. stability
9	1.26			high eco. stability
		0.25		very low eco. stability
			0.42	low eco. stability

Conclusion

We would like to highlight some points here. Information about land use in three different periods was obtained for cadastral area of Lužianky. Description of land use in c. a. Lužianky was developed for period of over 150 years as a basis for the evaluation and prediction of landscape development. For time period 1 materials of 2nd military mapping were used, for time period 2 materials of current land use based on planimetric mapping for purpose of land consolidation project were used and for time period 3 maps of general principles of functional organization of the territory as the output of the land consolidation project were used. For assessment of collected data, various calculations of ecological stability coefficients were performed. In this paper, we also attempted to compile the register of some available coefficients and we have evaluated them. Calculations of coefficients for all time periods have been done; also the results were compared and assessed. On the model cadastral area, we discussed and highlighted the need for adaptation of some coefficients.

References

ATLAS KRAJINY SLOVENSKEJ REPUBLIKY. 2002. Bratislava : Ministerstvo životného prostredia SR; Banská Bystrica : Slovenská agentúra životného prostredia. 344 p. ISBN 80-88833-27-2.

BOLTIŽIAR, M. et al. 2012. Vývoj krajiny vo výskumnom polygóne suchého poldra Beša na východoslovenskej rovine v časovom horizonte 1770 - 2008. In *Folia Geographica,* No. 20, Vol. 54, pp. 23-36. ISSN 1336-6149.

BUČEK, A., LACINA, J. 1995. Přírodovědná východiska ÚSES. In LÖW, J. et al.. *Rukověť projektanta místního územního systému ekologické stability. Teorie a praxe.* Brno : Doplněk. 124 p. ISBN 80-85765-55-1.

FALŤAN, V. et al. 2008. *Zmeny krajinnej pokrývky úpätia Vysokých Tatier po veternej kalamite*. Bratislava : Geografika, 96 p.
GARZIA-RUIZ J. M. et al. 1996. Land-use changes and sustainable development in mountain areas: a case study in the Spanish Pyrenees. In *Landscape Ecology*, No. 11, Vol. 5, pp. 267-277. ISSN 0921-2973.
JANČOVIČ, P., PETROVIČ, F. 2012. Trends of the Cultural Landscape Development between Towns Piešťany and Hlohovec. In *Životné prostredie*, No. 1, Vol. 46, pp. 34–37. ISSN 0044-4863.
KONEČNÁ, J. et al. 2012. *Hodnocení účinnosti realizací protierozních a vodohospodářských zařízení v modelových územích*: redakčně upravená roční zpráva. Brno : VÚMOP, v.v.i., 131 p.
KUPKOVÁ, L. 2002. Data o krajině včera a dnes. In *Geoinfo*. Vol. 8, No. 2, pp. 16–19.
LIPSKÝ, Z. 2000: *Sledování změn v kulturní krajině*. Kostelec nad Černými lesy : ÚAE LF ČZU, 71 p.
LÖW, J. et al. 1984. *Zásady pro vymezování a navrhovaní územních systému ekologické stability v územně-plánovací praxi.* Brno : Agroprojekt, 55 p.
MEDERLY, P. et al. 1993. *Regionálny územný systém ekologickej stability – okres Žilina.* Nitra : Regioplán; Žilina : Ekoped, 112 p.
MEEUS, J. H. A. 1993: The transformation of agricultural landscapes in Western Europe. In *The Science of the Total Environment*, Vol. 129, No. 1-2, pp. 171-190. ISSN 0048-9697.
MÍCHAL, I. 1982. Principy krajinářského hodnocení území. In *Architektúra a urbanizmus, XVI/Z*, Bratislava : VEDA SAV, pp. 65–87.
MIKLÓS, L. 1986. Stabilita krajiny v ekologickom genereli SSR. In *Životné prostredie*, Vol. 20, no. 2, Bratislava : ÚKE SAV, pp. 87–93. ISSN 0044-4863.
MUCHOVÁ et al. 2009. *Metodické štandardy projektovania pozemkových úprav*. Nitra : SPU v Nitre v spolupráci s MP SR. 397 p. ISBN 978-8-552-0267-9.
MUCHOVÁ, Z., PETROVIČ, F. 2010. Changes in the landscape due to land consolidations. In *Ecolog,*. Vol. 29, No. 2, pp. 140-157. ISSN 1335-342X.
MUCHOVÁ, Z. et al. 2007. *Všeobecné zásady funkčného usporiadania územia v obvode projektu pozemkových úprav v katastrálnom území Lužianky.* Technická správa, Geodetická odborná kancelária s.r.o. 140 p.
OBERHOLZER, G. 2000. *Die Weiterentwicklung der Kulturlandschaft.* München : Universität der Bundeswehr. 152 p.
OLAH, B. 2003 *Vývoj využitia krajiny Podpoľania – Starostlivosť o kultúrnu krajinu prechodnej zóny Biosférickej rezervácie Poľana*. Vedecké štúdie 1/2003/B. Zvolen : Technická univerzita Zvolen, 111 p. ISBN 80-228-1251-X.
PÄRTELA, M. et al. 1999. Landscape history of a calcareolus (alvar) grasslands in Hanila, western Estonia, during the last three hundred years. In *Landscape Ecology*, Vol. 14, No. 2, p.129-132. ISSN 0921-2973.
PETROVIČ, F. 2005. *Vývoj krajiny v oblasti štálového osídlenia Pohronského Inovca a Tribeča.* Bratislava : ÚKE SAV, 209 p. ISBN 80-969272-3-X.
REHÁČKOVÁ, T. et al. 2007. Metodický postup stanovenia koeficientu ekologickej stability krajiny. In *Acta Environmentalica Universitatis Comenianae,* Vol. 15. Bratislava : Univerzita Komenského v Bratislave. pp. 26-38. ISSN 1335-0285.
SKLENIČKA, P. 2003. *Základy krajinného plánování.* Praha : Naděžda Skleničková, 321 p. ISBN 80-903206-1-9.
ŠOLCOVÁ, L. 2013. *Vývoj krajiny s disperzným tzpom osídlenia v Novobamskej štálovej oblasti*. Nitra : UKF Nitra, 209 p. ISBN 978-80-558-0208-4.
ŠPULEROVÁ, J. et al. 2009. *Príručka na mapovanie historických štruktúr poľnohospodárskej krajiny.* Bratislava : Ústav krajinnej ekológie SAV, 16 p.
ŠPULEROVÁ, J. et al. 2011 Inventory and classification of historical structures of the agricultural landscape in Slovakia. In *Ekológia,* Vol. 30, No. 2, pp. 157-170. Bratislava : Slovenská akadémia vied. ISSN 1335-342X.
STEJSKALOVÁ, D. et al. 2012. Metoda ekologického a estetického hodnocení společných zařízení pozemkových úprav. In *Littera Scripta*, Vol. 5, No. 2, pp. 287-303. ISSN 1802-503X.
STREĎANSKÝ, J. et al. 1995. *Tvorba krajiny.* Nitra : VŠP. 104 p. ISBN 80-7137-224-2.
SUPUKA, J. et al. 2013. *Landscape structure and biodiversity of woody plants in the agricultural landscape*. Brno : Mendelova univerzita v Brně, 187 p. ISBN 978-80-7375-905-6.
ZEMAN, M. 2012. Historické mapové diela na geoportal.sazp.sk. In *Enviromagazín.* Vol. 17, No. 5, pp. 20 – 21. ISSN 1335-1877.
ZONNEVELD, I. S. 1995. *Land Ecology*. Amsterdam : SPB Academic Publishing.

Acknowledgement
Results obtained in the research tasks/projects VEGA no. 1/0656/12 and no. 1/0268/14 have been used/presented in this paper.

Souhrn
Na podkladě katastrálního území Lužianky (Nitriansky kraj, okres Nitra, výměra – 12,419,820 m^2, Podunajská nížina v nadmořské výšce, 233-139 m. n. m.) byly shromážděny informace o třídách využití krajiny k definovaným časovým horizontem. Byl zpracován popis vývoje tříd využití krajiny pro období posledních cca 150 let jako podklad pro hodnocení a predikci vývoje krajiny. Pro časový horizont 1 byly využity podklady II. vojenského mapování ověřené na mapách stabilního katastru. Pro časový horizont 2 byly využity výstupy účelového mapování polohopisu z projektů pozemkových úprav a třetí časový horizont byl naplněn údaji dle návrhu obecných zásad funkčního uspořádání území. Jedná se o návrh nového funkčního uspořádání, který vyplynul z realizovaného projektu pozemkových úprav v roce 2011. Údaje o plošném zastoupení jednotlivých druhů pozemků byly zpracovány na podkladě polohopisného zaměření území ve třetí třídě přesnosti. Z podkladů MÚSES pro účely pozemkových úprav byla určena ekologická kvalita jednotlivých mapovaných prvků, v podrobnějším členění podle metodiky Muchová a kol, 2009. Celkem bylo pro TP 1 použitých 96 areálů tříd využití území v 7 druzích pozemků, pro TP 2 - 1643 areálů v 6 druzích pozemků a pro TP 3 - 1655 areálů v sedmi druzích pozemků. Byly zpracovány mapové výstupy a tabulkové sestavy, na základě kterých byl analyzován průběh vývoje modelového území a bylo poukázáno na stálost některých krajinných struktur. Pro posouzení shromážděných podkladů vyjadřujících stav krajiny v různých časových horizontech, se využily výpočty koeficientů ekologické stability podle různých autorů. Příspěvek obsahuje i souhrnný popis dohledání koeficientů ekologické stability území. Pro všechny vymezené časové horizonty se vypočítalo devět vybraných koeficientů, jejichž výsledky se navzájem porovnaly. Z výsledků vyplynula diskuse o objektivnosti, úplnosti a využití jednotlivých koeficientů. Bylo poukázáno na potřebu přizpůsobení resp. úprav některých koeficientů.

Contact:
Ing. Jaroslav Bažík
Department of Landscape Planning and Ground Design, Horticulture and Landscape Engineering Faculty, Slovak University of Agriculture (SUA) in Nitra, Slovakia
Hospodárska 7, 949 76 Nitra, Slovakia
tel.: +421 37 641 5226, e-mail: jarobazik@gmail.com

BACK TO THE GREEN LANDSCAPE

Hedvika Psotová
Arvita P spol. s r.o. Otrokovice

Abstract
The contribution deals with the impact of new investments into the countryside and the possibilities of compensation of these effects based on examples of realized masterplans. New trasporting networks, commercial and industrial areas are significantly resulting in quality of the landscape and the deterioration of the ecological stability.
New site plans could could enjoy with benefit historical landscape structures or create new scene. European programmes and grants can be advantageously use to improve the state of nature and the landscape.

Key words: countryside, green vegetation, ecological stability, grants

Introduction
Actually there is strong and permanent pressure to built on outdoor countryside. Instead ring of gardens and small holdings around settlements, old alleys along the roads, riverside green and fields there are realized new construction and buildings. Landscape is there intersected by transport corridors intersect transport structures, following by industrial and storage zones. The impact of these changes is seen in the fragmentation, decline of ecological stability and the reduction in the landscape as a social and recreational space.

Materials and methods
Landscape and rural area deals with a number of specific material – czech and european legislation, conventiones, standards like European Landscape Convention, Natura 2000, SEA,EIA Individual ministeries have legal and economical instruments to regulate and support the development of landscape, for example land planning, land repploting, teritorial systems of ecological stability and others. However – there is very hard to coordinate all needs and interests, coordinate them and compensate negative effects of development.

Results
Area of town Hulín is heavy stressed by trafic development and related activities. I would like to demonstrate the possibilities of compensation. Green planning rpresents enormous potential as the most negative effects offset or minimize to an acceptable level.

Fig. 1: Natural Park Záhlinické rybníky – meadow

The actual state of landscape
Hulin is located in the district of Kroměříž, in the southern part of the regional area Haná. Hulín belong according Typology of Czech landscape to megatyp central European collective

openfields. The current biodiversity is low, ecological stability decreases, exposure to wind and water erosion is due to oversized blocks of arable land high. This landscape is not attractive for living, it is so called “landscape on stands”.

The only exception is south – south-west part od the area with large gravel mining lake and namely Natural park Záhlinické rybníky. This komplex of ponds, meadows and alluvial forrests is a Unixe landscape ad biologiccaly valuable
The large majority of area create condition for intensive farm fields and technical infrastructure (see photo No 3). Current arable lan dis 89% and this number far exceeding the average percentage of arble land in Czech republic (71,2%). In case of continuous production priorities we can confidently expect a decrease environmental condition, further degradation of biodiverzity and reducing soil fertility.

Fig. 2: Water landscape in Natural park

Urban plan Hulín
Urban plan Hulín as a basic tool to realize new project and land acitivites claims following areas :

Housing	80,2 ha
Civic amenities	0,3 ha
Production	223,5 ha
Recration	0,8 ha
Transportation	88,7 ha
Green	47,8 ha
TSES	21,9 ha
Total	463,2 ha

Changes in land use account for 14.4 % of the total area of the cadastral area and significantly affect sustainable development in the region, not least the recreational potential of the landscape and " residential " value territory.
Extremely significant change in land use represent transportation projects. Besides the direct occupation of the land fund this type of construction significantly affects the economic, natural and aesthetic relations in the countryside
The municipality therefore started with the preparation of compensatory measures that would contribute to improve the situation. The basis has become land replotting folowing implementation projects to revitalize the landscape.
Currently implemented a forest park with an area of 10 ha to shield traffic from settlement. Little ponds and wetlands, park ways and alleys are realised using EU grand resources and Czech subsidies. Ready is the implementation of two biocenters and other landscape elements.

Fig. 3: Landscape of Central European collective openfields

Conclusion

Hulin remains productive landscape due to fertile soils and the status of settlements in the region. Thanks to reprezentantives of town and active inhabitants are developed also other landscape features - natural, eco-stabilizing, water, recreational, aesthetic, and more. Hulin has became multifunctual harmonious landscape.

Souhrn

Příspěvek pojednává o významných změnách ve využití území, které přináší realizace velkých záměrů. Na příkladu města Hulína je demonstrován rozsah změn a možnosti kompenzace negativních vlivů na krajinu, které tyto změny, jako je realizace velkých dopravních staveb, přinášejí. Územní plán vytváří předpoklady, pro realizaci záměrů ve prospěch krajiny je však zapotřebí vynaložit značné úsilí ze strany zastupitelstva města i aktivních občanů. Bez investic města do projektové připravenosti by realizace opatření ve prospěch přírody a krajiny zůstala na papíře.

Contact:
Ing. Hedvika Psotová
Arvita P spol. s r.o.
Otrokovice, Příčná 1541, PSČ 765 02
telefon, e-mail: 420 577 938 161, arvita @arvita.cz

BIOCLIMATIC CONDITIONS FOR THE RECREATIONALLY IMPORTANT AREAS IN THE MEDIUM SIZE CITY

Tomáš Středa[1], Hana Středová[1], Iva Šedivá[2]
Mendel University in Brno[1]; Department of the Environment, Municipality of Hradec Králové[2]

Abstract
Air temperature and humidity conditions depending on the land cover and land use were monitored in Hradec Králové by a network of meteorological points. The sensors had been placed in a wide variety of urban and suburban environments. The article analyzed the data from the period 2011/2012 and 2012/2013, separately for warm and cold season of the year. Maximum temperature differences among the individual monitored points in warm season were as fallow: average 3.5°C, absolute maximum 7.7°C and absolute minimum 4.9°C. The data from reference standard meteorological stations were used for the comparison and modeling. Air temperatures at the points of interest can be successfully modeled by regression relationships. A spatial expression of point measurements of air temperatures were provided by GIS methods in combination with CORINE land cover layer. The effect of land cover was also reflected in the formation of humidity. Analogical modeling of relative humidity (based on a simple regression with the data from reference station) is loaded with a relatively significant error. Using of this procedure is thus limited. The Universal Thermal Climate Index (UTCI) was used to express a stress of the organism by their environment.

Key words: land cover, city development plan, microclimate, recreation, thermal discomfort

Introduction

Urban Heat Island (UHI) is a function of meteorological factors (air temperature, precipitation, solar radiation, cloud cover, air flow, evapotranspiration etc.) and the character of the city itself: the number and population density, topography, altitude, water bodies, land cover - built-up area, surface color, distance between buildings, building heights, surface resistance, surface geometry of the city - the so-called "street canyon", "anthropogenic heat" of heating and industry, surface retention etc. (Oke, 1997; Voogt, 2002). Often presented idea of the heat island as concentric isotherms with maximum temperature in the center and gradual decrease towards the outskirts is greatly simplified. Especially warm bodies with the characteristics features (parking, industrial equipment, flat roofs, asphalt roads, etc.) are defined as "micro urban heat islands - MUHI" (Středa et al., 2011). Evaluating of satellite thermal images and data on mortality (for example in Montreal, Chicago, Lisbon or Paris) proved a direct connection between the risk of death in areas with higher surface temperatures during extreme hot days.

Materials and methods

A network of special purpose monitoring points was established in Hradec Králové in 2011 to analyze the influence of surface properties (land cover and land use) and its horizontal variability on temperature and humidity conditions (Tab. 1, Fig. 2). Sensors monitor the temperature and humidity in a wide variety of urban and suburban environments. A data from standard meteorological station of Czech Hydrometeorological Institute (CHMI) were used as reference.

CHMI station „Hradec Králové Svobodné Dvory“ and „Nový Hradec Králové“ are the standard climatological stations with the monitoring in meteorological box at two meters above the grasslands. The special purpose measuring by the sensors U23 HOBO Pro v2 Temperature/Relative Humidity Data Logger U23 - 001 located in the radiation shield took a place at a height of two meters above ground. The measurement step at all stations was ten minutes.

The evaluation was carried out separately for hot and cold part of the year and light and dark part of the day due to significantly different effect of solar radiation, the surfaces radiation, patterns of airflow etc.

Tab. 1: Location and specification of measurement points

Name, abbreviation and location of measurement	numerical designation	Brief characteristics of the environment
Technické služby (TS): 50°11'43.159"N, 15°51'18.336"E	1	significant proportion of horizontal concrete and asphalt surfaces, partly grassland, sunlit spaces all day
Městský park – Jiráskovy sady (Park): 50°12'21.884"N, 15°49'31.925"E	2	grown woody vegetation in the city center, grass cover, full shade, near the confluence of two major rivers
Městské lesy (Les): 50°10'39.974"N, 15°54'14.036"E	3	Middleage predominantly coniferous forest, shadied by trees (except afternoon), the absence of significant areas with artificial surface
Historické centrum města – Hudební síň (Hudební síň): 50°12'39.493"N, 15°49'55.767"E	4	The historical part of the city center, enclosed area (courtyard) with vertical surfaces and limited air flow, artificial solid surface, insolation from morning until afternoon
MŠ Průmyslová (MŠ vnitroblok): 50°12'52.516"N, 15°49'32.781"E	5	location surrounded by residential buildings of five floors high, the immediate surroundings of the measurement with the occurrence of woody and shrubby vegetation, grass cover, small summer swiming pool, afternoon partially sunlit
MŠ Malšova Lhota (MŠ Malšova L.): 50°12'29.911"N, 15°53'6.672"E	6	edge of the suburban build-up area, woody and shrubby vegetation, grass cover, most of the day overshadowed
Stanice ČHMÚ Svobodné Dvory (Svobodné Dvory): 50°13'21.367"N, 15°47'15.969"E	7	situated according to the principles for the meteorological stations establishment, the sensor in the metaorolological box
Stanice ČHMÚ Nový Hradec Králové (Nový Hradec): 50°10'39.01"N, 15°50'18.98"E	8	situated according to the principles for the meteorological stations establishment, the sensor in the metaorolological box

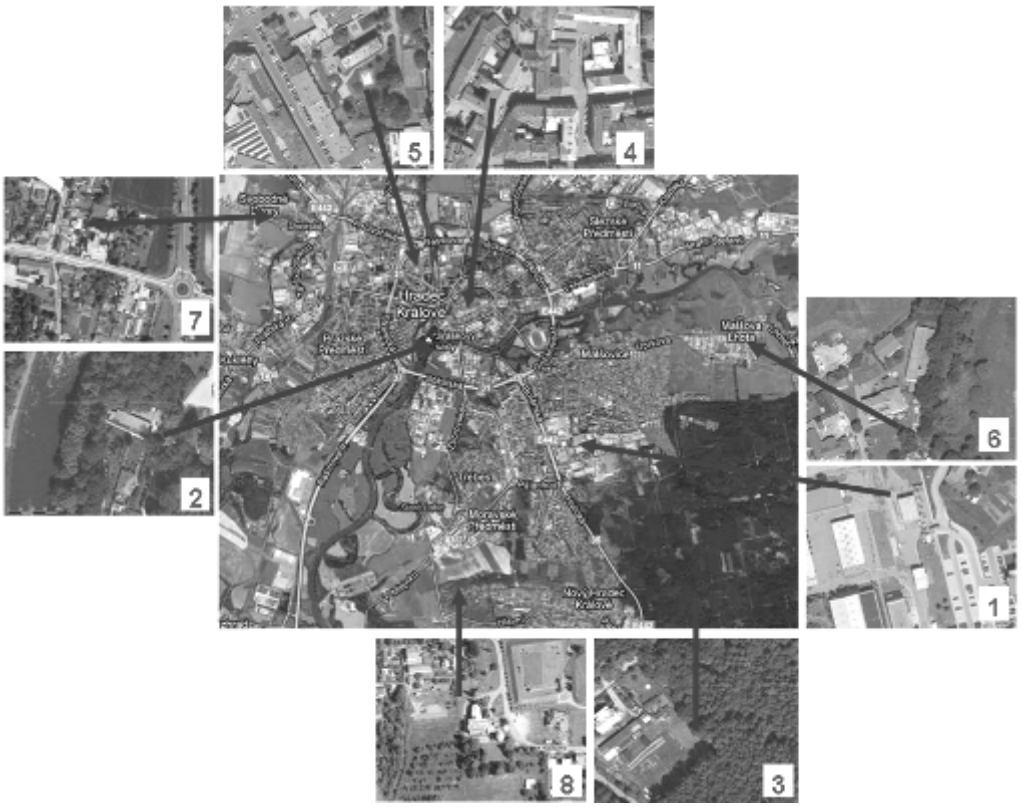


Fig. 1: Location of measuring points

The areas with relatively identical parameters and the similar impact on the climate were defined based on the layer of land cover CORINE (Coordination of Information on the Environment) from 2006. The area of interest was divided by CORINE methodology into six different surfaces with representative measurement point.

Results

Tab. 2 and 3 show the warmest point in term of mean, minimum and maximum values is „Hudební síň" locality. The coldest point in term of mean values is „Les", in term if minimum „TS" and „Les" and in term of maximum „Park". The „Park" is thus location with the most intense cooling effect at extremely high temperature episodes and shows the smallest temperature amplitude. „TS" and „Hudební síň" show the highest amplitude of extremes due to artificial surfaces.

Fig. 2 shows a course of air temperatures and their differentions during the extremely hot day.

Tab. 2: Basic statistical analysis of air temperature during the warm period 2012

Whole season July – September 2012						
	N valid	Average	Median	Minimum	Maximum	St. dev.
Les	12960	*14.6*	*14.4*	-1.8	35.3	6.3
TS	12960	16.1	15.9	*-2.6*	37.6	**7.1**
Park	12960	15.7	15.7	1.4	*32.2*	*5.6*
Hudební síň	12960	**17.7**	**17.3**	**2.3**	**39.9**	6.6
MŠ vnitroblok	12960	16.2	16.0	1.5	33.3	5.9
MŠ Malšova L.	12960	15.2	15.1	-1.5	35.8	6.3
Nový Hradec	12959	15.8	15.6	0.4	34.8	6.0
Svobodné Dvory	12959	15.7	15.5	-0.1	35.4	6.2

Note: maximum in bolt, minimum in italics

Tab. 3: Basic statistical analysis of air temperature during the warm period 2013

Whole season July – September 2013						
	N valid	Average	Median	Minimum	Maximum	St. dev.
Nový Hradec	6048	21.2	20.5	9.2	37.6	5.4
Svobodné Dvory	6048	21.1	20.5	8.7	37.1	5.5
Les	6048	*20.1*	*19.4*	*7.2*	38.1	5.9
TS	6048	22.1	21.4	8.0	39.9	**6.4**
Park	6048	21.1	20.5	11.1	*35.9*	*4.7*
MŠ vnitroblok	6048	21.8	21.3	10.3	36.5	5.1
Hudební síň	6048	**23.6**	**22.4**	**11.7**	**41.4**	5.9

Note: maximum in bolt, minimum in italics

Spatial expression of the temperature in Hradec Králové and its surroundings (2012)

Spatial expression of point measurements of air temperatures with use of CORINE layer and GIS interpolation methods is shown in Fig. 3 to 6. Although it is a generalized expression of the surface temperature distribution the temperature difference depending on surface and surounding are obvious. It shows also the cooling effect of vegetation and water bodies. During the hot day (20 August 2012), the difference of air temperatures in central and suburban parts of Hradec Králové in the light part of day exceeded 5°C.

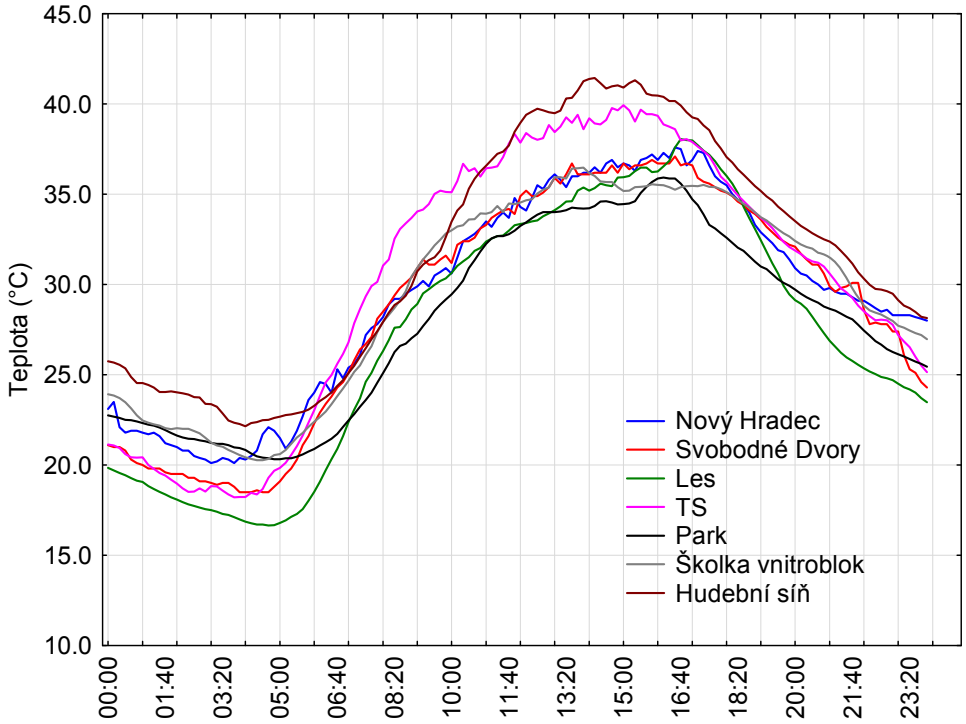
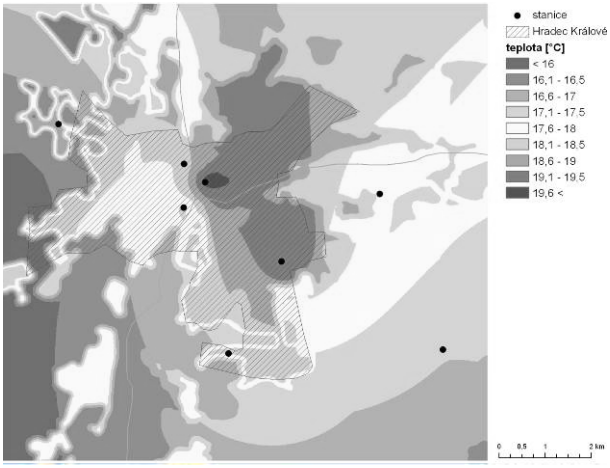


Fig. 2 The course of air temperature during the hottest day (28 July 2013)



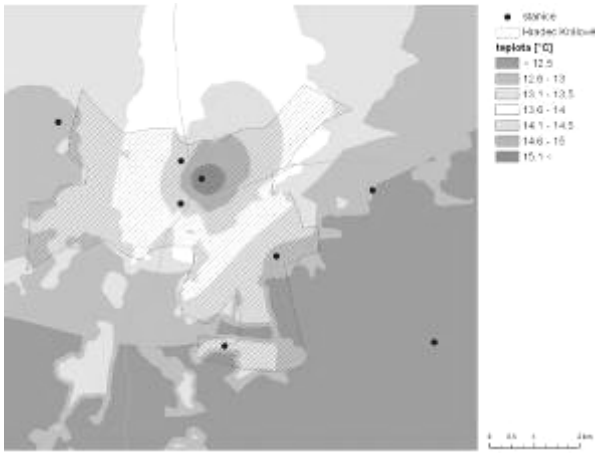


Fig. 3 Average air temperature in a light part of day in warm season (left)
Fig. 4 Average air temperature in a dark part of day in warm season (right)

Conclusion

A significant positive thermoregulation effect of vegetation (including the disperse one) was proved. Air temperatures at measurement points can be modeled by regression relationships with a high degree of reliability. The effect of "land cover" was also reflected in the humidity formation, although the modelling of relative humidity using a simple regression is loaded with a relatively large error. Tested mapping expression and distribution of temperature or air humidity using the CORINE layer is generalized output with just orientation information value. To maximize the informative value a more punctual data of land cover in GIS are needed. Nevertheless the vegetation removing and unifying of areas with higher radiation balance increases temperature extremes and resulting biological stress and discomfort.

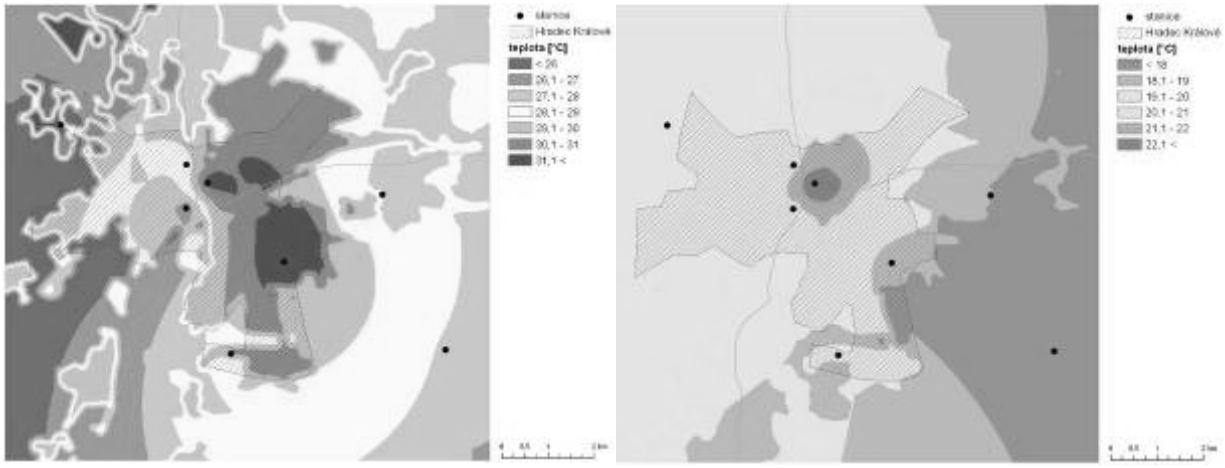


Fig. 5 Average air temperature in a light part of hot day (left)
Fig. 6 Average air temperature in a dark part of hot day (right)

References

OKE. T. R. Urban climates and global environmental change. In Applied Climatology (eds: Thompson. R.D. and Perry. A.). Routledge. 1997. London-New York. pp. 273-287.
STŘEDA. T.. STŘEDOVÁ. H.. ROŽNOVSKÝ. J. Microclimate of tourist attractive areas of Brno city. Public Recreation and Landscape Protection - Hand in Hand? Conference proceeding. Mendel University in Brno. Brno. 2011. pp. 78-84. ISBN: 978-80-7375-507-2.
VOOGT. J. A. Urban heat island. In: Encyclopedia of global environmental change. Volume 3. Causes and consequences of global environmental change. Wiley. 2002. pp. 660-666. ISBN: 978-0-470-85362-7.

Acknowledgement

The paper was supported by project of Ministry of agriculture NAZV QJ1230056 „The impact of the expected climate changes on soils of the Czech Republic and the evaluation of their productive functions“.

Souhrn

Pro analýzu teplotních a vlhkostních podmínek v závislosti na charakteru povrchu (land cover a land use) byla v Hradci Králové v roce 2011 založena síť meteorologických bodů. Senzory monitorují teplotu a vlhkost vzduchu v širokém spektru urbánních a suburbánních prostředí. V článku jsou vyhodnocena data z období 2011/2012 a 2012/2013. zvlášť pro teplou a chladnou část roku. V teplé části roku byly mezi lokalitami zjištěny rozdíly průměrných denních teplot vzduchu až 3.5 °C; v maximální teplotě 7.7 °C a v minimální teplotě vzduchu 4.9 °C. Pro možnost modelování meteorologických podmínek byla použita data z referenčních standardních meteorologických stanic. Teploty vzduchu na zájmových bodech lze s velkou mírou spolehlivosti modelovat prostřednictvím regresních vztahů. Pro plošné vyjádření bodových měření teplot vzduchu byly použity GIS metody v kombinaci CORINE land cover layer. Vliv „land cover“ se projevil také při formování vlhkostí vzduchu. Modelování relativní vlhkosti vzduchu s využitím jednoduché regrese s využitím dat z referenční stanice je zatíženo poměrně velkou chybou. Využití tohoto postupu je tak limitováno. Data mohou být použita pro vyjádření zátěže organismu stavem okolního prostředí např. pomocí Universal Thermal Climate Index (UTCI).

Contact:

Ing. Tomáš Středa. Ph.D.
Mendel University in Brno
Faculty of Agronomy
Zemědělská 1. 613 00 Brno
+420 545 133 305. streda@mendelu.cz

BOHEMIAN FOREST BIOSPHERE RESERVE AND RECREATION

Jiří Junek[1], Jitka Fialová[2], Hana Kubíčková[2]
Independent forestry journalist[1], Mendel University in Brno[2]

Abstract
One of the core projects in the UNESCO MAB (Man and the Biosphere - Man and the Biosphere) was the establishment of a coordinated world network of sites representing the main ecosystems of the planet, which should protect genetic resources, and where might well be done research on these ecosystems, as well as its monitoring. These places in the global network were named "Biosphere Reserve". At present are in 117 countries declared 610 biosphere reserves, of which 12 cross-border. Šumava is one of six Czech biosphere reserves, declared by UNESCO, which also include Krivoklatsko, Trebon, Mountains, White Carpathians and the Lower Morava. Each of biosphere reserves is something unique. Šumava Biosphere Reserve was declared in 1990 to protect the Bohemian forests, meadows, lakes and rivers in the typical conditions of the European Central Highlands.
Šumava is unique and undisturbed forested developing biological community. The life of the local people is significantly affected by the adverse natural conditions which have a direct impact on the historically sparse population of the Bohemian Forest.
In the BR Šumava is due to many different entities depends on countless beneficial and positive activities, which completely fits with the mission biosphere reserve.

Key words: tourism, information centre, public

Egyptian cross - the symbol MaBV in 1970 was declared on the UNESCO general conference program generally known by the acronym MAB - Man and the Biosphere, in which are advertised throughout the world biosphere reserve.
One of the flagships of BR is possible without exaggeration signs of regional products and services FOREST original product ®, www.regionalni - znacky.cz. In the history of skiing in Šumava nothing rivals the Giant Mountains. To be satisfied with today's guests and skiers home, this is a long-term project seeks to provide a white trail in the Bohemian Forest, www.bilastopa.cz. Tourist Information Centres in Sumava, regardless of whether they are operated by the state, municipalities, NGOs or the private sector take care of it to make guests feel at home, but increasingly directed its activities at residents of the Bohemian Forest.
The fact that the BR Šumava is not only natural, but also an equally rich cultural area, to convince hundreds of cultural events not listed on the website www.isumava.cz. Its location on the entire Šumava recall that historically the cultural center of gravity is just around the edges of the biosphere reserve and in a way in Šumava wider scale balances the superiority of nature in the central part of the biosphere reserve. Administration of NP and PLA (www.npsumava.cz) as one of the Šumava Biosphere Reserve partners offers in addition to the care of the National Park of nature in its many facilities activities of environmental education mediation natural experiences. For all our names, most recently the area of forest games at Stozec or nature trail packhorse bogs. Green buses crossing the Bohemian Forest in the summer or Wizard Šumava are also activities in which the organization is gradually applied a broader view of the Šumava Biosphere reserve. Šumava landscape of dense forests and meadows interwoven web of mountain streams, rivers and navigation channels gives us the ability to create unique and original products as well as offering a roof over your head in a quaint guest houses, hotels and restaurants.
Forest has always provided an opportunity for rest and entertainment, was a source of guidance and inspiration and the environment, the scope of which mystery, variety of shapes and colors attracted humans. At first serve mankind merely its natural existence, it has provided fuel, livelihoods and protection from enemies. In the deep woods of yore took place individual and collective game hunting (in the 15th and 16th centuries, with the participation of a large number of hunters and beaters), initially as a way of obtaining food, and later as the main form of entertainment and sports activities of the royal court and the ruling feudal layers. Already at that time had a positive effect in the development, strengthening and maintaining physical and mental health of people residing there. Today we would say that was already filled hygienic and recreational function. These beneficial effects on human health have been known since antiquity. But not until the 18th century was the beginning of modern exploitation of the natural environment for recreation and regeneration of physical and mental powers of man in the true

sense of the word. Jean Jacques Rousseau was one of the first philosophers who pioneered the "return to nature", and led his contemporaries to a romantic view on the forest, and yet preserved natural values.

Nature in the South and West Bohemia at that time was still in many places almost untouched and deep, especially frontier forests still not undergone major felling. These included several wealthy aristocratic families that protect them against penetrating destructive efforts. The most powerful of these were the Schwarzenberg family, who owned a large part of the region, a large part of the Bohemian Forest. Their forests, mainly in the central part of the Šumava, were still almost intact, inaccessible, impenetrable and gave a many dangers. In large forest complexes still exist native species of carnivores which elsewhere have been exterminated. So far, there lived wolves, lynx and bears, along with cloven and other types of forest wildlife. Even here, however, their numbers gradually declined (Adam F. Schwarzenberg therefore ordered in 1721 the protection of bears, which can be considered as one of the first measures to save endangered animals). The loss of wildlife and contribute poachers, whose domains were mainly frontier forests. Among poachers (mainly Bavaria) and forest staff there were frequent clashes, which often ended in the death of one of the parties. Around 1820 was reportedly in Šumava all deer expended and reintroduced until 50 years after the founding of a small Obůrky under Boubín.
It is obvious that for tourism were our forests too impracticable and dangerous. People in the country lived a very primitive way and had no time for fun and recreation in today's concept. The townspeople were not welcome in the country and in deep forests, which were studded with myths and legends, they were afraid to enter.
Recreational use of forests and consisted mainly of hunting game that became more and more a social event and a fun pastime manor layers. Penetrating new ways of hunting (French baiting) together with modern firearms require the gradual disclosure of the forests, clearings and distribution of building roads. In respect of damage caused by hoofed animals on agricultural land, thus starting from the mid-18th century building large field of game, especially in the interior, where large carnivores were exterminated. In the wild game reserves to be able to better protect, maintain high status, from hunting easier obese selected pieces and then with great certainty hunt.
The gradual disclosure of forests, which facilitate hunting game and led to the gradual development of tourism, increasing interest in nature and preserved its value depended on deforestation, canalization of watercourses and the construction of forest roads. In the mid 18: th century due to a deepening lack of wood began to think about the larger felling in remote areas, and thus came the extensive forests of the Sumava and some other preserved forest complexes. For the easiest way to transport wood was seen floating on the rivers and streams. From the beginning, however, met with considerable difficulties. Initial attempts to navigate the Vltava River date back to the 16th century the era of the Rosenbergs, only 250 years later, however, began with usplavňování flows to a greater extent. In addition usplavňování rivers and streams began to build canals (Schwarzenberg in southern and Vchynicko - tetovský in the western part of the Bohemian Forest), build forest skids, driveways and establishing timber settlements in places still unoccupied. Large forest is gradually becoming less inaccessible from the edges, less dangerous, and people from rich layers have started to use more for your relaxation, walking and horseback riding, mostly at first again in close connection with hunting and hunting (parfosní spectacular manhunts through packs dogs that had been significant social and sports and recreational character).
Interest in tourism began to raise with us until the 19th century. In the second half appeared Šumava Czech writers, poets and musicians (Eliška Krásnohorská, Jan Neruda, Bedřich Smetana, Karel Klostermann, Jan Vrba and others). With the increasing public interest in preserved and yet little disturbed natural forest formations is possible to connect the beginnings of conservation efforts and gradually evolving nature conservation. Parts of preserved forest and natural forest were excluded from logging (see Boubin primeval forests and Žofín) and later gradually announced as canceled. Most of the surviving forests are gradually disappearing under the pressure of exploitation efforts and the expansion of large-scale forestry.

The felling of most of the then existing large residual forests in the Šumava contributed significantly to the wind storm in 1870 and subsequent extensive bark beetle calamity. That ended the previous hard but idyllic way of life of local residents, based on logging, retail and handicrafts, mainly glass production. It led to the ultimate access to previously remote or

outlying settlements. The newly built railway to link to the world, brought the economic development of business, industry and gradually organized tourism. Šumava ceased to be so impracticable and dangerous that people were afraid to enter the forest on its highest peaks. Karel Klostermann writes in his "Črty ze Šumavy" in 1890 about how tourists are enjoying the convenience and does not have to make sacrifices his love for nature as it was before.
More far-reaching changes in the relationship of man to nature was not until the 20th of civilization century, and especially the development of the automotive industry. Today most of the population lives in cities and not so immediate contact with living nature, as should people in the country still in the last century. Yet a large part of urban people lose the forest positive attitude and desire to get at least a minute from time to time in the wild, breathe clean air and get rid of at least a moment of stress from everyday hustle and bustle of busy urban environment. Despite the distance from the city Centek, the necessity of means of transport and the time and cost to achieve the outdoors, forests, and even remote forest complexes, increasingly sought after and made available to modern forms of organized tourism and recreation. For this purpose are especially appropriate national forest and natural parks, public gardens and forests in the immediate vicinity of residential areas and large urban agglomerations.
Boubínská nature trail is a path from civilization and orderly nature to its original form and unrestrained. It passes through several zones, which are different levels of what life in the forest intervened and human interference. The core of the Boubin primeval forest remained untouched for centuries and reserve around it is constantly expanding. In some places, one feels as if returning to some kitschy fairy-tale world. The country is covered with moss and ferns, lichens and trees along the way is lots of lush green Paloučku. The trail is occupied by tourists who like mravenečkové carry their sandwiches, compete in the knowledge of nature and demonstrate the tourist calf. The trip is willy-nilly a collective matter, but the area is so beautiful that one completely forgets that he wants only to himself.
From Kubova Huť to Boubín based blue tourist sign, followed by the new route is marked in the field with purple arrows. The forest here is no different from other Czech forests. Trees are perhaps a little higher, and everywhere there is a lot of animals from Fireflies, butterflies and flies to frogs and birds that eat them. After about three kilometers way to re-establish the blue and starts to increase forest cover, which is much wilder. The trail runs along the exposed roots and rocks and a flood of old trees with thick větvovým transmits less light. Just below the top of the trail begins to thicken around the grass, the trees are coated with pine needles and forest already dangerously resembles a fairy tale.
On top of Boubin can still get a snack and get refreshed before the next trip. It's hard to miss the memorial stone dedicated to Cardinal Friedrich von Schwarzenberg, who visited the local peak in 1867. Then it was the exceptional company. Forests were less accessible and the people in them except for the romantics, mystics and the Cardinal or no interest. Mountain Boubin measures 1,362 meters, but the tower, which is exactly 21 meters high, trumps even the highest mountain in the Czech part of the Bohemian Forest Plechý (1.378 m). In good weather it is seen Alpine peaks. Very interesting is the view of the forest Boubínský that the structure is clearly distinguishable from the surrounding forests and monoculture that height resembles broccoli slaw salad. A Green Forest is one of the surging sea.
The section between the mountain and forest Boubin is probably the most beautiful of the entire trail. The progressive transformation of economic forest to its wild progenitors of the approaching its peak. First, the blue mark comes down to the crossroads at the crosses from which it is possible to immediately issue a primeval forest in two ways. The blue trail is in the forest before, but does huts around hunting lodge and chapel. Hubert, who stands at the green routes. Although this is just a period of reconstruction, but there is a nice view and you can relax there. The chapel served Mass before the start of the hunt, as the St. Hubert was the patron saint of hunters and his intercession will not remain unanswered.
After fifteen minutes to come to the forest. Forest Boubin is a purely Czech Central or better and has almost harmless. When looking more closely, it is possible to know that the site is acquired fantasy. Despite the stream lies rotting trunks covered with moss and tree stumps sticking out the saplings. The remote locations glimpse meadows covered with purple flowers and elsewhere impenetrable thicket. The roots of some trees float in the air, there's a lot of fallen trees and some trees sticking up in the middle of kinks. This plays a confusing variety of imagination.
The forest is fenced. On a trip around the corral a few stops with information boards about Boubín history, its composition or a lot of interesting information about local protected species

The journey continued in Kaplického creek that runs through the forest soon comes to Boubínskému pond. There is no sweeter thing than it dip after hiking legs. The water is icy. Boubín Lake was built in 1836 and served in 1957 as a reservoir for boating channel. Wood, luckily not from rainforest, after it sailed to a nearby Lenorská glassworks. The tribes split up the meter logs and thrown into the water. Along the canal then waited bidelníci who long sticks rozstrkávaly seal. At the lake there are several benches, wooden tables and shelter. In the water they ride trout.
From the lake you can continue along the blue and after about 2.5 km to come to a crossroads. Green brand continues to Kubova Huť 7 km hike forest nature trail.
To Kubova Huť train also goes from blue marks from 1 km to stop Zátoň. Trains run on weekends at regular two-hourly intervals.
On Kubova Huť (990 m) - a mountain village in the saddle under Boubín - an information system is a nature trail NP and PLA gets in touch with nature trail Forestry Forests of the Czech Republic, state, forest Boubin race. It was opened in 2000, the length of the route is 13.2 km and leads mainly boubínskými forests. The trail includes 30 stops with more than thirty information boards. Most of them are in the format of 120 cm x 80 cm portion in the format 70 cm x 40 cm. Information is given in three languages - Czech, English and German. The trail can browse through the sections and in both directions without losing continuity. Any information board is a closed circuit specific information. For smaller children can be arranged on the trail split into several parts.

First stop – start of the nature trail - is located about 4 km from Vimperka near the village Pravětín, the last stop - the end of the nature trail is located about 2 km from the railway station Zátoň. The distance between paths and endings Boubínským forest is also about 2 km. The trail is marked with a green tourist trail, it is entered on the uniform labeling of the Club of Czech tourists. Offering together with seasonally open information centers in LČR Zátoň and PLA Šumava by Ida sawmill on the use of both the school and the teaching of tourist and recreational activities. Construction of the path provided in 1999 - 2000, Integrated School of Forestry Vimperk (repealed in 2005) along with LZ Boubin. Translation and checking texts in the School of Forestry participated in Laubau a longtime employee of forestry from USA. Installation and landscaping panels with access bridges made ISŠL pupils, who were the first to use the newly built trail to teach vocational subjects.
Additional objects on the trail (modification springs, resting places and Wood cottage, including the above-mentioned bridges with landscaping) implement Lesy Czech Republic sp - LZ Boubin along with integrated schools forest trail was funded with the support of Phare and the Ministry of Agriculture.
Forest district forest plant Boubin Forests of the Czech Republic, sp, preparing seating for tourists. Benches with tables producing center associated production of forest plant Boubin Lesy ČR, sp in Zbytinách. For example, the forest district Včelná sitting on top of Boubin, sitting at a waterhole Vlach Pregnant, sitting on a fountain forestry sector Borek. The forest district Zátoň such as sitting at the cottage on Bazumu, the cottage on the forestry sector Lenora, sitting at the quarry. Forest district Kubova Hut paved sitting at Strnad nurseries, forest district Zdíkov sitting on Lizu, on Kyzu, sitting at the lay- by parking space at the Moonstone by Javorník. It's just a few examples.
Lesy ČR, sp successfully completed the restoration of the cross in the chapel of good water near the village Ktiš in the district Prachatice of 1874. Joy will have tourists who have given locality lots of visitors. Way of the Cross includes 14 stops in a circle with a diameter of about 50 meters. The renovation of preserved all the way foresters stopping replaced interceptions modified - stone. Completely new stop - wood - installed in those cases where the individual stops over time for various reasons preserved. Way of the Cross is finished with hand- hewn wooden cross. The main part of the redevelopment of the Cross took place in 2013, when the firm had also disassembled and then reassembled and all stone pedestal. The reconstruction of the cross Lesy ČR paid from the Programme 2000 businesses nationwide supports community functions of forests. The cost of reconstruction amounted to about 100 thousand. Place a Calvary Chapel is located at the foot of the hill Ktišská Mountain (911 m), near hiking trails Ktiš - Miletínky and is accessible from forest roads "Křížovická" on forest district Prachatice. In this place there is also the frontier of space tourists navštěvovanéhoVojenského Boletice and the Blanský les.

At the entrance to the forest Forest Enterprise Lesy ČR, sp Boubin building a parking area for motorized tourists, such forest district Zdíkov u Javorníku at the Moonstone, as well as the beginning of the journey "Do dvanáctky", next on Kamraty and “U Oborohu”.
The forest district Mlynářovice is repaired and maintained chapel in Putin forest district Kubova Hut clean dam water reservoirs. On 20 October 2010 a monument was unveiled significant boubínskému forester Jaroslav aside and forestry personalities of Boubin to forest district Zátoň by the lake in the NPR Boubínský forest.
About programme 2020 public will find helpful tourist information at the link : http://www.lesycr.cz/volny-cas-v-lese/program-2020-lesu-ceske Republic / Pages / default.aspx
In terms of tourism, especially for children and youth, it is certainly interesting information that Zátoň in the area of the forest district operates a museum with an information center, auditorium with video and audio equipment : For detailed information see link:
http://www.lesycr.cz/lz5/vyznamne-objekty/Stranky/default.aspx
LZ Boubin on its website also offers accommodation in hunting lodges, hunting lodge on Boubin and the forest district and informational - educational center for Zátoň. http://www.lesycr.cz/lz5/ubytovani/Stranky/default.aspx
Essential tourist information can be obtained on the website of the Forests of the Czech Republic, sp http://www.lesycr.cz/Stranky/default.aspx

Information, education and accommodation center Forests of the Czech Republic, sp Zátoň
"In 1750 Joseph left the Prince of Schwarzenberg in the periphery of Justice (economic, which was built in the old days - 14th century) build a hunting lodge to find high-ranking guests at treat by grouse mating call and were looked after. The palace was later converted into a lodge." So much for establishing Zátoň castle wrote Jan 1883 Chadt princely forest adjundkt. This building was used as a princely myslivna later as forest district state forests. When forest district object left, there was only a flat and stable.
State building before reconstruction was as follows : predominantly stone masonry in places with bricks, ceilings flat ceiling - wood, Ceiling buried soil, roofs partially damaged. Roofing - the original asbestos shingle laid. The building stables in disrepair, ceiling construction violated. Flow through a podtékají sewage and rainwater. Undermined podzákladní supporting pillar. Lamination of various outbuildings (shed) at the main building. The economic background to the main building partially repaired. The perimeter wall to the direction of the communication repaired. Entrance gates and doors newly inserted.
Multi-purpose building includes operational part - forest district offices, the inspection room and technical facilities forest district (garages, warehouses). Base for excursions (object Boubin): room for about 40 people, accommodation for about 40 people. Dual-circuit exhibition: Lesy Czech Republic sp - Boubínská area, space for more exhibits.
Exposure museum shows: history and present state forests and Boubínská information about Boubínský forest with cutout King firs, forest tools and demonstration of horse stables, plants and animals of the area.
Lecture Hall offers over 30 audiovisual works on forestry, forest and nature.
Open to the public: July-August, daily except Monday
in other months by appointment on phone 388 436 122The text has been mentioned several times in 2020 Program Forests of the Czech Republic, sp What does it mean ? The role of the LCR, a firm managing state forests is to ensure a balance of production and non-production functions of the forest, thus ensuring the fulfillment of the production function and public interests in its field of activity. Therefore, in the years 1998 - 1999 by professionals undertaking in collaboration with experts from the conservation, research and vocational education, an " Programme 2000 - ensuring public interest objectives in LČR". In summary, the implementation of specific measures under the program in 2000 through the organizational units of the company in the period from 2000 to 2010 spent over 339 million CZK. The vast majority of measures are financed from its own resources, ie mainly from the sale of wood as the main material product of the forest.
Implementation of specific measures under this program takes place entirely on land with the right to manage LCR. These measures carried out both individually LČR through its organizational units, ie individual forest administrations, forest enterprises and administrations flows, and in cooperation with local and regional partners such as municipalities, micro, nature conservation authorities and NGOs. Of course, the implementation of any measures respecting the relevant legislation.

The document was from the beginning designed as an open in the sense that it can be supplemented by other sub-themes in relation to the development of the knowledge society needs a recommendation or obligations arising from international treaties to which the Czech Republic is bound. At the turn of the years 2010 - 2011 was based on the facts and experiences with the current implementation of the revisions and additions. The updated document called the 2020 program - ensuring public interest objectives in LCR, is a guide not only for the employees of LCR, but is also designed other professionals, forest owners and all visitors and nature lovers. Specific suggestions can be sent electronically to Program2020@lesycr.cz. Suggestions as much detail as is necessary to specify both spatial (at least in the subject line indicate the region to which the story refers) and a specific description of the measures broken down by individual chapters of the program. All suggestions received will be assessed in terms of their feasibility with regard to the relevant aspects. Selected topics will be included in the project pipeline, projects will then be implemented with regard to the coverage of the whole territory of the Czech Republic and the funds available. By 2020, the plan LČR paste on the implementation of more than 500 million CZK.

Due to the rapid decline in the grouse in Šumava decided in 1988 by the then Ministry of Forestry and Water Management on the establishment of a rescue breeding capercaillie, which will be implemented by the former LZ Prachatice, location Mlynářovice. The reason was to maintain or re- introduction of capercaillie in the local area, from which almost disappeared.

In the same year saw the construction of rearing and other equipment needed. The objects were placed in the area of the former forest nurseries. The equipment consists of 13 rearing boxes for breeding flock of chickens and a teen site for location hatcheries, nurseries for small portable chicken, including animal feed warehouse, freezer and bathroom.

The fall was imported basic breeding flock of grouse in the number 4 cocks and 4 hens from Germany, which was the beginning of efforts to artificial breeding - of course without any personal experience. Began to receive information from Dr. Ashenbrenera of Germany. In 1989 it was extended breeding flock which was extremely low. They were imported from Germany 4 chickens.

The first success came in 1995, when 18 were bred grouse. Into the wild was launched five cocks and hens 7. In 1996, the Forests of the Czech Republic sp, LZ Prachatice, Ministry of Environment exemption to basic protective conditions of the critically endangered capercaillie, set out in § 56 of the Act. č.114/1992 on nature and landscape protection. This exception relates specifically to the captive breeding of this species for the purpose of reproduction and release into the wild.Drain bred grouse since the beginning in Great Plain. In 2012 was built a new facility on the site drain base (Braces) under Boubínem. It is a fenced area with shelter, to which they are bred grouse transported and where the process of becoming independent closely. Fencing other hand partially protects them from predators and impedes Grouses in early exit discharge locations.

Telemetry observations discharged chickens carried out in the years 2006, 2007, 2010 and 2012 unfortunately confirms the enormous pressure from predators in the first week after launch. Mortality in this critical first week is 60 %.

The existing discharge led to the LZ Boubin to create two subpopulations capercaillie, and in Great blue cheese and Sheeting. The size of each subpopulation is estimated at about 20 individuals, both in the field they have been living for several years. The behavior of individuals of both subpopulations shows the parameters of wild individuals capercaillie, in a search for suitable habitats that inhabit and in recent years successfully nest.

References

JIRÁČEK, J.: Průvodce lesy jižních Čech, České Budějovice, 1998

Souhrn

Jedním ze základních projektů UNESCO v programu MaB (Man and the Biosphere – Člověk a biosféra) bylo zavedení koordinované světové sítě míst reprezentujících hlavní ekosystémy planety, v nichž by měly být chráněny genetické zdroje, a ve kterých by zároveň mohl být proveden výzkum těchto ekosystémů, stejně tak jako jeho sledování. Tato místa světové sítě byla pojmenována "biosférická rezervace". V současnosti je ve 117 zemích světa vyhlášeno 610 biosférických rezervací, z toho 12 přeshraničních.

Šumava je jednou ze šesti českých biosférických rezervací, vyhlášených organizací UNESCO, ke kterým patří také Křivoklátsko, Třeboňsko, Krkonoše, Bílé Karpaty a Dolní Morava. Každá z biosférických rezervací je v něčem jedinečná. Biosférická rezervace Šumava byla vyhlášena

již v roce 1990, aby ochránila šumavské lesy, louky, jezera a řeky v typických podmínkách evropských středohor.
Šumava je jedinečné, lesnaté a nerušeně se vyvíjející biologické společenství. Život zdejších lidí významně ovlivňují nepříznivé přírodní podmínky, které měly i přímý vliv na historicky řídké osídlení Šumavy.
V území BR Šumava se díky mnoha rozličným subjektům odvíjí nespočet prospěšných a pozitivních aktivit, jež se zcela slučují s posláním biosférické rezervace.

Contact:
Jiří Junek
Independent forestry journalist
junek@bohemica.cz

Ing. Jitka Fialová, MSc., Ph.D.; Ing. Hana Kubíčková
Department of Landscape Management
FFWT Mendel University in Brno
Zemědělská 3
613 00 Brno
jitka.fialova@mendelu.cz; hanicta@centrum.cz

BROWNFIELDS AND TOURISM: CONTRIBUTIONS AND BARRIERS FROM THE POINT OF VIEW OF TOURISTS

Stanislav Martinát[1], Tomáš Krejčí[2], Petr Klusáček[2], Tomáš Dohnal[2], Josef Kunc[3]
Silesian University in Opava[1]; Mendel University in Brno[2]; Masaryk University in Brno[3]

Abstract
The paper pays attention to the relations between regeneration of brownfields and tourism. The first, theoretical part is focused on examining the relationships of both phenomena, in the second part the results of thematic questionnaire survey are presented. The survey with tourists was held in three locations in the South Moravian Region, where brownfields were regenerated for tourism. The contribution attempts to answer the research question - how visitors perceive regenerated brownfields that have found a new use in tourism. Respondents were asked for identification of types of brownfields that have the greatest potential for re-use in tourism and consequently, what tourists themselves prefer as the best possible re-use options in the studied regenerated brownfield sites. In the first case, the maximal potential was seen in the formerly industrial brownfields, less in agricultural brownfields; on the contrary the most problematic for tourism development brownfields originally used for housing were identified. In the second case, majority of respondents found a new use of the site for tourism as appropriate, however the return to the original function of former brownfields (industrial or agricultural production) is also strongly supported. In the final parts of the contribution, recommendations for potential investors in brownfields are formulated.

Key words: regeneration of brownfields, tourism, South Moravian Region, Czech Republic

Introduction

The occurrence of brownfield sites is an important expression of contemporary socio-economic development of the Czech Republic (Frantál et al., 2013). These sites could be found as a consequence of both transition and globalisation processes in economy within the whole spectrum of economic activities from sites and buildings after terminated mining, through abandoned factories after industries or their administration backgrounds, to buildings and sites originally used for tourism and leisure activities. Discussion on re-use of these sites is based in both economic, social and environmental risks and problems, which are closely linked to the issue of brownfields (De Sousa, 2000, 2003). These risks are connected to permanently growing extent of built-up areas at the expense of greenfields, urban sprawl in the hinterland of big cities as result of suburbanization, on the other hand to population decline of city cores, where numerous brownfields are located. Mentioned negative trends should be reduced by regeneration of such sites that have already been used for economic activities, but during the course of time such function was limited or lost. In context of tourism as an option for re-use of brownfields economic, social and environmental benefits can be discussed. As stressed by De Sousa (2000) and Alker and Stone (2005), with occurrence of brownfields typically shortening of attractiveness of areas and their hinterland is connected, which makes utilization of area for both urban and rural tourism more complicated. On the other hand, some brownfields have certain historic, architectonic or urbanistic values, sometimes even location of industrial brownfields within the city centres creates great potential for re-amalgamation of such sites into living city organism. Thus the use of such urban brownfields for tourism and leisure activities could definitely be an option how to contribute to sustainable urban development of cities (Steinführer et al., 2010). Regeneration of brownfields for use in tourism and leisure activities should be easier in areas in direct neighbourhoods or in proximity of tourists attractions, on the other hand, financial situation of especially small cities and municipalities don´t allow to invest to regeneration of plenty of brownfield sites since their marketability is usually limited (Vojvodíková et al., 2013 or Frantál, et al., 2013).

According to the National Strategy for Brownfields Regeneration (CzechInvest, 2008), brownfields are defined as sites (real estates, buildings or land) that are used insufficient way, neglected or could be possibly contaminated. Brownfields originated as relict of industrial, agricultural, residential, military or other activities and can´t be suitably and effectively used without pending regeneration process. In the official databases of the CzechInvest agency 2 355 of brownfield sites on total areas of 10 326 hectares, nevertheless on the basis of expert estimations it could be stressed that more real numbers should be for time higher both as for numbers and spatial extent. Such number and extent of brownfields is strongly influenced by

phase of economic cycle, in which certain region occur. During times of economic recession huge leaving of plenty of production sites is expected, on the other hand, re-use of such sites and higher frequency of brownfields regeneration could be anticipated during the times of economic prosperity.
It is obvious that re-use of brownfield sites for tourism is accompanied by certain particularities. In the first place real (or even perceived or potential) contamination of area could be mentioned. This problem makes re-use of such brownfield for tourism almost impossible. The contaminations originated decades ago with limited evidence on composition and strength constitute fundamental problem for investors during decision making about future of such sites. Detailed field survey and decontamination of these sites represent for plenty of sites potentially regenerated for tourism necessary first step that should precede selling of such sites to investors or even limited interim use (Haase and Rall, 2011). On the other hand, increased interest in contaminated sites by form of regulated tourism might increase to make pressure on decision sphere to speed-up decontamination and cleaning processes and push forward regeneration processes (Alexandrescu et al., 2014).
The next important aspect that has to be necessarily taken into account is the social perspective of studied issue. Sites with occurrence of brownfields are usually perceived with certain prejudices, which is caused by bad technical state of buildings, but also connected to socio-pathological phenomena which might occur in proximity of brownfield sites (Klusáček et al., 2011). Thus brownfields gain negative stigma on both local and regional level without reference to real or just perceived (environmental or social) risk (Meyer and Lions, 2000). As could be shown on plenty of examples (Hrušov – Martinát et al., 2013, Kunčičky – Vojvodíková et al., 2012), perception of such sites by local population and tourists is highly important (Kunc et al. 2014a; Kunc et al. 2014b) and worth consideration. The above mentioned stereotypes about brownfields could be exceeded by continuous work with local population, by information campaigns aimed to public education or by temporary use of brownfield sites. As evidenced by researches carried out by Haase and Rall (2011), temporary use of brownfields are usually perceived better by population than completely abandoned sites. Thus temporary use of brownfields creates great conditions for speeding-up regeneration process or even its planning and creates good conditions for acceptance of new use by local public. As another issue connected to regeneration of brownfields, classification or prioritisation of brownfields sites could be mentioned as possibility for public and private investors to invest effectively limited financial sources to the most suitable sites (Doleželová et al., 2014). The regeneration of brownfields for tourism use has been for example studied by Edwards and Llurde´ si Coit (1996) or Levi and Kocher (2006).

Materials and methods
The aim of questionnaire survey was to identify preferences of re-use options of visitors of former brownfields that were during the time of the survey used for tourism. The survey was carried out in three locations in the Boskovice region within the South Moravian Region at the beginning of tourist season during March 2013 (the Western park in town of Boskovice, Agrocentrum Ohrada in Vísky municipality, Sudický dvůr hotel in Sudice municipality) on the sample of 180 respondents (participants of tourism activities). Respondents were addressed in front of above mentioned former brownfield sites by skilled and trained students of Mendel University in Brno. With each of 180 respondent short standardized questionnaire was completed in form of semi-structured interview. Respondents were selected randomly with respect to balanced gender, age and educational structure that corresponded to average data on population of the South Moravian Region, where Boskovice region is located. Three fifths of respondents live in municipalities of the South Moravian Region, one quarter of respondents stayed in other regions and 14 % lived in one of three municipalities, where questionnaire survey was carried out (Boskovice, Vísky and Sudice). The questionnaire has been developed as the set of 15 questions that were aimed to analyse both particular sites and general attitudes of visitors towards regeneration of brownfields for tourism.
The Boskovice region as an area for given research was selected according to occurrence of plenty of brownfields as result of long-term tradition of industrial activities in the region and its proximity to city of Brno (circa 30 km north of Brno) as the second largest city of the Czech Republic (population 378 000 in 2013), which makes area highly attractive for tourism and leisure time activities (predominantly one-day trips) of Brno population. Because of geographical proximity of studied sites (distances between each other are not longer than 9 kilometres) and relatively similar answers of respondents in case of all three sites, answers were evaluated in

one group. The basic characteristics of former brownfield sites where the research was carried out, could be found in Table 1.

Tab. 1: Basic information on three studied former brownfield sites in the Boskovice region

	Western park (Boskovice)	Agrocentrum Ohrada (Vísky)	Sudický dvůr Hotel (Sudice)
original use	sandstone quarry	agricultural production	historical nobility farm
in operation since	1994	2004	2008
present-day use	entertainment center, hotel, climbing center	hotel, leisure time activities (horse riding)	hotel, leisure time activities (sport fishing and shooting, biking)

Source: web page of individual projects (www.westernove-mestecko.cz, www.new.ohrada.cz, www.sudickydvur.cz)

The main research questions defined in the initial phase of the presented research, were as follows: 1) Are the brownfield sites and buildings sufficiently attractive for use in tourism with respect to their historical architectonical value?; 2) Does original use of brownfield sites and building distinct influence on their re-use for tourism?

Results and discussion

In the introductory part of questionnaire, the attention was paid more to conversancy of visitors of three studied former brownfield sites with phenomenon of brownfield, second part of survey was devoted to survey of visitors preferences.

As shown in responses on awareness of visitors about knowledge on visited former brownfields, more than half of addressed respondents was aware of the fact that individual sites were originally used for other economic activities and had to be firstly regenerated for tourism activities (55 %). Similar share of respondents also positively responded to identification of original use of visited sites (52 %). The learned data gives us evidence about relatively high rate of conversancy of visitors with history of individual sites. This might be caused by both proximity of their residence and temporally not so far away period of regeneration, but also by industrial tradition of the Boskovice region, where industry has played important role in its economic history since mid 19th century and awareness of this tradition is still alive.

The next question was focused on primary reason to visit individual sites. What came up from answers is that just very limited group of respondents (just 7 %) visited sites to see way, how former brownfield was regenerated. More than half of respondents identified offer of tourism services as main motivation to visit sites. Roughly one third of respondents answered that they decide to visit the site without specific reason just randomly. Obvious replies were: *„…we drove around and stayed for lunch…"*. It can be concluded that respondents are aware of the fact that visited sites were originally abandoned brownfields, but attractiveness of these sites as former brownfields is not so astonishing to attract crowds of tourist. It seems that necessary precondition to attract tourists is to offer services of good price and quality and reason *"just to see former regenerated brownfield"* is not enough strong. It can be indicated that occurrence of regenerated brownfield in not sufficiently strong argument for visit.

Tab. 2: Evaluation of quality of brownfield regeneration projects in the three model sites

evaluation / point of view	very bad	bad	average	good	very good
functional	0 (0 %)	0 (0 %)	24 (13,3 %)	62 (34,5 %)	87 (48,3 %)
aesthetic	0 (0 %)	0 (0 %)	13 (7,8 %)	56 (31,1 %)	104 (57,8 %)

Source: questionnaire survey (n=180)

The next part of research was devoted to evaluation of quality of regenerations projects that occur in our three model sites. As follows from results in table 2, level of satisfaction with regenerations was relatively higher in case of aesthetic than functional point of view, on contrary, negative evaluations were not recorded at all (only average level of satisfaction, i.e. neutral attitude, with projects appeared). This could be interpreted as typical position of majority of population of the Czech Republic, when almost all brownfield regeneration projects are perceived as good step forward and from aesthetic point of view the areas or buildings that has

been regenerated at least to some extent, are perceived much more better than those abandoned, destroyed and neglected (Kunc et al., 2014a). This phenomenon is especially apparent in case of brownfields located in rural space, where economic attractiveness for potential investors and marketability of sites is usually lower than in urban areas and thus regeneration in more difficult. As is stressed by Frantál et al. (2013) or Klusáček et al. (2013), rural areas shouldn´t be perceived as one unit while thinking about brownfields regeneration potential since geographical location of individual types of rural areas (represented by e.g. transport connections, distance to regional centres) and location of individual brownfield sites within the area of towns and municipalities (inner parts, outer parts etc.) play crucial role during decision making about brownfield regeneration projects.

The question also rises, to which extent brownfield regeneration projects resonate (or are in contradiction) with original historical, architectonical and cultural values of individual sites. One of results of our research is that negative aesthetical and functional perspectives of regeneration of studied former brownfiels has not been recorded at wall (see Table 2), which gives us evidence on relative satisfaction of respondents with studied regenerations. Nevertheless, it was quite often that respondents commented regenerations for tourism use positively, but also expressed their opinions that use of brownfield sites for commerce (especially retail) and development of residential zones for housing would be more welcome.

From answers on awareness about problems connected to brownfields came out information shortage unambiguously. Just two fifths of respondents (42 %) were aware that they have already visited some of brownfields sites and just one quarter of respondents expressed that they were somehow informed about regenerations of brownfields or generally about issue of brownfields. It can be assumed that increase of awareness on possibilities and positives of regenerations of brownfields (in comparison to environmental problems connected to developments on greenfields) could be regarded as the most influential step forward. The greatest potential can be seen (De Sousa, 2001) in making pressure of local population to decision sphere to make regenerations quicker and even to start thinking about to start planning of brownfield regeneration projects by use of financial incentives, master plan changes, support for temporary use etc. The lack of information on brownfields and environmental benefits of their regeneration was usually commented in cases television and newspapers as sources of information, much more better attitudes were recorded in case of so called new media (internet, social networks) and marketing materials of individual municipalities, towns and cities. It could be concluded that while new media are focused more to younger population and brings relatively more information about brownfields, other types of media, as examples of more conservative ones, are focused more on older generation and are not really concern on brownfields and their regeneration. On the contrary, materials of cities and municipalities were mentioned relatively more often in positive sense and this could be marked as increased interest and concern of local decision sphere about *"their"* brownfields to make them organic part of their cities again and to attract new potential investors.

In the next parts of questionnaire, redevelopment potential of individual regeneration options was evaluated. As comes out from the results in table 3, the biggest potential for tourism in cases of industrial and agricultural brownfields was identified. On the other hand, the lowest tourism potential has been seen in sites and buildings whose original use was mining, housing (unused housing estates) and transport (bus and railway stations etc.). Very high tourism potential for industrial brownfields can be surely connected to architectonic specifics of industrial buildings developed during the 19th century. This benefit is hardly applicable in cases of other types of brownfields. On the contrary, as limitation for tourism use of industrial brownfields definitely real or even perceived contamination has to be stressed, but this environmental burden is not strongly taken into account by respondents. Rather surprising results appeared during evaluation of post-mining brownfields, where tourism potential has been evaluated as very low. Moreover, post-mining brownfields in category average potential (thus analogy for I don´t know / neutral answer) achieved the highest values (34 %), which might be interpreted as certain type of opinion inconsistency of respondents. They simply don´t know what to do with post-mining brownfields in future. This might be also caused by the lack of information about regeneration options and by low awareness on good practices of brownfield regeneration projects developed on post-mining areas. It has to be emphasized, that several relatively successful post-mining regeneration projects have already appeared (e.g. The Kukla Mine in Oslavany, The Pohoda Golf resort in Karviná, horse racecourse in Most, the Landek Museum in Ostrava, The Michal Mine in Ostrava etc. in the Czech Republic; Salt Mines in Hallstatt in Austria or in Wieliczka in Poland), which makes learned results even more

surprising. Moreover, flooded quarries might be used for tourism and leisure time activities (swimming, windsurfing, fishing, skating etc.). To sum up, further public education and marketing of example of good practices are certainly needed (De Sousa, 2006).

Tab. 3: Tourism redevelopment potential of individual types of brownfields (as perceived by tourists)

original use of brownfields	low (%)	under average (%)	average (%)	over average (%)	high (%)
industry	2,8	5,5	23,9	25,6	42,2
agriculture	6,2	10,5	25,6	30,5	27,2
mining	21,1	24,5	34,4	15,6	4,4
military	6,1	13,9	31,1	27,8	21,1
transport	15,5	30,6	30,6	1,5	12,8
housing	29,4	20,6	25	18,3	6,7

Source: questionnaire survey (n=180)

Another part of presented research was focused on survey of acceptance of alternative re-use options and contemporary use in three case study areas (see Table 4). Respondents were asked to give points on the scale from 1 (definitely not suitable use) to 5 (definitely suitable use).

Tab. 4: Alternative re-use options of three case study areas (according to preferences of tourists)

possible use	definitely not suitable (1)	not suitable (2)	average (3)	suitable (4)	definitely suitable (5)	average evaluation
leisure / tourism	0	0	15	64	101	4,47
industry	0	10	14	70	86	4,41
offices / administration	3	63	80	20	14	2,88
shopping malls	13	56	39	40	32	3,12
housing	27	31	89	21	12	2,78
parking	18	56	91	15	0	2,57
artificial lakes	13	29	28	31	79	3,74

Source: questionnaire survey (n=180)

Among of the proposed overview of alternative re-use options of three surveyed case study areas the best evaluated option was leisure time / tourism (see Table 4). It means that respondents voted for contemporary use of three sites. It is surprising that the second the most popular option industry was identified. This could be explained by the fact that the Boskovice region, where all three sites are located, is suffering by relatively high unemployment. Nevertheless, it is still surprising, that as a best way out from this situation new jobs in industry are perceived. It is obvious that with respect to long-term economic development of the region new jobs will be predominantly created by services (especially by tourism). This perception of industry as main employer in the region have to be also understood in context of long-term tradition of the importance of local industrial production since mid 19th century. It can be also stressed that surprisingly much less popular regeneration options housing or shopping malls were marked. Authors expected from tourists much more positive perception of these options.

Conclusion

The issue of regeneration of brownfields for tourism is a wide topic, which is still waiting for its embedding in human geographical theory. This attempt could be taken as an introductory step in this direction. The tourism sector, as permanently growing part of economy, offers possibilities, how to re-use at least part of brownfield sites. It is obvious that opinions of tourists towards individual types of brownfields and their attractiveness differ. However, it is of high importance to learn more about motivations of tourists to visit brownfields and how to make tourists to spent there their time and money to make these formerly abandoned sites vital part of economy again. There is plenty of concrete possibilities, how to support using of brownfield

sites for tourism. The support from central and regional governments for local administration should be primarily targeted to prefer investments to brownfield instead of greenfields. This could be reached by ongoing education of public officials and decision makers. The local population should be systematically informed about benefits connected to re-use of brownfields, examples of good practices should be more promoted and private investors should be more involved in planning, development and implementation of brownfield regeneration projects for tourism. The nature and education trails should be established and temporal use of brownfields for tourism should be supported (in case that hygienic and safety regulations are maintained). It is the fact that brownfield sites are usually not (with certain exceptions in cases of sites with important historical, architectonical or natural values) very important attractiveness that could massively attract visitors. This is the reason why it is necessary to strongly focus attention to quality of proposed tourism services and to manage marketing activities of individual sites according to specific target groups of tourists (Navrátil et al., 2011).

References

ALEXANDRESCU, F., MARTINÁT, S., KLUSÁČEK, P., BARTKE, S., 2014: The Path From Passivity Toward Entrepreneurship: Public Sector Actors in Brownfield Regeneration Processes in Central and Eastern Europe Organization & Environment, doi:10.1177/1086026614529436

ALKER, S., STONE, C. (2005): Tourism and leisure development on brownfield sites: an opportunity to enhance urban sustainability. Tourism and Hospitality Planning & Development 2(1): 27-38.

CzechInvest, 2008: Národní strategie regenerace brownfieldů. Ministerstvo průmyslu a obchodu, Praha, 12.

DE SOUSA, C. A., 2000. Brownfield redevelopment versus greenfield development: A private sector perspective on the costs and risks associated with brownfield redevelopment in the Greater Toronto Area. Journal of Environmental Planning and Management, 43(6): 831-853.

DE SOUSA, C. A., 2001: Contaminated sites: The Canadian situation in an international context. Journal of Environmental Management 62(2): 131-154.

DE SOUSA, C. A., 2003: Turning brownfields into green space in the City of Toronto.
Landscape and urban planning, 62(4): 181-198.

DE SOUSA, C., A., 2006: Urban brownfields redevelopment in Canada: the role of local government. The Canadian Geographer/Le Géographe canadien, 50(3): 392-407.

DOLEŽELOVÁ, L., HADLAČ, M., KADLECOVÁ, M., MARTINÁT, S., POLEDNIK, M., 2014: Redevelopment potential of brownfields: A-B-C model and its practical application. E+M Ekonomie a management, 18(2).

EDWARDS, J. A., LLURDE´ SI COIT, J. C., 1996: Mines and quarries: Industrial heritage tourism. Annals of Tourism Research, 23(2): 341–363

FRANTÁL, B., KUNC, J., NOVÁKOVÁ, E., KLUSÁČEK, P., MARTINÁT, S., OSMAN, R., 2013: Location Matters! Exploring Brownfields Regeneration in a Spatial Context (A Case Study of the South Moravian Region, Czech Republic). Moravian Geographical Reports, 21(2): 5-19.

HAASE, D., RALL, E. L., 2011: Creative intervention in a dynamic city: A sustainability assessment of an interim use strategy for brownfields in Leipzig, Germany. Landscape and Urban Planning, 100(3): 189-201.

KLUSÁČEK, P., KREJČÍ, T., MARTINÁT, S., KUNC, J., OSMAN, R., FRANTÁL, B., 2013: Regeneration of agricultural brownfields in the Czech Republic – case study of the Czech Republic. Acta Universitatis Agriculturae Mendelulianae Brunensis, 61(62): 549-561.

KLUSÁČEK, P., KREJČÍ, T., KUNC, J., MARTINÁT, S., NOVÁKOVÁ, E., 2011: The post-industrial landscape in relation to local self-government in the Czech Republic. Moravian Geographical Reports 19 (4): 8-28.

KUNC, J., MARTINÁT, S., TONEV, P., FRANTÁL, B., 2014a: Destiny of Urban Brownfields: Spatial Patterns and Perceived Consequences of Post-Socialistic Deindustrialization. Transylvanian Review of Administrative Sciences 41 (E), 109-128.

KUNC, J., NAVRÁTIL, J., TONEV, P., FRANTÁL, B., KLUSÁČEK, P., MARTINÁT, S., OSMAN, R., ČERNÍK, J., 2014b: Perception of urban renewal: reflexions and coherences of socio-spatial patterns (Brno, Czech Republic). Geographia Technica, 9(1): 66-77.

LEVI, D., KOCHER, S., 2006: The use of coastal brownfields as nature preserves. Environment and behavior, 38(6): 802-819.

MARTINÁT, S., DVOŘÁK, P., KLUSÁČEK, P., KUNC, J., FRANTÁL, B., 2013: Cyklické využívání industrializované krajiny: případová studie Hrušov. In: Brownfields - cesta od

minulosti do budoucnosti. Vojvodíková, B. (ed)., European Science and Art Publishing, Praha, 36-49.
MEYER, P. B., LYONS, T. S., 2000: Lessons from private sector brownfield redevelopers: Planning public support for urban regeneration. Journal of the American Planning Association, 66(1): 46-57.
NAVRÁTIL, J., PÍCHA, K., HŘEBCOVÁ, J., 2011: The importance of historical monuments for domestics tourists: The case of South- Western Bohemia (Czech Republic). Moravian Geographical Reports, 18(1): 45-61.
STEINFÜHRER, A., BIERZYNSKI, A., GROßMANN, K., HAASE, A., KABISCH, S., KLUSÁČEK, P., 2010: Population decline in Polish and Czech cities during post-socialism? Looking behind the official statistics. Urban Studies, 47(11): 2325-2346.
VOJVODÍKOVÁ, B., VOJKOVSKÁ, D., MACEČKOVÁ, B., 2013: Brownfields in the area of small municipalities. Proceedings of the 13th International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM, 2013, 155-160. doi:10.5593/SGEM2013/BE5.V1/S20.021
VOJVODÍKOVÁ, B., MARTINÁT, S., DVOŘÁK, P., FRANTÁL, B., KLUSÁČEK, P., KUNC, J., KUCHTOVÁ, R., MARKOVÁ, B., TICHÁ, I., KRČMÁŘ, I., JALŮVKA, L., ZEZULA, K., POTUŽNÍK, M., KISZKA, J., 2012: Brownfieldy - souvislosti a příležitosti. Důl Alexander - zrcadlo minulosti, příležitost budoucnosti Kunčiček, Professional Publishing, Praha, 116.

Acknowledgement
This paper was supported by the Ministry of Education, Youth and Sports within the Institutional Support for Long-term Development of a Research Organization in 2014 (School of Business Administration in Karviná, Silesian University in Opava) and by the project no. MSM 6215648904 with title Czech economy in processes of integration and globalisation, development of agri-sector and sector of services under new conditions of European integrated market at the Mendel University in Brno.

Souhrn
Příspěvek se zabývá souvislostmi vztahů mezi regenerací brownfieldů a rozvojem cestovního ruchu. Ve své první části jsou v příspěvku analyzovány souvislosti dvou výše uvedených fenoménů z pohledu teorie, ve druhé části jsou prezentovány empirické výsledky založené na dotazníkovém šetření provedeném mezi turisty ve třech lokalitách ploch v Jihomoravském kraji (Westernové městečko v Boskovicích, Agrocentrum Ohrada ve Vískách a Hotel Sudický dvůr v Sudicích), které jsou v současné době využívány pro potřeby cestovního ruchu, nicméně šlo o brownfieldy. Předkládaný příspěvek se snaží odpovědět na základní otázku, a to jak turisté vnímají regenerované brownfieldy, které našly své nové využití v cestovním ruchu. Respondenti výzkumu (n=180) mimo také identifikovali typy nového využití ploch brownfieldů s největším potenciálem. V prvním případě, největší potenciál byl spatřován v brownfieldech po průmyslové výrobě (již méně v brownfieldech po zemědělských aktivitách), na druhou stranu jako nejvíce problematické z pohledu budoucího využití byly nejčastěji zmiňovány brownfieldy, které vznikly z obytných budov. Dále z výzkumu vyplynulo, že nové využití zkoumaných ploch brownfieldů pro potřeby cestovního ruchu je turisty považováno za vhodné, nicméně objevily se také relativně silné postoje, které hovořily ve prospěch nového využití brownfieldů pro průmyslové a zemědělské aktivity. V závěrečné části příspěvku jsou diskutována doporučení jak soukromým, tak i veřejným investorům.

Contact:
Mgr. Stanislav Martinát
School of Business Administration in Karviná, Silesian University in Opava
Univerzitní náměstí 1934/3, 733 40 Karviná, Czech Republic
Phone: 776 683 413, e-mail: martinat@opf.slu.cz

COMPLEX ASSESSMENT OF POTENTIAL TOURIST AREAS WITH EMPHASIS ON GEOTOURISM - CHKO ŽĎÁRSKÉ VRCHY

Aleš Bajer[1], Marek Havlíček[2], Ivo Dostál[3]

Mendel University in Brno[1], The Silva Tarouca Research Institute for Landscape and Ornamental Gardening[2], Transport Research Center[3]

Abstract
The study deals with relation of small protect areas to tourist trails network and availability of collective accommodation establishments. The study shows that there is sufficient quantity and category of accommodation. In most of small protected areas (except for 4 cases) there are available accommodation establishments within 3 km. There is even more than 500 available beds within 3 km in 13 small protected areas. The region has very good density of tourist trails (tourist marked hiking trails, marked cycling trails and local tourist trails). Trail distribution and availability and distribution of accommodation are significant factors of both area attendance and nature conservation (geoconservation). Geocaching may be sutaible tool of both visitors distribution and education.

Key words: PLA Žďárské vrchy, geotourism, tourist potential

Introduction

General part

Landscape protected area Žďárské vrchy (PLA ŽV) was declared within the district of Žďár nad Sázavou, Havlíčkův Brod, Chrudim and Svitavy in 1970. The total area is 709 km^2 at an altitude of 490 – 836 m (Devět skal). The objective of landscape protected area is cultural landscape preservation harmoniously balanced with a significant presence of natural ecosystems (Čech et al., 2002). Forests (49.5%) prevail in the area, followed by arable land (26.1%) and grassland (17.7%). Besides typical structure of forest landscape combined with grassland, the area also include build-up areas (5,0%), water areas (1,2%) and recreational areas (0,5%). The recreational areas are represented by tourist cottage settlements, camps and sport areas. 9 basic categories of land use selected from topographic maps were used for the purpose of interpretation of land use (Skokanová et al., 2012). Recreational use of parts of landscape protected areas was investigated in several areas of Moravia (Havlíček, Chudina, 2013; Havlíček et al. 2012).

PLA ŽV is at the intersection of geological units of northeastern edge of central part of Czech massive consolidated by orogenesis during the late paleozoic. The southwestern part belonging to *stražecke moldanubikum* is made up of paragneisses with presence of ortogneisses, amphibolites or crystalline limestones, marginally serpentinites. The central and northeastern part is covered by *svratecke krystalinikum.* It is mainly composed of migmatites with muscovite-biotite ortogneisses or mica shists and mica shist - ortogneisses.
Into northeastern edge of the area here intervenes *poličské krystalinikum* with fine-grained biotic gneisses. Northwestern part of the area belongs to *poličské krystalinikum* with granites and granodiorites. In *hlinecka zone* here dominate phyllites and cherts, quartzite and slates. From west here intervenes tectonic relic of Bohemian Cretaceous Basin, mainly composed of sandstones and marlites (Bajer et al., 2014). During Holocene in river valleyes there were formed alluvial plains and peat bogs were formed in depression areas (Čech et al., 2002).

Geomorphology

In terms of regional geormorphological division PLA ŽV belongs to 4 geomorphological units - *Hornosvratecká vrchovina, Křižanovská vrchovina, Hornosázavská pahorkatina* and *Železné hory*. The cetral and eastern part of PLA ŽV belongs to *Hornosvratecká pahorkatina* unit and is represented by its subunit *Žďárské vrchy*. In Žďářské vrchy there dominates erosion denudation relief of etchplain with watershed ridges composed of gneisses and migmatites. Rock formations are typical landscape feature for the ridges. The most famous sites are *Devět skal* (the highest point of PLA ŽV, 836,3 m a.s.l.) *Čtyři palice, Malinská skála, Dráteničky* etc. Up to 30 m vertical rock walls were remodelated by cryogennic processes during cold periods of Pleistocene and called *frost-riven cliffs*. Under them there are cryoplanation terraces with scree

slopes, debris flows or boulder fields. Rock wall surface is covered by small cavity shapes – hoenycombs, rock shelters, pseudokarrens (Čech et al., 2002). In terms of tourist industry rock formations are important as attractive sites for walking and biking and are dominating feature of PLA landscape. At the same time they are popular climbing destination.

Climate
In terms of climate PLA ŽV belongs to colder, more humide and windy areas within the Czech Republic. Average annual temperature varies between 6,8 °C and 5 °C. Average rainfall is in the interval of 650-875 mm, at an altitude of 800 m a.s.l. is 1100 mm. Average snowpack at highest points of the area is from November to April (Čech et al., 2002). There are optimal conditions for winter sports – cross-country skiing and downhill skiing.

Hydrology
The main European Watershed divides the area of PLA ŽV into northwestern part (app. 54% of the area) drained by *the Chrudimka* river, *the Sázava* river and *the Doubrava* river to the North Sea and southeastern part (app. 46% of the area) drained by *the Svratka* river and *the Oslava* river to the Black Sea. The largest water body is *the Velké Dářko* pond (205 ha) (Čech et al., 2002). The function of ponds is both productive and recreational and landscaping in this region.

Geotourism
Geotourism is tourist industry providing information from the field of geology, pedology, geomorphology or archaeology and other related sciences to general tourist public in understable and popular way if possible, in situ respecting the principles of sustainable tourism development and environmental protection and geodiversity in a given area (Bajer, Kynický, 2007). Geotourism is a trend of european tourism that may offer special products and is the most promising tool of group tourism and tourism of special interest group. Geoturismus combines both educational and adventure tourism.
PLA ŽV may represent an ideal model area for application of geotourism principles due to both its natural (geological, geomorphological, pedological) variability (geodiversity) and the abundance of frequently visited rock outcrops.

Metodology
Assessment of relation of SPA (in most of them with significant element of geodiversity), collective accommodation establishments and network of tourist and recreational trails in the area.

Protected landscape areas
Small protected landscape areas within PLA ŽV and PLA borders were drawn on the basis of map server of Central list of nature conservation (ÚSOP), operated by Nature Conservation Agency of the Czech Republic (see http://drusop.nature.cz /mapa/). The main scope of area conservation was taken from data of Central list of nature conservation (ÚSOP) available on web pages: drusop.nature.cz

Collective accommodation establishments
Data of collective accommodation establishments (CAE) are obtaining from Accommodation Establishment Register that is continually updated based on available information sources and investigation of capacity and attendance of collective accomodation establishments. CAE provides minimally 5 rooms or 10 beds for temporary accommodation (hollidays, spa treatment, business trips, seminars, congresses,…). Accommodation with lower capacity is not included in this investigation. This type of accomodation is part of study of domestic and outbound tourism. CAE are hotels, guesthouses, tourist accommodation, cottage settlement, camps and other accommodation establishments (http://www.regionalnirozvoj.cz/index.php/116.html). List of capacity of CAE was created on the basis of review of CAE by Czech Statistical Office according to districts from web pages apl.czso.cz/huz/. Spatial database with number of beds in GIS software ArcGIS was created by investigation based on addresses and names of CAE.

Recreational (tourist) trails

Recreational (tourist) trails represent main directions of human entering into landscape, mostly with the purpose of recreation and knowledge. Only some landscape components are suitable for recreation. Important factors are mainly free passage throught the lanscape, estethic aspect and peaceful environment. Marked trails have been established for landscape accessibility. These trails represent the way of human entering to landscape for active recreational use. Supporting element is usually related infrastructure – traffic signs, information boards, rest areas, accompanying greenery (Sáňka et al., 2013).
There are most important types of marked trails and routes:

- cycling trail- dedicated separate communication paved for cyclists, or. walking and in-line skaters;
- cycling route – marked with indicative signs, uses existing roads, often in mixed operation with motor transport;
- hipo trail - trail riding on horseback;
- ski trail – in winter season cross-country skiing trail;
- tourist trail – for hikers.

Analytic expression of equipment of the hiking trails were carried out by means of the indicator „density of recreational trails in the area“. This indicator was applied from the methodology for assessment of importance of the soil (Sáňka et al., 2013), where landscape recreational potential was expressed mainly in context of visitors perception. Assessment includes tourist and cycling trails, nature trails and local tourist trails. Map output was elaborated using spatial analysis „line density“ in ArcGIS program with following settings:

- raster cell size: 25 m
- circle search of surrounding lines for calculation: 1780 m (corresponds to area of 10 km^2)
- Result value will represent conversion of trail density to 1 km^2.

Results

Small protected areas
On 1. 1. 2014 there were recorded 50 small protected areas (SPA) within PLA ŽV. Those areas make up about 2% of the whole area and include 4 national nature reseves, 9 nature reserves and 37nature monuments. Most sites have been declared to protect rock formations and their surrounding flora and fauna (18). There is also significant representation of peat bogs and peat bog meadows (9) and meadow and natural communities (9). Natural forest communities were the main reason for declaration of 7 areas, protection of water bodies and surroundings for 4 areas and meandering waterstreams and their surrounding vegetation for 3 areas.

Collective accommodation establishments
For the purpose of this study capacity of all collective accommodation establishments (CAE) both within PLA ŽV and its closest hinterland, especially in larger settlements (as are Bystřice nad Pernštejnem, Chotěboř, Polička, Přibyslav) was investigated.
Within PLA ŽV and its hinterland there were available 6960 beds in 126 CAE in 2014. Most of accommodation capacity was in the other accommodation establishments (2252 beds) that (in this region) include mainly children´s camps, recreational centers, cottages or youth homes. 3-4 stars hotels (26) provide a total of 2198 beds. Relatively high capacity (1375 beds) is in guesthouses in this region.

Tab. 1: Number of collective accommodation estabhlishments and number of beds within PLA Žďárské vrchy and its closest hinterland

Category of accommodation	Number	Number of beds
Hotel	26	2198
Guesthouse	42	1375
Tourist accommodation	10	474
Cottage settlement	5	268
Camp	9	393
Other	34	2252
Total	126	6960

Within PLA ŽV and its surroundingsin 2014 there was the highest concetration of CAE in larger towns and their surroundings (Nové Město na Moravě, Žďár nad Sázavou, Hlinsko) and in the central part of PLA (Tři Studně, Svratka, Fryšava pod Žákovou horou, Herálec). Administratively most of CAE were recorded in municipalities of Nové Město na Moravě – 13 CAE with capacity of 796 beds, Tři Studně – 13 CAE with 609 beds, Žďár nad Sázavou – 11 CAE with 643 beds, Sněžné – 7 CAE with 811 beds, Chotěboř – 7 CAE with 223 beds, Polička – 6 CAE with 220 beds. More than 200 beds were also available in CAE in Svratka (298), Trhová Kamenice (282), Fryšava pod Žákovou horou (228).

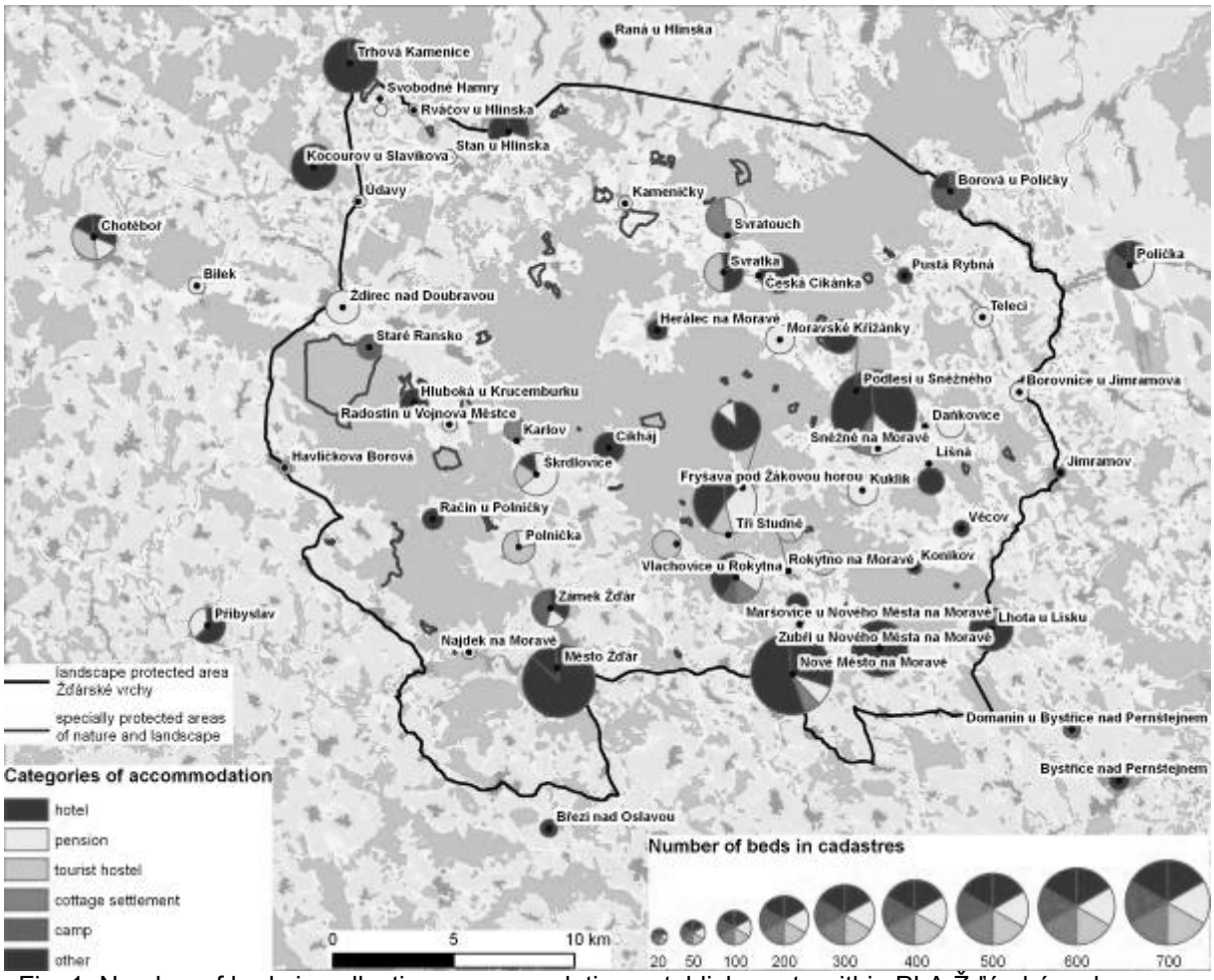


Fig. 1: Number of beds in collective accommodation establishments within PLA Žďárské vrchy and its hinterland for lands including the proportion of categories of accommodation, source ČSÚ and own investigation

Accessibility of small protected areas for staying visitors of PLA ŽV

The analysis of accessibility of small protected areas within PLA ŽV for visitors staying in local CAE was done by means of analytic tools within geographic information system (GIS) environment. A hinterland of individual small protected areas was studied at a distance of 3 km from their border. The authors consider this distance as an adequate attractive distance for visit to given localities by local staying hikers.

In following tables there are shown numbers of accommodation establishments in hinterland of small protected areas (at a distance of 3 km) and capacity of CAE in their hinterland is evaluated.

Tab. 2: Number of small protected areas (SPA) with a specific number of collective accommodation establishments (CAE) at a distance of 3 km from SPA border

Number of CAE	0	1	2	3	4	5	6	7	8	9	10	11	13	14	15	18
Number of SPA	4	10	6	8	4	1	2	4	1	2	2	1	1	1	2	1

The table. 2 shows that at a distance of 3 km of SPA border there are 46 SPA with CAE, only 4 SPA have no available accommodation. Approximately half of SPA has in its hinterland max. 3 CAE, there are SPA, however, with more than 10 CAE.

Tab. 3: number of SPA according to intervals of number of beds in CAE at a distance of 3 km from SPA border

Number of beds	Number of SPA
0	4
do 25	6
26 - 100	11
101 - 250	10
251 - 500	8
501 - 750	9
751 - 941	4

In hinterland within 3 km from SPA border in SPA ŽV was the most frequent number of beds in CAE from 26 to 100 (11 cases) and from 101 to 250 (10 cases). There is also a relatively significant representation of SPA where are available 251-100 beds and 501-750 beds in their hinterland. These are small protected areas in the central part of PLA ŽV. In hinterlands of 4 SPA there are available more than 750 beds (NM Pernovka, NR Olšina u Skleného, NR Drátenická skála, NM U Bezděkova. These are sites in larger hinterland of Nové Město na Moravě, Žďár nad Sázavou and suroundings of Sněžné and Tři Studně.

Tourist trails

Within PLA ŽV there are 468 km of tourist marked hiking trails and 328 km of marked cycling trails and routes. At the same time there are also local tourist trails (55 km) in the region. In most cases they are under the care of villages. There are 10 nature trails with a total lenght of 43 km within PLA. 5 of nature trails have been established and are maintained by villages, 4 of them by PLA Administration Žďárské vrchy and 1 of them by the Forests of the Czech Republic, State Enterprise. Only 3 nature trails have an education board dedicated exclusively to geological conditions – these are nature trails *Dářské rašeliniště, Borovské naučné stezky a Milovské naučné stezky*. The other nature trails provides geoinformation only as a part of education boards.

Density of tourist trails was evaluated as a sum of all categories of above mentioned tourist trails (hiking tourist trails, cycling trails and routes, local tourist trails and nature trails). Winter cross-country skiing trails are not included here. Only density of tourist trails using out of winter season was taken into account. The highest density of tourist trails was reached in the area between Nové Město na Moravě and Tři Studně and north and northwest from Žďár nad Sázavou (over 2,5 km of trails within km^2 with max. value 2,88 km of trails within km^2).

Accessibility of SPA using tourist trails

Tab. 4: Number of SPA with tourist trails at a distance of 0 m,, up to 250 m, up to 500 m.

Distance of trail from SPA	**0 m**	**up to 250 m**	**up to 500 m**
Marked tourist hiking trails	30	33	39
Marked cycling trails	10	20	31
Nature trails	4	4	4
Local trails	2	3	4

For the purpose of analysis of accessibility of small protected areas within PLA ŽV there were determined the categories of distance of tourist trails from SPA borders. Marked tourist hiking trails lead tourists into 30 SPA (distance 0m). Cycling trails and routes went throught of only 10 SPA. As regards distance up to 250 m from SPA borders tourists can reach 20 SPA using cycling trails and routes. At distance up to 500 m there are available tourist hiking trails into 39 SPA and cycling trails and routes into 31 SPA. Accessibility and potential attendance of SPA within 250 – 500 m is more difficult due to both conservation perspective and practical

accessibility for hikers and especially bikers. 11 SPA are more than 500 m from marked tourist hiking trails and 19 SPA are more than 500 m from marked cycling trails and routes. Attendance of these SPA is significantly limited by unsufficient tourist trails network, which can be at the same time consistent with the interests of nature and landscape conservation. Nature and local trails go throught only 4 and 2 SPA.

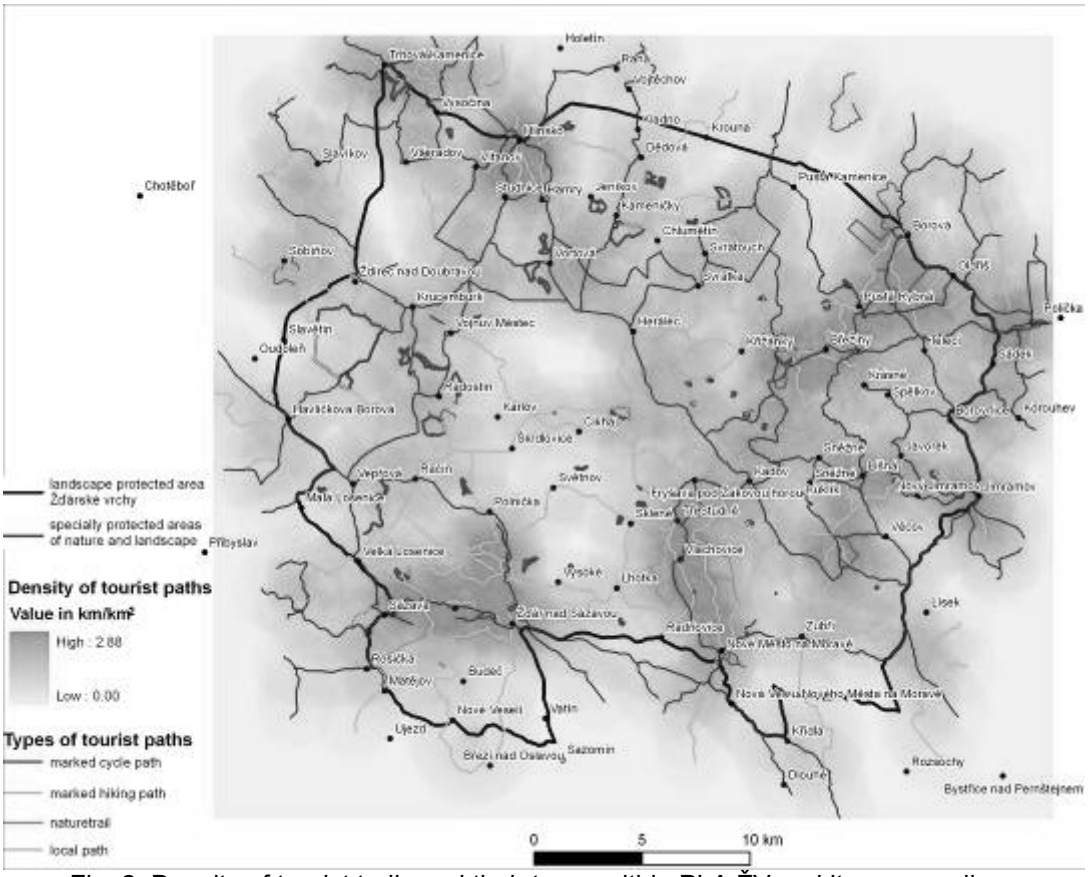


Fig. 2: Density of tourist trails and their types within PLA ŽV and its surroundings

Climbing

Climbing is permitted within PLA ŽV in rock formations: *Bílá skála, Čtyři palice, Devět skal, Drátník, Malinská skála, Milovské Perničky, Ostrá skalka, Pasecká skála, Pivovar, Rozštípená skála, Rybenské Perničky, Štarkov, Tisůvka, Uhlíř, Vávrova skalka, Zkamenělý zámek*. Most of these rock formations are at the same time a part of SPA. Climbing activity is permitted at the discretion of PLA Administration under the conditions agreed with representatives of local members of Czech mountaineering association. The use of magnesium is prohibited within PLA. (http://zdarskevrchy.ochranaprirody.cz).

Geocaching

An interesting form to increase public interest in geotourist sites is also worldwide game geocaching that in recent years has achieved mass popularity in the Middle Europe (Remeš, Vítek, 2010). The basic principle of the game is searching for hidden „treasures“ – so called *cache* (in nature they are mostly in the form of plastic box with a volume of 0,5 -1l), using GPS and given geographic coordinates. Increasing movement, however, also may due to inappropriately hidden box pose a potential threat to the site in context of both natural and archaeological sites conservation (Kovář, 2013). This aspect was taken into account by representatives of GSA (Geological Society of America) who in cooperation with Groundspeak, Ltd. (operator of world leading geocaching server) supported educational potencial of the game by upgrade in the form of virtual boxes so called *earthcaches*, where player are, instead of searching for physical box, performing set of educative tasks. Their correct sollution replaces successful finding of box in tradicional cache. Here is a big potential for mutual open cooperation with Administration of sites and geocacher community.

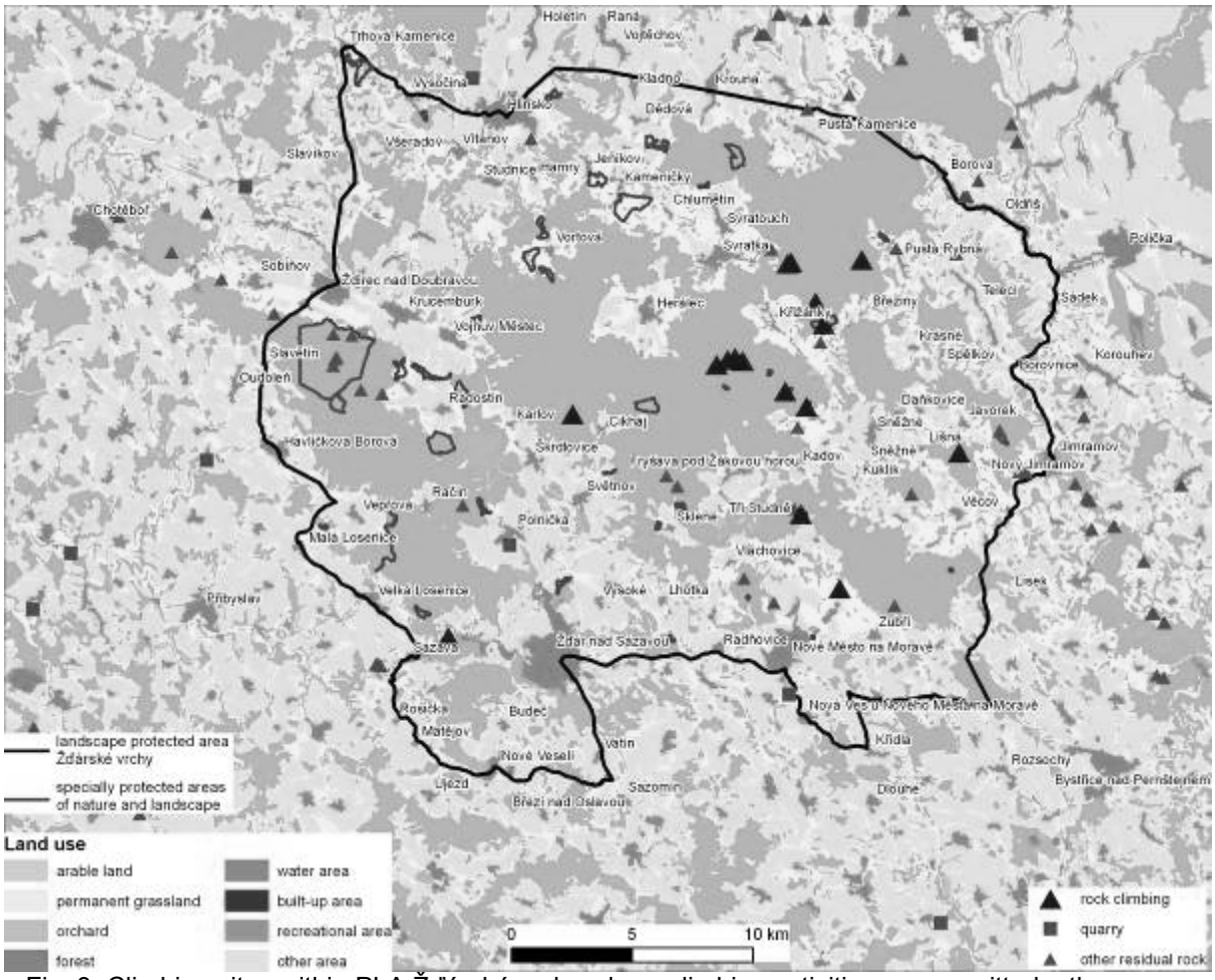


Fig. 3: Climbing sites within PLA Žďárské vrchy where climbing activities are permitted, other isolated rocks, quarry

Fig. 4: shows distribution of game boxes in SPA within PLA ŽV. It is evident that in nearly half of SPA here are game boxes, but those are physical boxes with one exception (earthcache Žďárské vrchy).

Conclusion

Rock formations are a most important tourist attraction of PLA ŽV. Their accebility to tourists is an important factor having influence on their attendance. Attendance is also influenced by the amount and variability of accommodation capacity in the vicinity. The study is focused on the assessment of the influence of tourist trails availability and accommodation establishments in relation to attendance of SPA (rock formations).

The results shows very good network of accomodation facilities in hinterland of ŽV and both quality and density of tourist trails networks especially in the most visited parts of LPA. Trails – their maintaining, marking may be an important factor for tourism distribution in the area and may contribute to protection of individual SPA. We may speak about „Tourism Distribution Controling". From this perspective it is possible to isolate some sites and on the contratry some may advertise (visualize).

Recently an important factor of both visitors distribution within the region and educational issue seems to be geocaching, when it is possible to affect the distribution of chaces, especially earthcaches.

References

BAJER, A., HLAVÁČ, V., KIRCHNER, K., KUBALÍKOVÁ, L., 2014. Za skalními útvary CHKO Žďárské vrchy, Brno, Mendlova univerzita v Brně, s. 85

BAJER, A., HAVLÍČEK, M., 2008. Hodnocení turistického potenciálu území s důrazem na geoturismus. In: Anonymus (ed.): sborník z 3. mezinárodní konference Aktuální problémy cestovního ruchu „Trvale udržitelný rozvoj v cestovním ruchu", Vysoká škola polytechnická Jihlava (CD ROM).

BAJER, A., KYNICKÝ, J., 2007. Geoturismus v kontetu středoevropské krajiny. *In Grhomanová L., (ed): Ekologie krajiny v ČR – Těžba nerostných surovin a ochrana přírody.* Česká společnost pro krajinnou ekologii – regionální organizace CZ-IALE, s. 5-11

ČECH, L., ŠUMPICH, J., ZABLOUDIL, V. A KOL., 2002. Jihlavsko. In: Mackovčin, P. a Sedláček, M. (eds.): Chráněná území ČR, svazek VII. Agentura ochrany přírody a krajiny ČR a EkoCentrum Brno, Praha, 528 p.

HAVLÍČEK, M., CHRUDINA, Z., 2013. Long-term land use changes in relation to selected relief characteristics in Western Carpathians and Western Pannonian basin – case study from Hodonín District (Czech Republic). Carpathian Journal of Earth and Environmental Science, 8 (3): 231-244.

HAVLÍČEK M., KREJČÍKOVÁ B., CHRUDINA Z., SVOBODA J., 2012. Long-term land use development and changes in streams of the Kyjovka, Svratka and Velička river basins (Czech Republic). Moravian Geographical Reports 20 (1): 28-42.

KOVÁŘ, J.J. Arecheologie a geocaching – případová studie Vildenberk. *Zprávy památkové péče*, roč. 73, č.6, s. 528-531.

REMEŠ, R., VÍTEK, O., 2010. Česko – geocachingová velmoc. In: Fialová, J.: Rekreace a ochrana přírody. Sborník příspěvků, Mendlova univerzita v Brně, s. 5-7.

SÁŇKA, M., VRUBEL, J., DOSTÁL, I., ŠIŠÁK, L., ANDĚL, P., HLADÍK, A., SLOUP, R., KALIVODOVÁ, K., JEDLIČKA, J., ŠŤASTNÝ, S., DOLEŽÍ, J., 2013. Metodika pro hodnocení významu funkcí půdy. Brno, Ekotoxa, 2013, 56 s. Certifikováno 19. prosince 2013 Ministerstvem dopravy ČR, č.j. 137/2013-520-TPV/1.

SKOKANOVÁ H., HAVLÍČEK M., BOROVEC R., DEMEK J., EREMIÁŠOVÁ R., CHRUDINA Z., MACKOVČIN P., RYSKOVÁ R., SLAVÍK P., STRÁNSKÁ T., SVOBODA J., 2012. Development of land use and main land use change processes in the period 1836–2006: case study in the Czech Republic. Journal of maps 8 (1): 88-96.

Definice kategorií hromadných ubytovacích zařízení - dostupné online z http://www.regionalnirozvoj.cz/index.php/116.html

Přehled hromadných ubytovacích zařízení z Českého statistického úřadu podle okresů a obcí - dostupné online ze stránek apl.czso.cz/huz/.

Turistické mapy – dostupné online z www. Seznam.cz, © Seznam.cz, a.s.

Acknowledgement

This study was elaborated in The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, v. v. i. throught institutional support (VÚKOZ-IP-00027073). Within *Transport Research Center v.v.i.* the realisation of this study was supported by grants of MEYS dedicated to development of research organisation and project Transport R&D Centre (no. CZ.1.05/2.1.00/03.0064). The study was alsos supported by the project „Platform for landscape

formation“, no. CZ.1.07/2.4.00/31.0032 of the Operational Programme „Education for Competitiveness“.

Souhrn
Práce je zaměřena na vztah maloplošných chráněných území k síti turistických tras a dostupnosti hromadných ubytovacích zařízení. Ze studie vyplývá, že v daném regionu je dostatečné množství a variabilita ubytovacích zařízení. Až na 4 výjimky mají všechna maloplošná chráněná území do vzdálenosti 3 km dostupné ubytovací kapacity. V 13 případech je dokonce k dispozici více než 500 lůžek v dosahu 3 km. V regionu je vyvinuta poměrně hustá síť turistických tras (turistických značených tras, značených cyklostezek a místních turistických tras). Jejich rozmístění a dostupnost a rozmístnění ubytovacích zařízení jsou významnými faktory, které mohou mít vliv na návštěvnost území, ale i ochranu živé i neživé přírody. Vhodným nástrojem (environmentálního) vzdělávání, ale i usměrnění návštěvníků v oblasti může být také geocaching.

Contact
Mgr. Aleš Bajer, Ph.D.
Mendel University in Brno, Department of Geology and Pedology, Zemědělská 3, 613 00 Brno, ales.bajer@mendelu.cz

Mgr. Marek Havlíček, Ph.D.
The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Lidická 25/27, 602 00 Brno, marek.havlicek@vukoz.cz

Mgr. Ivo Dostál
Transport Research Cente, Líšeňská 33a, 636 00 Brno, ivo.dostal@cdv.cz)

COULD AN ACTIVE PUBLIC RECREATION HAVE AN IMPACT TO POPULATION OF SOME INSECTS IN FOREST ECOSYSTEM - CASE OF FOREST DRAGONFLIES

Otakar Holuša, Kateřina Holušová
Mendel University in Brno

Abstract
Among the ways of modern public recreation include horse-riding in the forests or stream climbing in mountain streams and gorges. Both of these activities are often operated outside the marked trails in the forests, trough forest springs or watercourses respectively. There are described cases of this type of recreation in forests in the Moravskoslezské Beskydy Mts. in relation to populations of forest species of dragonflies. Among the right forest species of dragonflies in Central Europe include species of the genus *Cordulegaster*. *Cordulegaster bidentata* is the most abundant species in the forests of central Europe in the hills and mountains, which inhabits forest springs and streams. In some cases, the paths (trails) routed through these habitats. The case, horse-riding in forests with direct impact to larvae of *Cordulegaster bidentata*, has been recorded in the study of bionomics rheobiont dragonfly species. A one-time passage of horses is not destructive, but repeated ride on the same path is dangerous. Repeated passage of horses causes physical destruction of habitat i.e. trampling of sediments in shallow pools, where larvae are concentrated, but also direct trampling of larvae. Negative impact is also the chemical pollution of water excrement that is left in large quantities in the habitats. Threat increases during the emergency of larvae i.e. from May to June, when larvae dwell in coastal parts and are sensitive to any interference with the habitat or contact. Repeated recreation outside the marked paths, still on the same trails, is becoming an important negative factor in the threat of forest habitats springs and insect populations.

Key words: public recreation, negative impact, population density, *Odonata*, *Cordulegaster bidenata*

Introduction

Dragonflies inhabit biotopes i.e. wetland with water courses or lakes where there is no assumption of the negative impact of human recreational activities. In Central Europe, there occur some species of dragonflies that inhabit forest habitats i.e. rivers, streams and forest springs – species of following families *Calopterygidae*, *Gomphidae* and *Cordulegastridae*. Among the right forest species the species *Cordulegaster bidentata* is included, which is stenotopic species that inhabit forest streams and springs. The depth of these streams is usually only a few cm, springs are often create by wet soils. Species prefer lower Hills, avoiding the high mountains – the occurrence was found at altitude from 150 m a.s.l. to 950 m a.s.l. With this species we can most likely meet in the Czech Republic in the Carpathian region – in the region of the Vsetínské vrchy hills or in the Bílé Karpaty Mts. (Dolný et al. 2007, Holuša 2013, Holuša & Holušová 2013). Flight time activity of adults takes from late May until the last decade of September, with the centre of activity during late June to mid-August.
At present, even in these wetland habitats are carried out recreational activities - a modern way of „stream climbing“, but also in forest wetlands are individual tourism activities or horse riding carried out. It is not yet known, that recreational activities had a negative impact on the population of the species *Cordulegaster* (cf. Fränzel 1985, Pfuhl 1994).
The aim of this paper is evidence of the negative impact of horse riding on the species population of *Cordulegaster bidentata*, which was recorded in long-term study populations of this species in the Moravskoslezské Beskydy Mts., and evaluate the negative impact on the population of the species.

Materials and methods

Our study was conducted in a small spring area in the Moravskoslezské Beskydy Mts. (Ostravice village - valley of Mazák, altitude 680 m a.s.l.) in the eastern part of the Czech Republic. The spring area and contiguous streamlet (with total length 70 m) are in a small valley in large complex of forests (stemwoods) (see Fig. 1).

Fig. 1: Locality of forest spring area at Ostravice-Muchovice place with population of *Cordulegaster bidentata* – in 2011 locality without disturbing of vegetation and disturbances of spring (photo O. Holuša)

The bionomics of population of *Cordulegaster bidentata* at locality was studied from 2008 to 2013, every year during May-September. In cca 5-7days interval during May-June were observed number of exuviae, with data of position at vegetation, sex of exuviae. The abundance of imagoes was noted during three days at the end of July and at the beginning of August (Holuša 2007). All imagoes were marked and released. Daily observations took place from 7.30 to the dusk at 20.30 (CET). During bionomics study were recorded all negative phenomena in habitats that could have a direct impact on the species population.
Character of the locality was changing only partially – there were found changes of vegetation coverage, in 2010 at the end of the month May was significantly rainy weather and it influenced "flush" the lower half of locality. As a result of changes of vegetation and trees growth in the surrounding of locality, changing the recreational use of the site and its surroundings for horse-riding (recorded since 2008, i.e. since beginning of monitoring bionomics), which is run in the wider area of locality i.e. in the basin of the Mazak stream, just in the forest stands. During the study were monitored movement of horses across the site, recorded frequency during selected days during the summer period and evaluated the negative impact of horses on the habitat and population of the species.

Results
Use of the site i.e. the area of spring for horse-riding was the first time recorded in 2011. In 2013, the impact is so significant that during the month of July was to create a line through the site i.e. through habitat, wetland, pools, where larvae occur (see Fig. 2).
During the month there was a significant destruction of vegetation cover and creation a much damaged places where horses put down their hooves (see Fig. 3). In the section that was under the influence of horse hooves, no larvae were not found any exuvie during May, and not found any larva (25.VII.2013, 15.VIII.2013).
In July each day, it was found that the group of horses passing through the site several times a day during was recorded passage location 3 times a day, in a group of up to 5 horses. When passing horses stop, nibble on vegetation and also produce excrements that fall directly into the aquatic environment of the site. In places where horses run regularly, there is an accumulation of excrement (see Fig. 4). By passing the site, the horse acts disturbances – trampling of soil sediments in pools, trampling of larvae and chemical pollution of water by excrements.

Fig. 2: Locality of forest spring area at Ostravice-Muchovice in 2013 – created the beaten paths through the site - VII.2013 (foto O. Holuša)

Fig. 3: Detail of disturbance of the soil surface of wetland, an obvious place where horses hooves put down in the same places (foto O. Holuša)

Discussion

The observed way of recreation i.e. horse-riding in forests has a clearly negative effect on the species population of *Cordulegaster bidentata*. This disturbance will be seen negatively especially its repetition. A one-time pass site does not have a negative impact, can be compared to the natural passage of other large animals. Negative, this passage becomes a repeat (3x per day in summer), which leads to the destruction of wetlands and directly to the trampling of larva by horse hooves. Another negative effect is the change in water chemistry in wetlands, a large supply of excrements exposed to the water in a 50 m long of site.

This negative "recreational" affecting with another natural influences to the habitat can greatly affect the local population of the species. The habitats of species are not threatened in general, but this effect significantly disturbs the natural population dynamics.

The operator of such recreational activities should take into account the negative effects of horse-riding, it should use the route again, avoid also the buffer zones of small scale protected area. Above all, avoid forest wetlands and horse-riding to regulate. Choose for these activities strengthened forest roads, and after passing horses collect and clean excrements.

Fig. 4: Detail of accumulation of horse excrement on a forest path, creating a continuous layer beneath the wetland habitat (photo O. Holuša)

Conclusion

The occurrence of *Cordulegaster* species is threatened by interventions into waterways - direct disposal flow or affecting riparian vegetation, but also changes in the hydrological regime and especially water chemistry. The threats are also aggressive impacts in the landscape in river flows. These effects may appear currently in a forest complex as insensitive exploitation of wood and also chemical interventions such as liming of forests.

Among these negative effects can also include a finding of repeated recreational activity horse riding in habitats of *Cordulegaster* species. These activities by repeated passages create a significant disturbance of habitat. The negative impact is the impact of horse hooves, but also the amount of excrement that affects the water chemistry of wetlands.

Synergism of negative factors may also significantly reduce the local population of a species, the potential to affect the structure and dynamics of communities of streams and springs, their inhabitants and hence their diversity.

The solution is to regulate these recreational activities, particularly zoning, where these activities may not be operated i.e. buffers zones protected areas, and also forest wetlands or valuable habitats. These areas should be entered in the Planning Framework (cf. Holuša 2000), to avoid these recreation areas, or those activities in these areas directly prohibited.

References

DOLNÝ A., WALDHAUSER M., HOLUŠA O., BÁRTA D., HANEL L., 2007: *Vážky České republiky. Ekologie, ochrana a rozšíření*. Český svaz ochránců přírody, Vlašim, 672 pp.

FRÄNZEL U., 1985: *Öko-ethologische Untersuchungen an Cordulegaster bidentatus Selys, 1843 (Insecta: Odonata) in Bonner Raum*. [Diplomarbeit]. Mathematisch-Naturwissenschaftlichen Fakultät, Rheinischen Friedrich Wilhelms Univeristät Bonn, 130 pp.

HOLUŠA J., ST. (ED.), 2000: Oblastní plán rozvoje lesů. Přírodní lesní oblast 40 - Moravskoslezské Beskydy (platnost 2001-2020). Ústav pro hospodářskou úpravu lesů Brandýs nad Labem, pobočka Frýdek-Místek, 225 pp.

HOLUŠA O. 2007: Notes on the diurnal activity of adults of *Cordulegaster bidentata*. p. 33. In: MARTENS A., SAHLÉN G., MARAIS E. (EDS.): Abstracts. 5th WDA International Symposium of Odonatology. 16-20 April 2007, Swakopmund, Namibia, 84 pp.

HOLUŠA O., 2013: *Taxonomie, ekologie a zoogeografie vážek rodu Cordulegaster (Odonata: Cordulegastridae) ve střední Evropě*. [Disertační práce]. Prírodovedecká fakulta, Univerzita Komenského v Bratislave, 176 pp.

HOLUŠA O., HOLUŠOVÁ K., 2013: Biogeographical occurrence of *Cordulegaster* species in the Czech and Slovak Republics with notes to the habitat preference. pp. 22-23. In: v. BLANCKENHAGEN B., PLOSS E.: 32. Jahrestagung der Gesellschaft deutschsprachiger Odonatologen (GdO) e.V., 15. bis 17. März 2013, Petersberg bei Fulda, Hessen, 80 pp.

PFUHL D., 1994: Autökologische Untersuchungen an *Cordulegaster boltoni* (DONOVAN, 1807) (Insecta, Odonata). [Diplomarbeit]. Zoologischen Institut der Georg-August-Universität Göttingen, 114 pp.

Souhrn

Vážky obývají biotopy tj. mokřady s vodotečemi či vodními plochami, kde není předpoklad negativního vlivu rekreačními aktivitami člověka. Ve střední Evropě se vyskytují některé druhy vážek, které obývají lesní biotopy tj. říčky, potoky a lesní prameniště – druhy čeledí *Calopterygidae*, *Gomphidae* a *Cordulegastridae*. Mezi pravé lesní druhy patří druh *Cordulegaster bidentata*, který je stenotopní druh, který obývá lesní potoky a prameniště. S tímto druhem se můžeme v ČR setkat nejpravděpodobněji v oblasti Vsetínských vrchů či Bílých Karpat. Doba letu imág trvá od konce května až do poslední dekády září, s těžištěm výskytu od konce června do poloviny srpna.

V současné době i v těchto mokřadních biotopech v lesích jsou prováděny rekreační aktivity – moderní způsob je „stream climbing“, ale i v lesních mokřadech jsou překvapivě prováděny aktivity individuálního turismu či jízda na koni.

Cíl příspěvku je evidence negativního vlivu jízdy na koni na populace druhu *Cordulegaster bidentata*, který byl zaznamenán při dlouhodobém studiu populací druhu *Cordulegaster bidentata* v Moravskoslezských Beskydech a zhodnocení negativních dopadů na populaci druhu.

Bionomie druhu *Cordulegaster bidentata* je detailně studováno na lesních prameništích v povodí potoka Mazák od r. 2008. Během tohoto výzkumu byly zaznamenávány všechny negativní jevy v biotopech, který by mohly mít přímý vliv na populaci druhu.

Využívání lokality tj. vlastní prameniště pro jízdy na koni bylo poprvé zaznamenáno v r. 2011. V roce 2013 byly vliv natolik výrazný, že během měsíce July došlo k vytvoření linie (migrační trasy) přes lokalitu tj. vlastní biotop, tůně, kde se vyskytují larvy byly přímo pod vlivem rozšlapávání (viz. Fig. 2). Během měsíce došlo k výrazné destrukci vegetačního krytu a vytvoření velmi narušovaných míst, kam koně pokládají kopyta (viz. Fig. 3). V úseku, který byl pod vlivem koňských kopyt, nebyla během května 2013 zjištěna žádná exuvie, a nenalezena žádná larva (25.7.2013, 15.8.2013).

Zjištěný způsob rekreace tj. jízdy na koni má jednoznačně negativní vliv na populaci druhu. Tato disturbance se však projeví negativně především jejím opakováním. Jednorázový průchod lokalitou negativní vliv nemá, dá se přirovnat k přirozenému průchodu jiných velkých sudokopytníků. Negativní se tento průchod stává opakováním (3x za den v leté), což vede k destrukci mokřadu a přímým ušlapáním larev kopyta koní. Druhým negativním jevem je změna chemismu vody v mokřadu, velkým přísunem exkrementů dochází k ovlivnění vody v délce 50 m celého prameniště.

Toto negativní „rekreační“ ovlivnění biotopů při působení dalších přirozených negativních faktorů mohou výrazně ovlivnit lokální populace druhu. Celkově nejsou biotopy ohroženy, ale toto působení výrazně narušuje přirozenou dynamiku populace.

Provozovatel těchto rekreačních aktivit by měl brát v úvahu tyto negativní vlivy jízdy na koni, neměl by využívat trsy opakovaně, vyhnout se ochranným pásmům maloplošných chráněných území, vyhýbat se lesním mokřadům a jízdu koní usměrňovat. Vybírat pro tyto aktivity zpevněné lesní cesty, a po průchodu koní sklízet exkrementy.

Contact:

Otakar Holuša, Prof. Ing. Ph.D. et PhD.

Mendel University in Brno, Faculty of Forestry and Wood Technology, Department of Forest Protection and Wildlife Management

Zemědělská 3, 613 00 Brno

Tel: +420 606 960 769, email: holusao@email.cz

CURRENT POSSIBILITIES FOR QUANTIFICATION AND MODELING OF RECREATION SERVICES

Vilém Pechanec[1], Pavel Cudlín[2], Ivo Machar[1], Helena Kilianová[1]
Palacký University Olomouc[1]; Global Change Research Centre[2];

Abstract
Ecosystems provide settings for a hugely diverse array of recreational activities. Recreational values are among the most well-recognized of all ecosystem services by the public, and human preferences for recreation have been well-studied by economists and other social scientists. From a spatial perspective, we can map sources of recreational value, sinks of recreational value, users of a particular recreation area for a given activity, and the spatial flow that connects users to specific recreational areas. The text presents two key approaches of modelling tools InVEST and ARIES. Methodological approaches are compared with each other and the requirements for data confronted with national data sources.

Key words: approaches, ARIES, InVEST, compared

Introduction

Ecosystems provide settings for a hugely diverse array of recreational activities.
Recreational values are among the most well-recognized of all ecosystem services by the public, and human preferences for recreation have been well-studied by economists and other social scientists.
Recreation and tourism are important components of many national and local economies and they contribute in innumerable ways to quality of life, sense of place, social connection, physical wellbeing, learning, and other intangibles. A key reason for studying patterns of recreation or tourism is the economic significance of this industry. The total contribution of travel and tourism to the world's gross domestic product (GDP) in 2011 was approximately $6 B USD (9% of GDP), with expected growth to $10 B USD by 2022 (World Travel and Tourism Council 2012).
Recreation: The contribution of ecosystems toward providing diverse outdoor recreational opportunities such as hiking, bird watching, hunting, kayaking, etc.
Biodiversity-based recreation (e.g. bird watching, wildlife viewing, fishing, and hunting): High diversity and the presence of rare birds and wildlife (for birding and wildlife viewing) or habitat for specific game species (for fishing and hunting) are prerequisites for biodiversity-based recreational activities.

Modelling of ecosystem services

Increasing level of human impact on ecosystems results in continuous biodiversity decrease; scientists try to estimate the consequences in ecosystem functioning and the provision of ecosystem services. Several models resulting from the work of international teams are available for the purposes of modelling of ecosystem services, e.g. InVEST, ARIES, GLOBIO, IMAGE, WEAP and WaSSI models. Most of them are freely available models/algorithms that combine known algorithmizations of selected natural processes and methods for the assessment of environmental services. Tools for modelling of recreation services have only InVEST, ARIES and WASSI. All the models are based on the input information on land use, especially about its spatial structure, forms of uses and the structure of individual elements.

Approach by InVEST

Integrated Valuation of Environmental Services and Tradeoffs (InVEST) is a freeware that was developed by Natural Capital Project consortium. InVEST represents a modular solution consisting of a set of tools, which can be combined freely, and enables users to quantify, visualize and compare key ecosystem services according to different land-use scenarios. It further quantifies the values, generates maps, and establishes the value of "goods" and services from nature that contribute to sustaining and fulfilling human life. The description of natural resources is conducted from the perspective of biophysical features and services that they provide to people, or from the perspective of their expected socio-economic values. InVEST currently includes 15 modules that analyze different services of marine and terrestrial environment. The purpose of the InVEST recreation model is to predict the spread of person-days of recreation, based on the locations of natural habitats, accessibility, and built features such as roads that factor into people's decisions about where to recreate (Adamowicz et al.

2011). The tool outputs maps showing current patterns of recreational use and, optionally, maps of future use under alternative scenarios.
The model uses an interface to input all required and optional data, which are then sent to a server managed by the Natural Capital Project in California, where computations are performed. Consequently, this model requires a connection to the internet. The server outputs a vector polygon shapefile and .csv tables of results.

The InVEST recreation model consists of two individual tools, which must be run consecutively:

1. **Initial tool -** which computes photo-user-days (y_i), coverages of predictors (x_{ip}), and effects of predictors ($ß_p$).
2. **Scenario tool -** which uses effects per predictor () to estimate future visitation rates.

The time required to run the Initial Tool varies depending on the extent of the AOI, the number grid cells, and the number and resolution of predictor layers. The Scenario Tool takes less time to run.

Methods
The tool estimates the contribution of attributes of the landscape to the visitation rate, using a simple linear regression:
$y_i = ß_0 + ß_1 * x_{i1} + \ldots + ß_p * x_{ip}$ for i = 1 ...n (1)
where x_{ip} is the coverage of each attribute in each cell, i, within an Area of Interest (AOI) containing n cells. In the absence of empirical data on visitation for y_i, it parameterize the model using a proxy for visitation: geotagged photographs posted to the website flickr. Stated again, the InVEST recreation model predicts the spread of person-days of recreation in space. It does this using attributes of places, such as natural features, built features, and human uses, among others. A simple linear regression relates average photo-user-days per cell to coverages of attributes across grid cells within the study region. Then, armed with these estimates ($ß_p$ values), the model predicts how future changes to the landscape will alter visitation rate.

Photograph user days - Many of the photographs in flickr have been assigned to a specific latitude/longitude. Using this location, along with the photographer's user name and date that the image was taken, the InVEST tool computes the total annual days that a user took at least one photograph within each cell, then returns to users the average annual number of photo-user-days from 2005-2012 (Wood et al. 2013).
Predictor variables - It find that it often helps to consider at least one variable from several main categories: natural capital, built capital, industrial activities, and access or cost (eg distance to major airport). Often, single variables representing each of these categories can explain the majority of variation in photo-user-days. To facilitate this, the tool comes pre-loaded with several optional sources of global spatial data including total population and natural habitats on land and in the ocean. The tool also allows users to upload their own spatial data (in any vector shapefile format), if they have information on additional or alternative attributes that might be correlated to people's decisions about where to recreate.

Data
Area of Interest - this input provides the model with a geographic shape of the area of interest (AOI). The AOI must be projected and have an associated linear unit.
Global Default Data - the tool provides several global spatial datasets (tab. 1), which users can optionally include as predictor variables for their AOI.

Model outputs

- aoi_params.csv - text file contains the regression model parameters,
- grid.shp - polygon feature layer contains the gridded AOI with the number of photo-user-days and coverage of each predictor variable per cell - USDYAV is the average photo-user-days per year (using all photos from 2005-2010). This corresponds to the PUD described in Wood et al. (2013); USDYAV_PR is simply the proportion of total USDYAV per cell.
- init.json - configuration file contains the initial tool parameters.
- download - folder contains the feature layers for processed predictors.

Tab. 1: The default global predictor data provided by the Initial and Scenario Tools are from the following sources.

Predictor	Description	Source	Use in CR
2010 Population	A global distribution of ambient population (average over 24 hours).	http://www.ornl.gov/sci/landscan/	yes
OSM Points	Open Street Map point features.	http://www.openstreetmap.org/	yes
OSM Lines	Open Street Map line features.	http://www.openstreetmap.org/	yes
OSM Polygons	Open Street Map polygon features.	http://www.openstreetmap.org/	yes
Protected Areas	The World Database on Protected Areas. http://www.wdpa.org/	http://protectedplanet.net/	quiet yes
LULC	Globcover global land cover map for the period from December 2004 to June 2006.	http://ionia1.esrin.esa.int/	non-relevant
Mangroves	A global composite dataset gathered from a wide range of sources.	http://data.unep-wcmc.org/	non-relevant
Coral Reefs	Warm water coral reefs. Approximately 85% of this dataset originates from the Millennium Coral Reef Mapping Project.	http://data.unep-wcmc.org/	non-relevant
Seagrasses	An updated version of the "World Atlas of Seagrasses" (2003)	http://data.unep-wcmc.or	non-relevant

Approach by ARIES

From a spatial perspective, we can map sources of recreational value (areas capable of providing the natural setting needed for a particular activity), sinks of recreational value (landscape features that reduce those source values, if applicable), and the users of a particular recreation area for a given activity. A recreation flow model accounts for travel from a person's home to a particular location suitable for that recreational activity. Travel cost and recreational site choice studies also use basic transportation routing to connect recreationists to recreation sites, but typically do not map the process or facilitate comparisons with other ecosystem services (Clawson and Knetsch 1966, Hunt 2008).

The ARIES recreation models are intended to solely map an ecosystem's capacity to support a particular recreational activity, as opposed to the other attributes that contribute to the overall quality of a recreational experience, with the understanding that only the ecosystem attributes supporting recreation represent actual natural capital and are thus the ecosystem service (Boyd and Banzhaf 2007). By mapping the ecosystem's contribution toward different recreational attributes, we can explore tradeoffs between different types of recreational use, tradeoffs between recreation and other ecosystem services, and relative preferences for certain recreational attributes.

Methods

Recreation use models: Birding, hunting, and wildlife viewing. Initial mapping of recreational use relies on population or housing density data. For some activities, it may be possible to estimate the percentage of the population taking part in that recreational activity (i.e., the number of licensed hunters or anglers in a state relative to its total population). Representing users as a uniform percentage of the population engaging in a particular activity makes the admittedly naive assumption that the same percentage of recreational users across all communities engage in a particular activity. It also assumes that different user groups for the same activity have similar preferences, which is not always a realistic assumption.

A more realistic model would account for the fact that different types of communities are likely to prefer different recreational activities and to value attributes of a particular recreational experience differently. Indeed, in some cases individuals will choose their location of residence to provide proximity to an especially valued recreational amenity.

Recreation use models: Viewsheds. The use model for aesthetic views is based on locations where hikers have access to views (i.e. trails, vistas, outcroppings).

Recreation flow models. With information on how many visitors participate in a given activity at a particular recreation site and how far they travel, we can complete a simple flow model by distributing the visitor population across the landscape based on a population density map and

road networks that incorporate data on trailhead locations (if applicable for that activity). This allows the model to estimate travel times for people traveling from their residences to recreational sites. Where data are available, zip code based travel cost, recreational preference surveys, or permit data can show how far people travel to a particular site.
Recreation sink models. Sinks will be present for some, but not all types of recreation. For most types of recreation where the source value can be assessed in situ, no sink model is necessary. Habitat-based flow models could eventually be developed or an existing ones incorporated to account for spatial dependencies in wildlife habitat. For viewsheds, the sink model identifies areas of visual blight that reduce view quality, similar to the viewshed model described in the aesthetic viewshed module. It be assumed that obstructions (e.g., buildings, topography, or vegetation) or undesirable visual features (blight associated with development, energy infrastructure, or roads) reduce view quality (Benson et al. 1998).

Data

[1] biotic factors – data of species richness, rare habitat presence
[2] abitotic factors - riparian condition class,hydrograpy, rlevation, etc.
[3] human activity - Public lands, Developed land, Energy infrastructure, Transportation infrastructure, Population density, Roads: speed limits/travel capacity, Trails
[4] special data - scenic viewpoints, habitat for game species

Model output

1. Recreational user flow: The movement of people toward recreation areas, based on transportation networks, recreational preferences, site quality, and a distance decay function.
2. Recreational use: The amount of recreational use actually seen at a recreation area when accounting for demand and spatial flows of visitors.
3. Actual recreational users: The residential location of users who actually travel to sites via recreation flows to engage in recreational activities at source areas.
4. Transportation restricted recreational use: Recreational areas whose current accessibility via transportation networks makes their use level more limited than their attractiveness alone would dictate.

Compare of models

To quantify the value of natural environments, the InVEST recreation model predicts the spread of person-days of recreation, based on the locations of natural habitats and other features that factor into people's decisions about where to recreate. The tool estimates the contribution of each attribute to visitation rate in a simple linear regression. In the absence of empirical data on visitation, we parameterize the model using a proxy for visitation: geotagged photographs posted to the website flickr. Using photo-user-day estimates, the model predicts how future changes to natural features will alter visitation rates. The tool outputs maps showing current patterns of recreational use and maps of future patterns of use under alternate scenarios.
ARIES calculate four indicators of recreational services. I.) recreation value – its area capable of providing the natural setting needed for a particular activity, II.) sinks of recreational value – it means landscape features that reduce those source values, if applicable, and III.) the users of a particular recreation area for a given activity.
A recreation flow model accounts for travel from a person's home to a particular location suitable for that recreational activity. Travel cost and recreational site choice studies also use basic transportation routing to connect recreationists to recreation sites, but typically do not map the process or facilitate comparisons with other ecosystem services (Hunt 2008). Both models use different approach and indicators of recreation services. Models are free available. Both models can be fill in of national datasets.

References

ADAMOWICZ, WL, R NAIDOO, E NELSON, S POLASKY, J ZHANG. 2011. Nature-based tourism and recreation. In: Kareiva P, G Daily, T Ricketts, H Tallis, S Polasky (eds) Natural Capital: Theory and Practice of Mapping Ecosystem Services. Oxford University Press, New York.
BAGSTAD, K.J., VILLA, F., JOHNSON, G.W., AND VOIGT, B. 2011. ARIES – Artificial Intelligence for Ecosystem Services: A guide to models and data, version 1.0. ARIES report series n.1.

BENSON E.D., ET AL. 1998. Pricing residential amenities: the value of a view. Journal of Real Estate Finance and Economics 16: 55-73.
BOYD, J. AND L. WAINGER. 2003. Measuring ecosystem service benefits: The use of landscape analysis to evaluate environmental trades and compensation. Discussion Paper 02-63, Resources for the Future: Washington, DC.
CLAWSON, M. AND J. KNETSCH 1966. Economics of outdoor recreation. Johns Hopkins University Press: Baltimore, MD.
HUNT, L.M. 2008. Examining state dependence and place attachment within a recreational fishing site choice model. Journal of Leisure Research 40 (1): 110-127.
LAWSON, S.R. AND R.E. MANNING. 2002. Tradeoffs among social, resource, and management attributes of the Denali Wilderness Experience: A contextual approach to normative research. Leisure Sciences 24 (3): 297-312.
TALLIS, H.T., RICKETTS, T., GUERRY, A.D., WOOD, S.A., ET. AL. 2013. InVEST 3.0.0 User's Guide. The Natural Capital Project, Stanford.
World Travel and Tourism Council. 2012. Travel and Tourism: Economic Impact.

Acknowledgement
This work has been supported by grant no. CZ.1.07./2.3.00/20.0166 Center of Theory of Education financed by European Social Fund and state budget of the Czech Republic.

Souhrn
Rekreační služby jsou poměrně těžce uchopitelné Z dnes dostupných modelů pro ekosystémové služby tento proces umí modelovat a kvantifikovat pouze systém InVEST a ARIES, který není ve stavu finálního a plně funkčního nástroje. Při rozboru vstupních dat a použitých algoritmů se ukázalo, že oba přístupy jsou zcela odlišné, každý má svůj vlastní výklad na vyjádření rekreační služby. Oba přístupy se dají aplikovat i na naše území. V případě InVESTu používané globální datové zdroje pokrývají i naše území a dají se použít. Je diskuzní otázkou do jaké míry jsou turisté v ČR (domácí i zahraniční) zvyklí používat službu Flicker pro ukládání svých fotografií, která generuje velmi důležitý parametr pro výpočet. V případě ARIES se jedná o koncept, a je pouze na uživateli jak zabezpečí vstupní položky a jakými daty. Měřítko, aktuálnost a úplnost vstupních dat zde sehrává klíčovou roli.

Contact:
Assoc. Prof., RNDr. Vilém Pechanec, Ph.D.
Palacký University Olomouc, Faculty of Science, Dept. of. Geoinformatics
17. listopadu 50, 771 46 Olomouc
+420-585-63-4579; vilem.pechanec@upol.cz

DISPUTED RECREATIONAL AND ECOLOGICAL STABILIZATION FUNCTIONS OF CELECTED WINDBREAKS

Bronislava Spáčilová, Hana Středová
Mendel University in Brno

Abstract
Windbreaks protect soil from wind effects, but especially in homogenized landscape they have to meet other functions such as ecological stabilization, aesthetic and recreational functions. They are kind of biotic diversity residues in intensively farmed landscape. They play an essential role in ecological stability in the countryside with low forest cover and little near-natural communities and therefore should be formed essentially by autochthonous species, as far as possible from local populations and there should be a high species diversity. However, alien species *Acer negundo*, *Robinia pseudacacia*, *Ailanthus altissima* etc. are common in our windbreaks. Some of them are easily spread to the countryside or even negatively affect native species of our flora. Environmental stabilization function is also influenced by interconnectivity of these vegetation belts, which is often missing or disrupted by communications. The recreational function is directly determined by the presence of paths along windbreaks and the overall condition and appearance of windbreaks. For selected windbreaks some deficiencies were found in species composition, disruption of windbreaks, absence of paths or their branching off from windbreaks to monotonous agriculturally cultivated areas without scattered vegetation. Also appearance of minor illegal dumps or dead trees reduce the potential recreational function of windbreaks.

Key words: shelterbelt, vegetation, biocorridor

Introduction

Windbreaks (protective forest belts or shelterbelts) create a permanent soil protection from the harmful effects of wind and belong to the most effective measures against wind erosion. Meteorological dictionary (Sobíšek et al., 1993) defines windbreak as a belt consisting of trees and shrubs planted on the protection of the area from the harmful effects of wind.
In the Czech Republic windbreaks began to be planted especially after the drought in 1947 and after land consolidation in 1948, which had a number of negative effects on soil. Networks of windbreaks were therefore created in southern Moravia in the 60s and 70s. But gradually they ceased to be maintained and their effectiveness has become questionable (Podhrázská 2011). Inappropriate tree species composition negatively affects the "permanent" protective function of windbreaks because the species with short rotation – poplars - were favored.
Forest belts have many other functions. In addition to soil protection function they also also fulfill the climatic function (reducing evaporation from the soil, increase air humidity, etc.), environmental stabilization (base of ecological stability skeleton), the landscaping (diversify monotonous appearance of the landscape), aesthetic and recreational function (in case of a single continuous cover in site it can be visited by the inhabitants). Orchards can fulfill similar functions (Středa et al. 2011).
Dispersed vegetation is a kind of biotic diversity residue in anthropogenic landscape. It acts ecostability, especially in rural homogenized. Windbreaks are an important habitat for plants and animals in intensive agricultural landscape (Macků 2005).
Among the most obvious benefits that windbreaks or other green belts can bring people from surrounding villages, is the recreational function. They can become a meeting place, places of learning or serve daily recreation, which is associated with the use of areas close to human habitation.
The short-term recreational uses include physical and sports activities, crawl and also passive leisure activities, reading, relaxing or exploring plants. Accessibility by foot within ten minutes away is preferred (Kaplan, Kaplan 1995).
Recreational efficiency can be increased by modifying the stands of the species, age and spatial structure, introducing aesthetic elements, making accesible or adequate, nature-friendly and minimally detrimental management.

Materials and methods

In the south of Moravia 3 windbreaks that could serve short-term recreation were selected in the vicinity of villages (Fig. 1). For each shelterbelt a path for pedestrians was searched, its status

and relation to other routes in the area were identified. Species composition and functionality of windbreaks according to methodology of Podhrázská et al. (2008) were also assessed.

Shelterbelts description

a) Malešovice

Windbreak at Malešovice is two-row, 12 m wide and f about 14 m high (Fig. 2). The main tree species are *Fraxinus excelsior*), *Tilia cordata*, *T. platyphyllos*, *Quercus robur*, *Acer negundo*, *Ulmus minor*. Dead trees or somehow damaged trees are also present. The shrub layer is not very developed, represented here by *Sambucus nigra*, *Ligustrum vulgare*, *Cornus sanguinea*, *Prunus spinosa*, *Caragana arborescens*.

b) Medlov

Windbreak at Medlov is six-row, 21 m wide and about 15 m high (Fig. 3). the main tree species are Fraxinus excelsior, *Tilia cordata*, *Quercus robur*, *Acer negundo*, Acer pseudoplatanus, *Acer platanoides*. Further *Morus alba* and *Prunus padus* can be found there. Dead or somehow damaged trees are also present. The shrub layer is represented by C*aragana arborescens*, *Euonymus europaea* and *Rosa* sp.

c) Smolín

Windbreak at Smolín is five-row, 15 m wide and about 15 m high. The main tree species are *Acer negundo*, *Populus nigra*, *Quercus robur*, *Acer platanoides*, *Acer pseudoplatanus*, Fraxinus excelsior, *Tilia cordata*, *Ulmus minor*. The shrub layer is represented by *Euonymus europaea*, S*yringa vulgaris*, *Ligustrum vulgare* and *Caragana arborescens*.

Results and discussion

The methodology of evaluation and categorization of windbreaks (Podhrázská et al., 2008) categorizes windbreaks only in groups: functional, conditionally functional and dysfunctional. When evaluating selected windbreak near Smolin it was functional (deficiencies especially in species composition, relatively well developed vertical structure, it is only a line element that is not part of the line elements), windbreak at Malešovice was evaluated as a conditionally functional (deficiencies in voidage and vertical arrangement of trees, nonfunctional system of linear elements - there were no side strips, also deficiencies in species composition), as well as a windbreak in Medlov (part of a conditionally functional system of line elements, the elements are placed too far apart and missing side strips, also lack in vertical structure).
Windbreak with the largest proportion of "weaknesses" was located at Malešovice.
Windbreak in Medlov could act as local ecological corridor building on the forests, but it was interrupted by the construction of the expressway (Fig. 4).

Individual windbreaks are insufficiently vertically differentiated and their species composition is often inconvenient (mainly due to significant representation of Acer negundo). In terms of orientation to the prevailing wind directions the windbreaks meet this requirement.
The most frequent tree species were Acer negundo, Tilia cordata and Euonymus europaea, Acer pseudoplatanus and Sambucus nigra. Less represented species were Fraxinus excelsior, Quercus robur and genera Acer and Ulmus. At the other end of the spectrum of trees, ie the least frequently represented species were Morus alba, Quercus Cerris, Juglans nigra, Pyrus pyraster, Rhamnus cathartica and Prunus padus. The most abundant shrub species were Sambucus nigra and Ligustrum vulgare.
The species treasured in shelterbelts as Cornus sanguinea, C. mas, Corylus avellana, Crataegus sp. or Prunus spinosa were observed only sporadically or did not occur at selected localities.
The most widespread invasive species in windbreaks was therefore Acer negundo. It is a fast-growing and short-lived tree species, which is a property that is not very suitable in shelterbelts. It is light-requiring species which can create different deformations in an effort to break away from the other shade trees (Fig. 5). It promotes mainly on the edges of windbreaks (Fig. 6). It is also early deciduous so rather reduces the effectiveness of windbreaks during strong winds and absence of crops in the fields in autumn. It tolerates grazing respectively animals do not nibble

the bark because of bitter taste. Fruits are easily propagated over long distances, thus it easily spreads to the countryside.

The species Robinia pseudacacia was also observed in selected shelterbelts. This unpretentious fast growing tree can also easily spread to new habitats. Negative characteristic of Robinia is mainly its impact on species composition of the original vegetation undergrowth. Its presence reduces species diversity and increases the proportion of synanthropic species. However, this is a melliferous plant, appreciated by beekeepers.
Among non-native tree species Ailanthus altissima, Amorpha fruticosa, Lycium barbarum and Symphoricarpos albus were also recorded. Environmental stabilization function is somewhat controversial due to the large number of non-native or even invasive tree species that displace native species.
The species composition of selected windbreaks in surroundings of Medlov, Smolin and Malešovice indicates inconsistencies during the establishment of belts and the lack of care for the stands.
However, the selected windbreaks confirmed the presence of the most common species in the forest belts and windbreaks in our country, which are Sambucus nigra and Ligustrum vulgare and the most common trees are Quercus robur, Acer pseudoplatanus and Tilia cordata, Fraxinus excelsior and also Acer platanoides as skeletal trees (Vacek, 2009). But also allochtonnous Caragana arborescens, Acer negundo and Robinia pseudaccacia, Ailanthus altissima, Amorpha fruticosa, Lycium barbarum belong to common species in the shelterbelts. Some of them directly negatively affect native species of our flora.
At shelterbelt in Medlov there were no path for pedestrians and therefore it is impossible to recreational use (Fig.7). At the other windbreaks the path occurred, but at Malešovice it leads only along the part of windbreak and then deflects off windbreak (Fig.8). At Smolin the path continues along the windbreak but it is difficult walkable in the rainy season and id used by agricultural technology, so the potential visitor is forced to avoid it.

Interior of windbreaks often allows passage directly inside the stand (Figure), although due to the lack of trimming herbal undergrowth (Fig.9) it can be problematic, mainly due to the occurrence of ticks.

Fig.1: Map of selected localities


Fig. 2: Shelterbelt near Malešovice

Fig. 3: Shelterbelt near Medlov

Fig. 4: Windbreaks in Medlov interrupted by R52 in South Moravia

Fig. 5: Acer negundo inside shelterbelt

Fig. 6: Acer negundo inside shelterbelt

Fig. 7: Windbreak near Medlov without path

Fig. 8: Discontinued path along windbreak

Fig. 9: Interior of selected windbreak

Conclusion

Windbreaks have played a vital role in the frame of ecological stability in intensively farmed landscape with low forest cover, where are few near-natural communities. The principle of relative selection applies here while we include the less valuable elements to the skeleton of environmental stability. And even such a line element with the species composition which is relatively remote from potential vegetation (invasive species) may be relatively valuable in a given area.

At many localities already occur problems with the aged windbreaks. In mixtures of species with longer rotation period (oak, linden, maple) the poplars overgrow other deciduous trees and lean from a direct growth due to intraspecific competition, which requires thinning continuous change of species composition (Macků 2005).

Windbreaks are currently planned as parts of the USES (biocenters and biocorridors) which should be formed essentially by autochthonous species and, where possible, from local populations and there should be a high species diversity.

In selected shelterbelts at Medlov, Smolin and Malešovice non-native tree species: Acer negundo, Robinia pseudacacia, Ailanthus altissima, Amorpha fruticosa, Lycium barbarum and Symphoricarpos albus were recorded. Environmental stabilization function is therefore somewhat controversial due to the large number of non-native or even invasive tree species that displace native species. The species composition of selected windbreaks indicates inconsistency in the establishment of plantations and the lack of care for the stands.

Along the windbreak in Medlov there was no path for pedestrians and therefore recreational use is impossible. At the other windbreaks path occurred, but at Malešovice only along the part of the belt and then it deflects off windbreak. In Smolin the path continues along the windbreak, but it is harder walkable in the rainy season and it is used by agricultural techniques and any visitors are forced to avoid.

Current trends confirm the increasing aridity of the South Moravian region. It should therefore be considered with the increase in land area vulnerable to wind erosion. In the future we can expect a growing interest in measures to reduce the effects of wind erosion on agricultural land. No coincidence that the catastrophic drought that has affected our country in the past became the impulse for the establishment of windbreaks. Due to its multi-functionality windbreaks (protective forest belts) remain an important element not only to protect the soil against wind erosion.

Recovery of windbreaks can be financed from EU sources (Operational Programme Environment). Main layer should be composed mainly of oak, maple, linden tree, hornbeam and a crane or cherry. The shrub layer may be represented mainly by dogwood, hazel, privet, hawthorn etc. The areas should be fenced and trimming to protect young crops against weeds.

References

KAPLAN, Rachel, KAPLAN, Stephen. The Experience of Nature. A psychological Perspective. Michigan : Ulrich Bookstore, 1995. 340 s. ISBN 0-9140-0451-4

MACKŮ, J.Větrolamy versus biokoridory. In Sborník semináře „ÚSES – zelená páteř krajiny“. AOPK Brno, 2005, s. 55 - 65. [CD-ROM]

PODHRÁZSKÁ J. LITSCHMANN T., HRADIL M., STŘEDA T., STŘEDOVÁ H., ROŽNOVSKÝ J., KOZLOVSKY DUFKOVÁ J., KOHUT M., NOVOTNÝ I., JAREŠ V. 2011: Hodnocení účinnosti trvalých vegetačních bariér v ochraně proti větrné erozi. 1. vyd. Brno: VÚMOP, 36 s. ISBN 978-80-87361-10-8.

PODHRÁZSKÁ, J., NOVOTNÝ, I., ROŽNOVSKÝ, J., HRADIL, M., TOMAN, F., DUFKOVÁ, J., MACKŮ, J., KREJČÍ, J., POKLADNÍKOVÁ, H., STŘEDA, T. Optimalizace funkcí větrolamů v zemědělské krajině. Metodika, 2008. VÚMOP Praha, 81 s. 978-80-904027-1-3.

SOBÍŠEK B. a kol. 1993: Meteorologický slovník, výkladový a terminologický. 1. vyd. Praha: vyd. Academia. 594 s. ISBN 80-85368-45-5

STŘEDA, T., STŘEDOVÁ, H., ROŽNOVSKÝ, J. Orchards microclimatic specifics. In Bioclimate: Source and Limit of Social Development. 1. vyd. Nitra: SPU v Nitre, 2011, s. 132--133. ISBN 978-80-552-0640-0.

VACEK, S., SIMON, J. A KOL., 2009. Zakládání a stabilizace lesních porostů na bývalých zemědělských a degradovaných půdách. Lesnická práce, Kostelec nad Černými Lesy. 792 s.

Acknowledgement
This work was supported by project of the Ministry of Agriculture of the Czech Republic QJ1220054 „Impact of a change of climatic factors on the development of wind erosion processes, conceptual solution through the land adjustment measures“.

Souhrn
Větrolamy chrání půdu před účinky větru. V homogenizované krajině plní další funkce jako je ekologicko-stabilizační, krajinotvorná, estetická a rekreační (jako jediný souvislý porost v území může být navštěvován obyvateli). Hrají nezastupitelnou roli v kostře ekologické stability v krajině s nízkou lesnatostí. Často jsou navrhovány jako součásti ÚSES, a proto by měly být tvořeny zásadně autochtonními druhy, pokud možno z místních populací a měla by zde být vysoká druhová rozmanitost. Ekologicko-stabilizační funkci ovlivňuje také vzájemná propojenost těchto lesních pásů. Rekreační funkce je přímo určená přítomností cesty podél větrolamu i celkovým stavem a vzhledem větrolamu.
Na jihu Moravy byly vybrány 3 větrolamy, které by mohly sloužit krátkodobé rekreaci. U každého větrolamu byla hledána cesta pro pěší, zjišťován její stav a návaznost na další cesty v okolí. Dále bylo posuzováno druhové složení a funkčnost větrolamů dle metodiky Podhrázské a kol. (2008). Při hodnocení větrolamů se v případě větrolamu u Smolína jednalo o větrolam funkční (nedostatky zejména v druhové skladbě, poměrně dobře vyvinutá etážovitost, jedná se pouze o liniový prvek, který není součástí systému liniových prvků), větrolam u Malešovic byl vyhodnocen jako podmíněně funkční (nedostatky u mezernatosti a vertikálního uspořádání dřevin, nefunkční systém liniových prvků, kde chybí zejména vedlejší pásy, nedostatky také v druhové skladbě), stejně jako větrolam u Medlova (ten je součástí podmíněně funkčního systému liniových prvků, jednotlivé prvky jsou umístěny příliš daleko od sebe a chybí vedlejší pásy, nedostatky také ve vertikální struktuře větrolamu). Větrolam s největším zastoupením „slabých stránek“ se nacházel u Malešovic.
Větrolam u Medlova by mohl plnit funkci lokálního biokoridoru navazujícího na lesní porosty, byl však přerušen stavbou rychlostní komunikace. Větrolamy nejsou dostatečně vertikálně diferencovány a jejich druhová skladba je většinou nevyhovující.
Nejvíce zastoupenými dřevinami byly *Acer negundo, Tilia cordata* a *Euonymus europaea, Acer pseudoplatanus* a *Sambucus nigra*. Z keřů byly nejhojněji zastoupenými druhy *Sambucus nigra* a *Ligustrum vulgare*.
Nejvíce rozšířeným invazním druhem ve větrolamech byl *Acer negundo* a byly zaznamenány další nepůvodní druhy *Robinia pseudacacia, Ailanthus altissima*, *Amorpha fruticosa, Lycium barbarum* a *Symphoricarpos albus*. Ekologicko-stabilizační funkce je tedy poněkud sporná vzhledem k velkému počtu nepůvodních či dokonce invazních druhů dřevin vytlačujících původní druhy.
Druhové složení vybraných větrolamů v okolí Medlova, Smolína a Malešovic svědčí o nedůslednosti při zakládání porostů a o nedostatku péče o porosty.
U větrolamu u Medlova se nevyskytovala cesta pro pěší a tudíž je nemožné rekreační využití. U dvou zbývajících větrolamů se cesta vyskytovala, avšak u Malešovic pouze podél části větrolamu a následně se odklání mimo větrolam. U Smolína cesta pokračuje podél celého větrolamu, avšak je obtížněji schůdná v deštivém období a je využívána zemědělskou technikou, jíž je případný návštěvník nucen se vyhnout. Interiér větrolamů mnohdy umožňuje průchod porostem, ačkoli vzhledem k absenci vyžínání bylinného podrostu může být problematický zejména kvůli výskytu klíšťat.

Contact:
Ing. Bronislava Spáčilová, Ph.D.
Department of Applied and Landscape Ecology, Mendel University in Brno
Zemědělská 1, 613 00 Brno
+420 545 132 476, bronislava.spacilova@mendelu.cz

EFFECT OF DIFFERENTIATED PLAN TREES ON THE FORMATION OF HABITUS

Milan Rajnoch
Mendel University in Brno

Abstract
The shape and size of trees are given by their natural habitat, but are also dependent on the type and intensity of thinning. This issue was addressed on comparative parts of experimental plot. Simultaneously were also evaluated solitary trees in the immediate vicinity of these plots. Mensurational indices (tree height, base of first green branches, height of base of assimilation organs, the largest crown width, height of widest crown, total crown length, length of the sunlit part) of selected sample trees were monitored and other characteristics were derived from these mensurational indices (branching, crown plasticity, etc.).

Key words: education stands, habitus, aesthetics

Introduction

Among the most important characteristics of the species, revealing their aesthetic value of the vegetation elements include the habitus of individual genera, species and cultivars. The most widespread species may include Scots pine (Pinus sylvestris L.). Nevertheless, it has recently been using it mainly focused on the production utilization in terms of the provision of wood, not forgetting the importance of this species in shaping the environment. You come to the fore its significant non-production functions. Applying pine forest is very wide, especially since it withstands unfavorable habitat soil and climate, is resistant to various harmful substances, especially industrial pollution.
In the past, garden and landscape design has been used in the creation of baroque gardens and parks. In this long-term application in pine plantations, it is necessary not to forget the subsequent cultivation. The importance of education pine stands is manifested primarily on improving the spatial composition of future forests, increase their resilience against various harmful factors for the creation of better conditions for the application of modern educational technology in these middle-aged stands, stands to improve the structure of production and reasons for improving the structures of other functions forest (Jurča, 1973).

Methodology

To monitor the impact of various educational measures have been wired to the experimental area of the crop chosen method of comparative investigation. The research area was divided into six parts benchmarking. Elements of an area 0.1 hectares were surrounded by insulating strips on which the coppice grown in the same manner as the comparative markings.
The individual segments were made fytotechnic following interventions:
- Comparative element No. 1 - no intervention (control), in the text and tables marked K
- Comparative element 2 - tier intervention made a slight adjustment to the level spacing pines, coupled with cuts wolftree. It was cut down a total of 19.5 % of the trees - labeled S1.
- Comparative element No. 3 - made a slight tier intervention (as in panel 2), accompanied by a partial cleaning sublevels, 32.1 % were felled trees, labeled S2
- A comparative element No. 4 - a level i made strong underfloor intervention felling of 50 % pines - is flagged S3
- Comparative element 5 - made schematic remove every 4th series, accompanied by selection in the left inter-row; 34.7 % were felled - labeled 4ř + S- Comparative element 6 - done schematic remove every second series (removed 50 % of the trees) - marked 2ř.

All trees were observed following values:
breast-height diameter (d 1,3)
samplers height (h)
height Fitting 1 green branches (hz1) - the place where the stem grows first Green branch,
height deployment needles (hz2) - the place where begins a continuous assimilation apparatus,
widest crown height (hb) - height above ground, where the crown reaches the largest width
crown width at the point hb (b) - the largest crown width,
crown width at the point hz2 (bz) - crown width, which begins continuous assimilation apparatus,
Crown length (l) - from the top of the site hz1,

length of the illuminated part of the crown (lo) - the distance from the top instead of the b,length of the shaded part of the crown (ls) - the distance from the point b after Merisi Hz1.
The measured data were derived characters of trees - indicators of the size and shape of the trees:
branches - a numerical relationship l: h (ratio of crown length to total tree height)
embranchment - given by the ratio b : h (the largest crown width to the total height of the stencil)
ductility (crown index) - numerically expressed by the ratio l: b (crown length to its greatest width)
solar access - the ratio of the height of the sunlit part of the crown to the total length of the crown (lo : l).
The identified parameters crowns can derive further relations that characterize the shape of a crown samplers (eg, degree of slenderness - h : d, shading of crown – ls : l, expansiveness crown - b : l, etc.).

To compare the different structures of pine trees growing in the integrated plantation and freedom were selected as sample solitary pine trees growing on glades in the immediate vicinity of the research area. With these stencils in solitary position were measured and evaluated parameters crowns in the same way as the individual markings.
For comparison diversity of pine structures were further selected line of vegetation control on a section of highway D1 Prague - Brno at 169 - 170 km. There was comin ' pine trees, which created the vegetation cover of forests highway slope. The main criterion of evaluation indicators were again the size and shape of the tree. Even at these locations were determined following values:
branching
enbranchement
ductility (crown index)
slenderness (degree of slenderness)
expansiveness of the crown.

Results
Height deployment of the first green branch has the lowest value among the pines of freedom.
Height deployment needles (use green crown height) shows similar data with highs deployment of the first green branch. Also, the difference between the components with schematic and selective interventions on the one hand and the control panel and solitary pines on the other hand are alike. Reinforced interventions, respectively. timely release of canopy trees, shown by a significant lengthening crowns.
Height deployment widest part of the crown corresponds to the intensity of intervention in comparative markings. The lowest values are pine on the freedom that they have sufficient living space and can develop up to the crown.
Crown width of pine trees reaching the greatest values in the tree of freedom. Information on parts grown schematically show higher values than on parts other on which the mutual difference is very small.
The total length of the crowns of pine trees was greater on parts with schematic interventions rather than partial, which was carried out selective and on parts without interference. This confirms the assumption that the release of the extended length of the crown.
The length of the illuminated and shaded part of the crown is based on a comparison of the overall length and crown height deployment widest crown. As already mentioned, the release of pines extend mainly total length of the crown. The values of the illuminated part of the crown progressively increase with increasing height of the tree. The shady part is relatively short, yet data in solitary pines are higher than in the other sub- trees. The values, expressing the length of the shaded part of the crown, in all comparative boom differ slightly.
Branching is the largest trees in the pine trees on freedom, lower values are trees grown on parts schematically. The lowest figures show components with selective intervention and non-intervention.
Enbranchement trees is characterized by data analogous to the evaluation results branching. Differences between individual panels are not great, but some tendency for higher rozvětvenosti appears in the pines grown schematically markings. Significantly higher values are solitary trees.
Formability crowns (crown index) showed significant differences.

Also insolation crowns has relatively few significant differences. Some indication of higher data appears in a solitary pine on parts with a strong selective and combined intervention.

The results of evaluation of changes in the shape and size of the crowns of pine trees suggest that strong interventions in the pine coppice led to an extension and a slight extension of the crowns - ie to increase branching and enbranchement trees. This fact became evident mainly in solitary pine trees and on the experimental area on parts grown schematically. Living conditions in such a grown young-growth stand changes of stand structures more than grown young-growth stand grown selectively. Showed significantly higher values pine freedom. This fact can be explained by a sufficiently large habitat, limiting any of the parties to fully experience the light and enjoyment. This resulted in the largest extent on the length and width of the crowns on branching and v crowns and crown on the values of the index.

Diskussion

By comparing the findings of research by different authors show that in stands of cultivated selective interventions (if not extremely strong) to substantially change the properties ecotope. This is especially the climatic characteristics. Significant changes occur after loosening canopy. In particular row interventions cause major changes in the structure of vegetation, especially in the canopy. These interventions cause significant changes in the properties of ecotope. For example CHROUST (1973) reported that the release of the thick pine coppice increases not only the access of rainwater and soil moisture, but also the temperature of the air and soil. These changes affect the growth of trees, as already documented by other authors, especially the diameter increment, branching and enbranchement that increase. According to the results of experiments remission (1978) using the schematic (ordinary) hits crowns expansion increases and worsens the course of cleaning tribes from branches.

Conclusion

From the obtained results it can be concluded that interventions in the coppice may significantly affect the size of the crowns. However, it is necessary to consider the cases in which it is desirable to enlarge the parameters and which do not. In terms of production of wood may not be appropriate in young pine stands to seek enlargement crowns. In contrast, in the field of garden and landscape design, which is mainly for aesthetic reasons, require the greatest crown should be educational interventions carried out in the stands involved since early youth.

References

HIEKE, K.: Lexikon okrasných rostlin. HELMA, Praha, 1994, 730 s.
Chroust, L.: Vliv schematických výchovných zásahů na mikroklima borové mlaziny. Lesnictví, 19, 7, 1973, s. 567-582.
JURČA, J.: Racionalizace výchovy mladých borových porostů. In: Průvodce k podnikovému semináři JmSL. Brno, 1973, 90 s.
RAJNOCH, M.: Význam vlivu diferencované fytotechniky pro rozvoj mladých porostů na příkladu borovice lesní. Habilitační práce. Lednice, 1996, 83 s.
RAJNOCH, M.: Uplatnění borovice lesní v zahradní a krajinné tvorbě. Acta horticulturae et regiotecturae SPU Nitra, 2005, s. 142-144.
RAJNOCH, M.: Biotechnika krajinné zeleně. Přednášky. ZF MENDELU, Lednice, 2012.
REMIŠ, J.: Rozbor rozných metód a techniky výchovy borovicových húštin z hladiska prácnosti. Lesnícky časopis, 21, 1, 1976, s. 41-49
WAGENKNECHT, E.:Rationelle Dickungspflege. Neumann Verlag, 1962, 176 s.

Tab. 1: Indicators shape and size of the crowns on the experimental area

Part	Hight	Branching	Enbranchement	Ductility	Insolation
	Cm	l : b	b : h	l : b	l_o : l
1 K	700,0	0,34	0,14	2053,00	0,73
	800,0	0,35	0,15	2,33	0,71
	900,0	0,37	0,16	2,28	0,73
	1000,0	0,39	0,17	2,23	0,74
	1100,0	0,41	0,19	2,22	0,78
	1200,0	0,44	0,20	2,19	0,81
2 S_1	800,0	0,32	0,15	2,12	0,76
	900,0	0,35	0,16	2,25	0,75
	1000,0	0,38	0,17	2,30	0,74
	1100,0	0,41	0,18	2,33	0,75
	1200,0	0,45	0,20	2,28	0,77
3 S_2	700,0	0,31	0,16	2,00	0,84
	800,0	0,33	0,16	2,12	0,79
	900,0	0,35	0,16	2,29	0,72
	1000,0	0,37	0,17	2,27	0,71
	1100,0	0,39	0,17	2,26	0,76
	1200,0	0,41	0,18	2,23	0,69
4 S_3	600,0	0,27	0,13	2,00	0,87
	700,0	0,29	0,14	2,15	0,80
	800,0	0,32	0,15	2,17	0,73
	900,0	0,36	0,16	2,29	0,70
	1000,0	0,39	0,17	2,26	0,69
	1100,0	0,42	0,19	2,24	0,70
	1200,0	0,45	0,20	2,20	0,71
5 4ř+S	500,0	0,34	0,16	2,12	0,71
	600,0	0,36	0,17	2,05	0,72
	700,0	0,39	0,19	2,00	0,74
	800,0	0,41	0,21	2,00	0,74
	900,0	0,44	0,23	1,93	0,73
	1000,0	0,47	0,25	1,88	0,76
	1100,0	0,50	0,28	1,76	0,79
	1200,0	0,53	0,32	1,67	0,80
6 2ř	700,0	0,38	0,23	1,66	0,79
	800,0	0,41	0,24	1,71	0,77
	900,0	0,44	0,26	1,70	0,74
	1000,0	0,48	0,28	1,71	0,72

Tab. 2: Indicators shape and size of the crowns of freedom

Hight	Branching	Enbranchement	Ductility	Insolation
cm	l : h	b : h	l : b	l_o : l
600,0	0,78	0,46	1,71	0,63
700,0	0,76	0,49	1,57	0,66
800,0	0,76	0,53	1,45	0,70
900,0	0,78	0,57	1,36	0,75
1000,0	0,81	0,63	1,28	0,80
1100,0	0,84	0,71	1,19	0,85

Tab. 3: Indicators shape and size of the crowns in the canopy area of comparative D1

Thickness class	characters crowns				
cm	h : d	l : b	l : h	b : h	b : l
0 – 2,0	115,000	1,230	0,675	0,550	0,815
2,1– 4,0	88,500	1,290	0,740	0,570	0,780
4,1– 6,0	71,000	1,330	0,785	0,585	0,755
6,1– 8,0	61,000	1,340	0,815	0,595	0,745
8,1–10,0	55,100	1,370	0,820	0,600	0,735
10,1–12,0	50,800	1,380	0,815	0,600	0,730
12,1-14,0	47,700	1,370	0,800	0,595	0,730
14,1-16,0	45,000	1,360	0,780	0,590	0,740
16,1-18,0	43,500	1,320	0,750	0,575	0,750

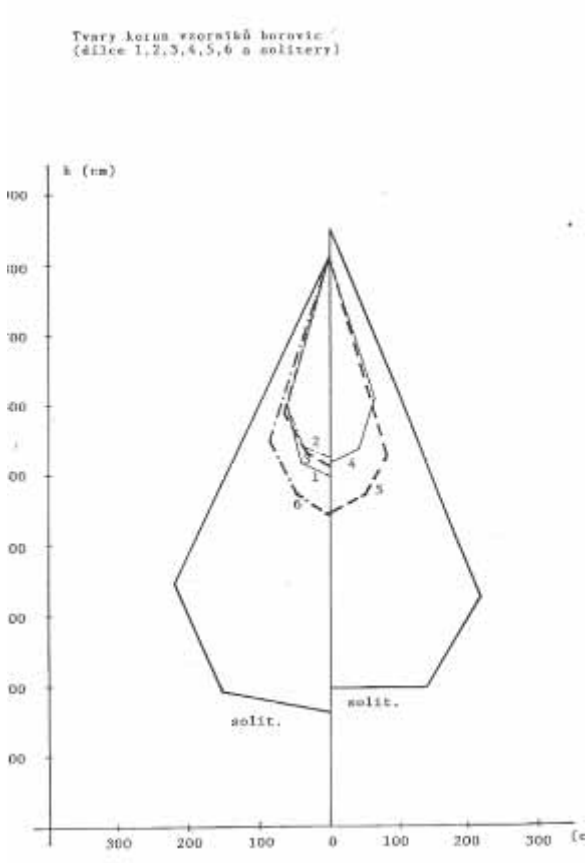


Fig. 1: Crown-shaped pines samplers

Souhrn
Tvar a velikost stromů jsou dány jejich přirozeným habitem, ale jsou závislé mj. i na druhu a intenzitě výchovných zásahů. Této problematice byla věnována pozornost na komparativních dílcích pokusné plochy. Současně byly hodnoceny i solitérní stromy v bezprostřední blízkosti těchto ploch. Na vybraných vzornících byly sledovány taxační veličiny (výška stromů, nasazení první zelené větve, výška nasazení asimilačního aparátu, největší šířka koruny, výška a nejširší koruny, celková délka koruny, délka její osluněné části) a z nich pak odvozeny další charakteristiky (ovětvení, rozvětvenost, tvárnost koruny apod.).

Contact:
Doc. Ing. Milan Rajnoch, CSc.
Ústav biotechniky zeleně
Zahradnická fakulta MENDELU
Valtická 337
691 44 Lednice
Telefon: +420 602 703 938
e-mail: rajnoch@zf.mendelu.cz

ENVIRONMENT FRIENDLY METHODS TO TREAT WASTEWATER FROM SMALL RECREATION FACILITIES AND SUMMER CAMPS

Jan Šálek [1], Václav Tlapák [2], Petr Hrůza[2]
Vránova 96, Brno 621 00[1]; Mendel University in Brno[2];

Abstract
This paper focuses on wastewater treatment in small recreation facilities and summer camps by environment-friendly treatment methods. The recreation facilities in question are located in natural environments, are seasonally in use, most often in summer during the school holiday. The advantages of "natural sewage disposal plants", which are soil filters with marshland vegetation, soil filters without vegetation, biological tanks, and irrigation by treated wastewater, are the ability to sustain long-term interruption of use, irregular loading over their capacity, and the abrupt process of being put in use again, a purifying effect comparable to artificial (machine) treatment methods, environment-friendly character, and a natural inclusion in the environment.

Key words: wastewater, recreation facilities, natural sewage disposal plants

Introduction

Currently, there is a huge development of recreation facilities in natural environments. The first group is facilities with a hotel character and specially equipped large recreation resorts that are open for visitors all year round. The second group, which is the one this paper focuses on, comprises smaller facilities - most often holiday homes or facilities with seasonal operation. A separate group is formed by camp sites, predominantly of temporary character, operated in summer, mostly during summer holidays. It is crucial to tackle the issue of wastewater treatment in the above mentioned facilities. Wastewater from large resorts is treated in artificial (machined) wastewater treatment plants. This field has been satisfactorily dealt with in the Czech Republic. Alternatively, environment-friendly methods of wastewater treatment can be used, especially soil filters with vegetation (reed-beds) with horizontal and vertical flows.
The trouble is wastewater treatment of small recreation facilities and holiday homes that have separate wastewater and sewage treatment systems.
The issue of short-term and temporary recreation facilities, especially summer camps, has been totally neglected so far. The complexity of this issue is brought by the large number of these facilities, their temporary operation, difficult or even impossible connection to the public sewage system and other watercourse suitable to let out treated wastewater, etc. A solution that seems to be the simplest is natural wastewater treatment and no-effluent arrangement. The advantage of natural treatment methods is their environment-friendly character, easy inclusion in the landscape, and the ability to handle long usage interruptions and irregular overloading. The efficiency of the treatment is comparable to artificial (machinery) treatment methods. The no-effluent arrangement means further use of the treated wastewater, evapotranspiration, and in very exceptional cases infiltration of properly treated wastewater in the groundwater. Tab. 1 presents the natural methods of wastewater treatment by small producers.

Materials and methods

Usage of natural methods of wastewater treatment from recreation facilities has to be preceded by well performed pre-treatment. The pre-treatment can be performed by biological septic tanks in the smallest facilities, or mechanically in larger facilities (fine trash screens, grease traps, exceptionally sand traps, and sedimentation tanks with sludge management). According to a study conducted by Rozkošný, Kriška and Šálek (2010), classic septic tanks are unsuitable due to their low efficiency. Fig. 1 shows the arrangement of a simple biological septic tank.
Biological septic tanks are designed as underground devices and linked to soil filters. Two soil filters connected in series are sufficient for detached houses and smaller recreation facilities. The device is supplemented with sludge fields with macrophytes to drain the stabilized sludge, a small area designed for the regeneration of the filter filling, and a tank for accumulation of the treated wastewater before it is used for irrigation. Instead of mere soil filters, soil filters with vegetation (reed-beds) can be used with a vertical or horizontal overland or subsurface flows. The arrangements of soil filters with vegetation and with a horizontal subsurface flow (fig. 2), and with a vertical down (fig. 3) or up flow (fig. 4) are shown in the figures below.

Tab. 1: Kinds and arrangements of natural wastewater treatment.

Kind of natural wastewater treatment	**Possible uses**
a) Soil (ground) filters without vegetation	
Vertical and horizontal flows	Wastewater treatment and secondary treatment
b) Soil filters with wetland vegetation (reed-bed wastewater treatment)	
Horizontal overland, sub-surface and vertical down flows	Wastewater and polluted surface water
Vertical up flow	Wastewater treatment, especially in summer
c) Biologial tanks (parts of stabilization reservoirs)	
Aerobic with low loads	Wastewater and surface water treatment
Aerobic continually aerated	Intensive continual wastewater treatment
d) Aquacultures and bioeliminators with wetland vegetation, duckweeds, algae, cyanobacteria	
Reservoir and channel aquacultures	Wastewater treatment and secondary treatment
Combination of aquacultures with vegetation	Wastewater treatment and secondary treatment
Channel bioeliminators	Wastewater treatment by advance growth walls
e) Irrigation by treated wastewater	
Irrigation of vegetation	Irrigation of vegetation, exceptionally all-year irrigation
f) Artificial controlled wetlands	Wastewater secondary treatment, evapotranspiration
g) Infiltration of treated wastewater	Artificial infiltration of wastewater

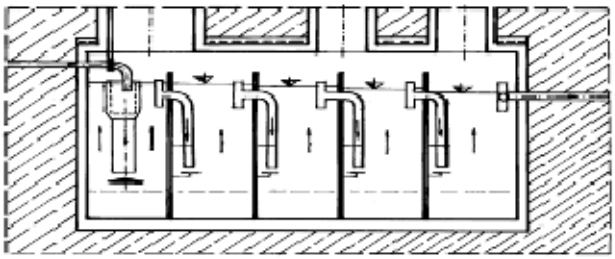


Fig. 1: The arrangement of a simple five-chamber biological septic tank

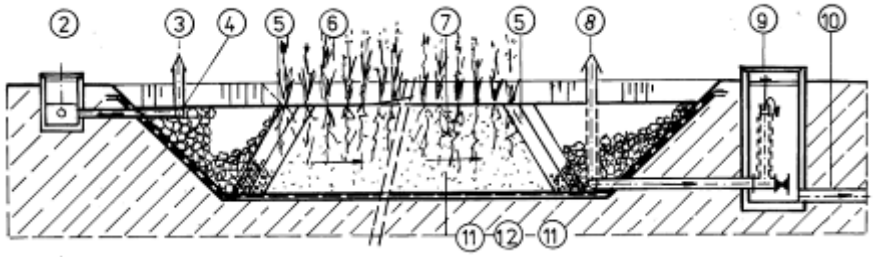


Fig. 2: The arrangement of a soil filter with vegetation and a horizontal subsurface flow 2, 3 - wastewater inlet, 4 - distribution piping, 5 - inverted filter, 6 - vegetation, 7 - filtration media, 8 - aeration, 9 - control spillway, 10, 11 - outlet, 12 - liner

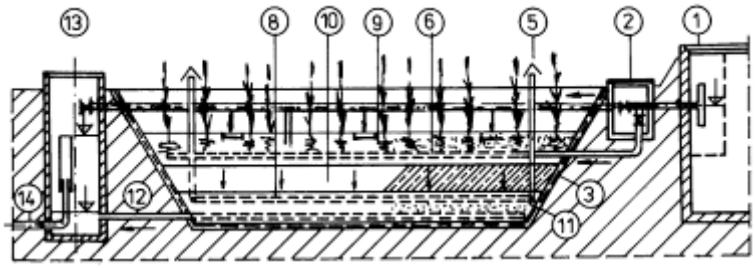


Fig. 3: The arrangement of a soil filter with vegetation and a vertical down flow: 1, 2 wastewater inlet, 3 - sump, 5, 8 – aeration, 6, 9 – distribution piping, 10 – filter, 12, 14 - outlet, 13 – surface level control

The arrangements can be supplemented with impulse wastewater supply or discharge, which increases the oxygen supply into the filtration media; in extreme cases there is artificial aeration.

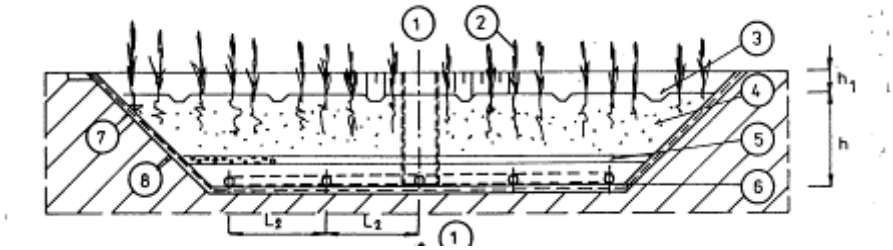


Fig. 4: The arrangement of a soil filter with vegetation and a vertical up flow: 1 - sump, 2 - vegetation, 3 - collecting grooves, 4 - filtration media, 5 - inverted filter, 6 - wastewater inlet, 7, 8 - liner

Small producers, especially solitary detached houses and small recreation facilities use aerobic biological tanks for secondary treatment, as a second stage of biological treatment. Fig. 5 shows an example of a combination of a soil filter with a horizontal flow and a secondary treatment biological tank.

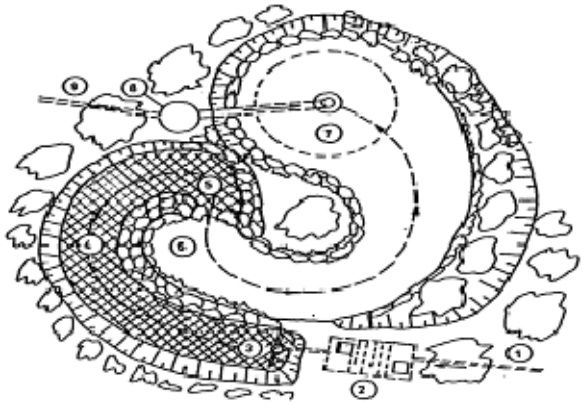


Fig. 5: The arrangement of a natural wastewater treatment device for small facilities: 1 - wastewater inlet, 2 - biological septic tank, 3 - inlet in the filtration field, 4 - filtration field, 5 - outlet into the biological tank, 6 - biological tank, 7 - outlet, 8 - control well, 9 - outlet

Results

The facts presented in the paper are based on long-term authors' research. As a result, the combinations for wastewater treatment suitable for the conditions in the Czech Republic are presented, see tab. 2.

Tab.2: Arrangements of natural wastewater treatment

Pre-treatment	**Biological treatment**	**Secondary treatment**
a) Natural treatment methods for larger recreation facilities up to 300 EO		
Full mechanical treatment level (trash screen, grease and sand traps, sedimentation tanks)	Soil filters with and without vegetation (fig. 2-5) Aerobic biological tanks in the cascade (fig. 6)	Artificial controlled wetlands Secondary treatment biological tanks Irrigation by treated wastewater
b) Natural treatment methods for small recreation facilities and holiday homes		
Biological septic tank with a trap for larger impurities and grease Screens, grease trap, a couple of ground sedimentation tanks	Soil filters with and without vegetation Aerobic biological tanks Combination of the above mentioned methods (fig. 7)	Irrigation by treated wastewater Secondary treatment by aquacultures (duckweeds, etc.) Controlled secondary treatment wetlands and infiltration
c) Natural treatment methods for summer camps and other temporary recreation facilities		
Biological septic tank Ground sedimentation tanks, screens, grease and oil traps	Vertical flow soil filters with and without vegetation (fig. 4-5) Overland flow soil filters with vegetation	Secondary treatment biological tanks Subsurface irrigation Controlled wastewater infiltration

No-effluent operation of natural treatment plants allows for a combination with all-year-round irrigation by treated wastewater, vegetation irrigation by wastewater with corresponding

accumulation, controlled wetlands transferring water into the air by evapotranspiration and exceptionally infiltration of properly treated wastewater in groundwater and enriching the groundwater sources.

Discussion

The concept, arrangement and design of natural wastewater treatment methods is based on data published by Šálek and Tlapák (2006) with focus on technical problems. The use of natural treatment methods for holiday homes and recreation facilities were presented by Šálek, Žáková and Hrnčíř (2008) and the publications prepared by a team of authors Šálek, Kriška, Pírek, Plotěný, Rozkošný and Žáková (2012), where artificial methods of wastewater treatment, precipitation water management and waste disposal were added. The issue of treatment processes was dealt with by Mlejnská et al. (2009). The authors have also used the results of a detailed study on the functions of natural treatment methods performed by Šálek, Rozkošný and Kriška (2008) in five regions of the Czech Republic. Partially, the authors have used an older methodology presented by Šálek (1999) focused on the arrangement of vegetation wastewater treatment plants and biological tanks Šálek (1994).

Conclusion

The paper presented summarizes the data from gained by long-term research into natural wastewater treatment methods, focusing on three categories of facilities used for recreation in the country. The paper presents the combinations of natural wastewater treatment methods that have proved to be useful in the practice. The recommended solutions, natural wastewater treatment methods for facilities located in the landscape, are an important contribution to the environment-friendly wastewater management in the natural environment.

References

MLEJNSKÁ,E. et al.: *Extezívní způsoby čištění odpadních vod.* Praha:VÚV TGM, 2009, 119 s.
ROZKOŠNÝ,M.,KRIŠKA,M.,ŠÁLEK,J.: Možnosti využití přírodních způsobů čištění odpadních vod a posouzení vlivu předčištění. *Vodní hospodářství,* 2010, č.5, s.116-121.
ŠÁLEK J.: *Návrh a využití biologických nádrží na čištění odpadních vod*. Metodiky ÚVTIZ Praha: 1994, č. 15, 44 s.
ŠÁLEK, J.: *Přírodní způsoby čištění odpadních vod.* Brno: PC-DIR, VUT, 1995, 115 s.
ŠÁLEK,J.: *Navrhování a provozování vegetačních kořenových čistíren,* Praha: ÚZPI MZČR, 1999, č.2, 54 s. ISBN 80-86153-037-0
ŠÁLEK,J., ROZKOŠNÝ,M., KRIŠKA,M.*: Poznatky z průzkumu kořenových čistíren odpadních vod v moravských krajích a části kraje Vysočina*, Brno: 2008, 37s., přílohy č.1-4, 86 s.
ŠÁLEK, J., TLAPÁK, V.: *Přírodní způsoby čištění znečištěných povrchových a odpadních vod.* Praha: ČKAIT, 2006, 283 s.
ŠÁLEK, J., ŽÁKOVÁ, Z., HRNČÍŘ, P.: *Přírodní čištění a využívání vody.* Brno: ERA, 2008, 115 s.
ŠÁLEK,J.,KRIŠKA,M.,PÍREK,O.,PLOTĚNÝ,K.,ROZKOŠNÝ,M.,ŽÁKOVÁ, Z.: Voda v domě a na chatě – využití srážkových a odpadních vod. Praha: Nakladatelství Grada Publishing a.s., 2012, 144 s. ISBN 978-80-247-3994-6

Souhrn

Náplň příspěvku je zaměřená na problematiku čištění odpadních vod malých rekreačních zřízení a letních táborů, přírodními způsoby čištění. Jedná se o rekreační zařízení nacházející se v přírodním prostředí, s přerušovaným celoročním provozem, nebo provozovaných v letním, nejčastěji prázdninovém období. Předností „přírodních čistíren“, které tvoří půdní filtry s mokřadní vegetací, půdní filtry bez vegetace, biologické nádrže a závlahy čištěnými odpadními vodami, je schopnost překonání dlouhodobého přerušení provozu a nárazového přetížení, poměrně rychlé počáteční zprovoznění, srovnatelný čisticí účinek s umělými (strojními) způsoby čištění, ekologický charakter, příznivé začlenění do přírodního prostředí. Předložená práce shrnuje poznatky z dlouhodobého výzkumu přírodních způsobů čištění odpadních vod, zaměřuje se na tři kategorie objektů využívaných k rekreačním účelům v krajině a uvádí v praxi ověřené kombinace přírodních způsobů čištění odpadních vod.

Contact:

prof. Ing. Václav Tlapák, CSc.
Department of Landscape Management
Faculty of Forestry and Wood Technology
Mendel University in Brno
Zemědělská 3, 613 00 Brno
Telephone: 00420 545 134 087, e-mail: tlapak@mendelu.cz

ENVIRONMENTAL LOSSES CAUSED BY DEVELOPMENT OF GREAT RECREATION-RESIDENCE CENTERS, ARŁAMÓW RESIDENCE IN THE TURNICKIE MTS. (SE POLAND) CASE STUDY

Andrzej Gałaś
AGH University of Science and Technology

Abstract
Tourism and recreation investments are public acceptable generally, and they are welcomed as a potential source of workplaces and economic growth. In relation to the little onerous or no impact forms of land development such as farmhouses, hiking or biking routes, there is no fear connected with environmental losses. In the previous years a strong criticism and rejection related to mass forms of tourism has been indicated however a return to such project realization is nowadays observed. In the paper a case study related to medium size hotel extension to the multi functioning SPA center with football and golf ground, swimming pool, conference rooms, and airfield has been discussed. In a now called place name Arłamów Residence, in the 70's were built a palace with hunting resort for the onetime government elites. In case of political changes in early 90's described area become opened. An unique condition of the environment components has been appreciated and the Turnicki National Park project has been prepared in 1993. Century-old stand of wild Carpathian forest and foothills landscape were the main protection reasons. Twenty protected species, six from IUCN Red List (i.a. brown bear, wolf, lynx) prove great biodiversity of such area.

Key words: tourism and recreation investments, environment components, impact assessment

Location of the research area

Arłamów Residence, the subject of the studies, is located in the Outer Eastern Carpathians, within the area of the Sanocko – Turczańskie Mts., in the range of the Turnickie Mountains. The relief refers to the geological structure. It is formed by ridges lying parallelly to each other and similar in height, which correspond to the strike of monoclinal folds arranged in a repeating sequence of scales and steep folds running NE-SW and NNW-SSE. They are obsequently and subsequently cut along softer rocks by rivers and streams and form a rectangular lattice river network (Kotlarczyk, 1993).
Geologically the area belongs to the Flysch Carpathians and the Skole Nappe which is distinguished in that part of the area. This unit is built of patches of sandstones, shales and marls, which form ridges, typical for the part of the Carpathians, or the above-mentioned groups of scales and folds.
After World War II, Polish and Ukrainian natives were displaced from the area, which resulted in a very small number of inhabitants and a very low population density. The Holiday Centre of the Council of Ministers Arłamów was opened in the 1970's and served as a hunting ground for the communist elite and their guests. In 1991, the guard posts at the entrances to the area were removed and the area became publicly accessible (RDSF Krosno).
For centuries this area has been dominated by forest management. It is one of the largest forest complexes in the Carpathian Foredeep. A large forest cover (62-80%), where the average age of the stand is over 80 years, is the result of intensive afforestation in the 1960's and 1970's. In order to maintain protective and productive functions of the forest, the Promotional Forest Complex Birczańskie Forests, where Arłamów was also included, was designated in 2001. The area is extremely attractive for various forms of tourism and recreation. A few marked hiking trails are complemented by forest tracks and paths. Sleeping accommodation, B&B, small pensions in farms and the centre in Arłamów (110 beds) were not fully occupied in 2002 (Gałaś & Paulo, 2002).
Arłamów Residence was built on top of a mountain belonging to the Turnica Range. The mountain is 590 m. a.s.l. high and it dominates over the neighbourhood. The highest peak of Turnickie Mts., Suchy Obycz (617 m. a.s.l.) is located NE. The summit around the resort is deforested and IV class soils covered with meadows have developed in the lower parts of the slopes.

Nature Protection

The functions which the discussed area served in the years 1970 to 1991 caused that it avoided significant economic activities and valuable habitats were preserved in natural or semi-natural

conditions. It was quickly noticed by naturalists who, as early as in 1982, started documenting those unique features of the environment. Finally, the project of Turnicki National Park was initiated in 1993 (Michalik). In 1995, the project was blocked by the Minister of Environmental Protection, Natural Resources, and Forestry, later Regional Directorate of State Forests in Krosno also withdraw its support. The discussion, which took place in the following years resulted in the project abandoning.
The Przemyśl Foothills Landscape Park (PFLP) was designated in 1991, covering the northern part of the area by protection. Its aim was to protect fir and beech forests on hilltops and riparian and broadleaved ones in the lower parts, as well as vegetation of three geobotanic provinces (mountain, lowland – highland and Pontic – Pannonian). Flowery meadow steppes and numerous flysch outcrops of frontal folds of the Carpathians were included into the area of the park too (Kotlarczyk, 1993).
The remaining, southern part of the area, together with the summit where the Arłamów centre is located, was covered by protection in 1992, as the Słonne Mountains Landscape Park was designated (SMLP). Forest habitats with significant amount of yew are the most valuable ones in the park. There are also refuges of White-tailed Eagle, Eurasian Eagle Owl and Black Stork (Park Protection Plan) in the area.
The forest reserve "Turnica" was created in 1995, also within the PFLP. It includes a part of an old beech-fir forest covering the area of 151.85 hectares in the Turnica Massif. Arłamów resort borders on it in the south. Deeply cut ravines and narrow valleys of streams create favourable conditions for development of particularly rich plant habitats. Protected plants such as Lesser Butterfly orchid *(Platanthera bifolia*), Wild Ginger (*Asarum Europaeum*), Heart-leaved Comfrey (*Symphytum Cordatum*) and various species of birds (Ural Owl, Lesser Spotted Eagle, White-backed Woodpecker) are especially worth mentioning there (Michalik, 1993).
The Promotional Forest Complex Birczańskie Forests was established in the area in 2001. Its main goal has been to carry on sustainable forest management and protection of natural resources in the forests. The tasks are accomplished through logging of trees mainly from sanitary clean-up treatments and ongoing reforestation and afforestation (RDSF in Krosno).
According to naturalists, to guarantee maintaining natural values of the Turnickie Mountains, it is necessary to refrain from construction of hotels and to promote agritourism in the edge zone of the area (Piórecki, 2002).
In 2007-2008, the areas of Natura 2000, PLB180003 and PLH180013, were established in the Słonne Mountains. A habitat refuge was also designated to protect 7 types of habitats important for the European Community (Carpathian beech forest fertile and sour variants, also lowland and mountain hay meadows and others), as well as 12 species of animals (wolf, lynx, otter and others) (nature 2000.pl). A bird refuge was established to protect 24 species of birds (including the Golden Eagle – 12% of the national population, the Ural Owl (10%), the Lesser Spotted Eagle (2%), and others) (Table 1).

Description of accomplishing of Arłamów Residence development
Modernisation and extension of the centre in Arłamów in the period 2009-2013 included (Łyjak et. al., 2008, Fig.1):

- ✓ a hotel with 421 beds, an 1150 m^2 indoor pool, SPA centre, 14 conference rooms. The building footprint is equal to 13,343 m^2, there are 4 floors in the building and its height is about 20,
- ✓ an underground parking of the area 3,723 m^2,
- ✓ an extension of the existing stable and riding school of the area 1,135 m^2,
- ✓ a sport hall (full-size sport field, 2 tennis courts) with the floor area 4,063 m^2, 19.6 m high,
- ✓ an outdoor soccer field and a tennis court,
- ✓ a car park for passenger cars and buses (597 places),
- ✓ a biomass fuelled heating boiler station, total heat power 6 MW, alternative fuel – oil,
- ✓ reconstruction of the water supply and sewage treatment plants,
- ✓ construction of a water reservoir on the Jamninka creek an area of more than 1 ha,
- ✓ extension of a sewer and storm water treatment system,
- ✓ modernization and extension of the airfield for sport aircrafts and helicopters,
- ✓ development of existing roads and car parks.

The original investment plan also included construction of a wind power plant.

The opening ceremony of the Centre took place in December 2013. The calendar of events for 2014 included, among others, such mass events as: The Warrior Boxing Night, Car Rally Arłamów etc.

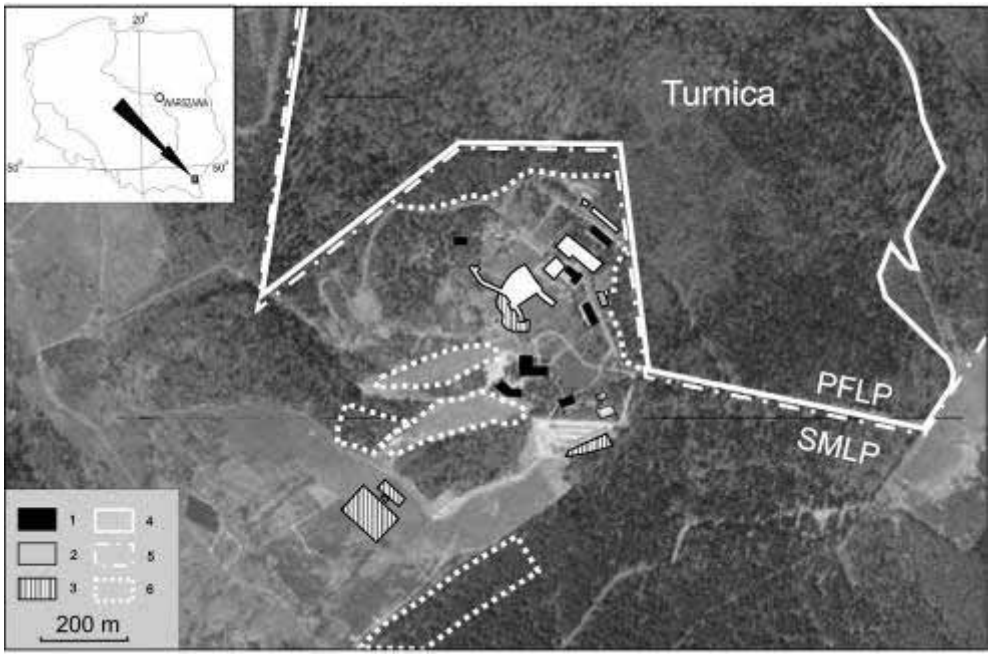


Fig. 1: Arłamów Hill (phot. Ekoportal). 1 - existing buildings of Arłamów Hotel, 2 – new buildings of Arłamów Residence, 3 – surface deformation, 4 – Turnica Reserve, 5 – Landscape Park, 6 - habitat refuge of Natura 2000.

Analysis of the environmental documentation

Protection Plan which has been operative in the Słonne Mountains National Park since 2005 stipulates usage of the existing infrastructure for the purpose of tourism and recreation. In case of spatial planning in communes, it is prohibited to erect new buildings within the limits of ecological corridors, such as areas along streams and rivers and within spring zones. In SMNP – the goals of the protective measures are to preserve the cultural landscape, aesthetic and scenic values and protection of different forms of the relief (Table 1).

The report presented an assessment of noise emission, adopting as an acceptable level the value specified for recreational and leisure areas (permissible level during the day – 55 dB at night – 45 dB) (Łyjak et al., 2008). Such assumption is understandable as acceptable sound levels for birds and animals have not been set in Poland. Hence, it would be appropriate to use the guidelines from the Handbook of good practice... (Bohatkiewicz (ed.)., 2007) and adopting the following acceptable levels for birds inhabiting open areas – 50 dB and forests – 40 dB (Reijnen et al., 1995). It is assumed in areas of meadows and pastures that isophone 55 dB covers the area where there is a reduction of bird population by 25%. This is due to scaring and abandonment of nests.

Lost and endangered values of the environment

As a result of expansion of Arłamów Residence, a large hotel and sports complex whose tallest building is approximately 20 m high has appeared. Apart from the existing forms of recreation that were previously provided by the hotel Arłamów, the offer of leisure activities has been greatly expanded (soccer, swimming, etc.) and SPA has been opened. The number of beds has increased four times and it is estimated that the traffic on the road to the complex will reach an average of 360 cars per day. It will cause a major change in concentration of tourists in the area. It is expected that the number of tourists will be around 1,000 people a day and in case of special events it will be even higher (Łyjak et al., 2008).

Traffic on the road along the section bordering the forest belonging to the Turnica Reserve will be harmful for bird species. It is a steep driveway to the hotel and it will cause exceeding of the sound level causing scaring away of birds. This will be also associated with an increased penetration of persons and thus further impact on the number of birds in the Turnica Reserve and around it. In this case, it can be predicted that movement of the species deeper into the reserve will change the balance, distribution and population density of the key species occurring

in the area of the Słonne Mountains Natura 2000 PLB180003. Reduction of the acreage of the diverse landscape containing open areas through the construction of Arłamów Residence was inconsistent with the requirements for protection of feeding grounds of the Lesser Spotted Eagle and the Golden Eagle – the key species for this Natura 2000 area.
Habitat of broad-leaved forest and central European and subcontinental oak-hornbeam stand occurring in the Turnica Reserve and in the area adjacent to sports field belonging to the hotel complex should be considered as endangered, as a result of penetration by guests of the complex and the people associated with the place. This will be the effect of treading and moving along the unmarked paths. It should also be noted that Arłamów Residence is not a typical accommodation place and a base for hiking, horse riding or cycling. Potential guests are athletes, participants of MICE events and scientists (the complex is also prepared for academic conferences). The events already held in Arłamów after its opening in December 2013, were set to thrill-hungry people but not necessarily nature-oriented ones (car rally, boxing). Such selection of guests will cause that instead of hiking in the mountains and bird watching they will be interested in off-road driving, quad riding and paint-ball or hunting etc.

Tab. 1: Required ways of managing environmental resources necessary for the proper protection of birds listed in Annex I of the Birds Directive (2009/147/EC).

Species name, code	**Required protection and management**	
	nesting	**feeding ground**
Breeding birds of the forest landscape		
Black Stork (*Ciconia nigra*)	Zonal protection	Preservation of wetlands
Honey Buzzard (*Pemis apivorus*)	Preservation of old growth forests in broadleaved and wetland forests	
Lesser Spotted Eagle (*Aquila pomarina*)	Zonal protection	Preservation of diverse landscapes with open wetland areas, which should not be afforested
Golden Eagle (*Aquila chrysaetos*)	Zonal protection	Preservation of landscapes containing vast open areas which should not be afforested
Erne (*Haliaaetus albicilla*)	Zonal protection	Preservation of water reservoirs and wetlands
Owl (*Bubo bubo*)	Zonal protection, protection of large forest complexes, protection of windfallen trees and dead wood	
Ural Owl (*Strix uralensis*)	Protection of hollow trees and dead and dying wood in forests, putting up nest boxes	
Three-toed Woodpecker (*Picoides tridactylus*)	Protection of dead and dying trees in forests	
Collared Flycatcher (*Ficedula albicollis*)	Preservation of old broadleaved forests and riparian forests with plenty of hollows	
Breeding water birds: lake and pond birds		
Moor Buzzard (*Circus aeruginosus*)	Protection of large patches of common reed and lesser bullrush, in case of reed exploitation leaving uncut refugia	
Common Tern (Sterna hirundo)	Obviating damming of river valleys, leaving sandy islands in rivers	
Breeding birds of the agricultural landscape		
White Stork(*Ciconia ciconia*)	Preservation of extensive agricultural landscapes	
Carboy (*Lanius collurio*)		
Warbler (*Sylwia nisoria*)		
Corncrake (*Crex crex*)		

The greatest impact, however, is the irreversible loss of landscape values. Expansion of the complex and, in particular, construction of the hotel with a height and dimensions not congruent with the nature of the area resulted in the seizure and degradation of the land covering the area of 2.44 hectares. It is a direct interference in one of the main objectives of protection of the Słonne Mountains Landscape Park i.e. degradation of aesthetic, scenic and diverse forms of the relief. The complex in its scale and nature does not correspond to the local architecture and its location on the exposed mountain top significantly interferes with the landscape.

Conclusions
In the light of the effective law, the threshold values set for tourist and recreation facilities are perhaps too lenient in terms of their impact on the environment. This is due to the fact that

tourist industry is generally perceived as slightly harmful to the environment which of course is not always true (Gałaś et al., 2013).
The example discussed in the paper proves that the system of environmental impact assessment in terms of facilities for recreation and tourism in Poland is leaky. Despite the implementation of all procedures provided by law damage of the environmental state, loss of protected landscape values and endangering of habitats and species important for the European Community has occurred.
Application of environmental indicators in land management or landscape – functional valorisation, takes into account the desire for environmental – spatial orderliness (Gałaś & Król, 2008, Gałaś & Gałaś, 2011), which was lacking in case of the decision concerning construction of Arłamów Residence.
It seems that it would be useful to develop a group of environmental indicators which, if exceeded, would be the basis for drawing conclusions about the level of impact of tourist and recreation facilities. Such a tool would allow coexistence of recreation and nature protection.

References

BOHATKIEWICZ J., (ED.). 2007, Podręcznik dobrych praktyk wykonywania opracowań środowiskowych dla dróg krajowych. GDDKiA/EKKOM Sp. z.o.o., Kraków
GAŁAŚ A., GAŁAŚ S. (2011) Landscape: functional valorisation and sustainable development in the Valley of the Volcanoes in Peru. Pol J Environ Stud 20(4A):67–71
GAŁAŚ S., GAŁAŚ A., ZVIJÁKOVÁ L., ZELEŇÁKOVÁ M., ŠLEZINGR M. & FIALOVÁ J., 2013, Environmental Impact Assessment Process in the V4 Countries in the field of Recreation and Tourism. Fialová, J; Kubíčková, H (eds.). Public Recreation and Landscape Protection - with man hand in hand: Conference Proceedings, Brno, p: 45-50.
GAŁAŚ S., KRÓL E. 2008, Indicators for environmental-spatial order assessment on the example of the Busko and Solec Spa communes. Mineral Resources Management, 24/2: 95-115.
GAŁAŚ A., PAULO A. 2002, Mapa Geologiczno-Gospodarcza Polski: arkusz Rybotycze, Dobromil (wraz z objaśnieniami). Państw. Inst. Geol. Warszawa.
KOTLARCZYK J., 1993, Budowa geologiczna, rzeźba i krajobraz. [W:] Turnicki Park Na-rodowy w polskich Karpatach Wschodnich. Dokumentacja projektowa: 15-40. Kraków, PFOP Pro Natura.
MICHALIK S. (RED.), 1993, Turnicki Park Narodowy w polskich Karpatach Wschodnich. Dokumentacja projektowa. Polska Fundacja Ochrony Przyrody PRO NATURA, Kraków.
Łyjak Ł., Kunysz P. & Kowalski J., 2008, Raport o oddziaływaniu na środowisko planowanego przedsięwzięcia p.n. – budowa Wschodnioeuropejskiego Centrum Kongresowo-Sportowego „ARŁAMÓW" w miejscowości Arłamów, gmina Ustrzyki Dolne województwo podkarpackie. Ochrona Środowiska, Przemyśl.
PIÓRECKI J., 2002, Development of tourism in projected Turnica National Park in Przemyśl foot-hills in Polish Eastern Carpathians (in Polish, English summary) . [In]: Partyka J. red., Tourism in National Parks, tourist traffic – facilities – Conflicts – dangers. Institute of Nature Conservation PAN, Ojców National Park, s. 649-658.
REIJNEN M. J. S. M., VEENBAAS G. & FOPPEN R. P. B., 1995, Predicting the effects of motorway traffic on breeding bird populations. Road and Hydraulic Engineering Division, DLO-Institute for Forestry and Nature Research. Delft.

Acknowledgement

Financial support was provided by the AGH University of Science and Technology statutory funds no. 11.11.140.175

Souhrn

Investice v oblasti volného času a cestovního ruchu obecně nevyvolávají společenské konflikty a místní samospráva je vítá jako potenciální zdroj pracovních míst a hospodářského oživení. Pokud to jsou projekty s malou nebo omezenou intervencí do životního prostředí, jako jsou např. agroturistické zařízení, turistické nebo cyklistické stezky, nejsou obavy, že dojde k ohrožení přírodních hodnot. Po období silné kritiky a nesouhlasu s masovými formami turistiky a rekreace, především velkých lyžařských areálů a kongresového - sportovně-relaxačních center, lze sledovat návrat k realizaci právě takových menších investic.
Tento příspěvek hodnotí příklad přestavby horského hotelu středních rozměrů na mega komplex zahrnující lázně, fotbalové hřiště, golfové pole, sportovní haly, bazény, konferenční

místnosti a letiště pro vrtulníky. Předmětem analýzy je Rezidence Arłamów, tak se v současnosti nazývá místo, kde byl v 70. letech postaven malý palác spojen s loveckým mysliveckým revírem pro vládnoucí elitu. Izolace území za účelem zajištění pohodlného a bezpečného odpočinku, měla za následek, že v jeho okolí byla zakázána jakákoli hospodářská činnost. Po politických změnách v 90. letech byla tato oblast zpřístupněna veřejnosti. Výjimečný stav přírody daného území byl rychle doceněn a v roce 1993 povstal projekt Turnička národního parku. Hlavními motivy ochrany byla existence téměř stoletých porostů karpatského pralesu, Podhorský krajinný ráz a rozmanitá geologická stavba okrajové části Karpat. Bohatství fauny představuje 20 chráněných druhů, z nichž 6 (včetně medvěda hnědého, vlka a rysa) je zapsáno v "Červené kronice".
V současné době patří analyzované území do Chráněné krajinné oblasti Słonne Gory, lokality Natura 2000 (chráněné ptačí území, území evropského významu) a v jeho bezprostřední blízkosti se nachází lesní přírodní rezervace Turnica . Žádná z těchto forem ochrany přírody a biodiverzity nepředstavovala významnou překážku pro přestavbu Rezidence Arłamów do dnešních rozměrů, ve které je nabídka rekreace určena zejména sportovcům, myslivcům a byznysmenem. Proces EIA v tomto případě nedokázal, že komplex by mohl plnit své funkce a zároveň nevytvářet ohrožení pro cenné elementy životního prostředí, pokud by byl vybrán jiný varianta pro jeho lokalizaci, např. mimo chráněné území.

Contact:
Ing. Andrzej Gałaś, Ph.D.
AGH University of Science and Technology
Faculty of Geology, Geophysics and Environmental Protection
Al. Mickiewicza 30
30-059 Kraków, Poland
0048 12 617 44 75
pollux@geol.agh.edu.pl

EXTENSIVE GREEN ROOF VEGETATION SELECTION FOR FRIENDLY ENVIRONMENT

Zuzana Poórová, Daniela Kaposztásová, Zuzana Vranayová
Technical University in Košice

Abstract
Then God said, *"Let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, and over all the creatures that move along the ground."* So God created man in his own image, in the image of God he created him; male and female he created them. God blessed them and said to them, *"Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground."* Then God said, *"I give you every seed-bearing plant on the face of the whole earth and every tree that has fruit with seed in it. They will be yours for food. And to all the beasts of the earth and all the birds of the air and all the creatures that move on the ground--everything that has the breath of life in it--I give every green plant for food."* And it was so. God saw all that he had made, and it was very good.

Key words: annual, plant establishment, plant specification, sedum, soil depth

Introduction

In just few years, green roofs have gone from a historical curiosity to a booming growth industry – primarily because the environmental benefits of extensively planted roofs are now beyond dispute, whether for industrial or governmental complexes or private homes in urban or suburban settings. This paper deals with extensive green roofs. Nature helping the body, views offered for people living near green roofs, relaxant attributes of wildness in built environment. In bigger detail it focuses on its plants and vegetation, its construction, attributes and best use and choice of plants.

Material and methods

Plant specification marries up the expertise of growers, designers and horticulturists with the site specifications producing a list of plants creating nice design of the site. Combined processes of bidding, purchasing, installing, establishing, ongoing maintenance etc. are all contingent on each plant specification so special attention should be afforded to this phase of projecting extensive green roof (Snodgrass, 2006).
Specification process should begin with functional and site specific questions. Where is the location. What are the light conditions. Is the irrigation going to be necessary. What is the height of the roof. How much weight is the construction going to be able to carry. Is the roof near some river or lake. Is the projected roof on an exposed or sheltered place. What about storm water management. How should the color scheme of projected extensive green roof look like.

Preparing extensive green roof for planting. Before plants are installed, all engineer and protective works on the roof should be completed to ensure avoiding potential damage to the plants. Once roof is ready for the planting, the medium can be spread to the specific depth and thoroughly moistened. Plastic film should not be laid over the substrate, because it may cause overheating the medium and affect planted plants later (Snodgrass, 2006).

Weight of designed extensive green roof plays a critical role in plant specification. Steel, wood, concrete or some other constructive material can be engineered to support any designed load of soil. More complicated it is when it comes to existing buildings and existing roofs. Some of them were designed to support more weight, in these cases, simple light extensive green roof can be offered as a replacement of the old roof.
Weight of designed extensive roof is also a question of climate. Cooler climates must be designed to accommodate loads of snow, therefore these roofs must be designed structurally stiffer than the roofs designed in warmer climate. For this reason, it is much easier to retrofit roofs in colder climate than in warmer ones (Snodgrass, 2006).

Medium depth and its greater depth means more diversity of used plants because of more options for growing roots of used plants. Composition of the underlying medium influences load of soil. This also means influencing plant specification in terms of weight, water absorption

capacity, drainage rates etc. The ideal medium is lightweight, retaining water well, also porous and freely draining. The more water the medium retains, the more weight is being added to the roof. The medium supplies and absorbs nutrients, anchors the plants, provides enough weight to avoid floating when wet and avoids being flown off during establishment (Dunett, 2004)
Generally, extensive green roof medium is a blend of sandy or granular materials that balances water absorption with adequate porous surface. A variety of natural and unnatural materials can be used to achieve balance. Lelite, pumice, diatomaceous earth, sand, expanded and active clays, expanded shale, gravel, bricks and tiles. And vermiculite or perlit can be used in conjunction with other materials (Snodgrass, 2006). But we need to face the fact that using these kinds of materials the green roof is going to be less environmental and more expensive than purely natural medium.
More organic medium, more planting options are available. Predominantly organic medium is not recommended for extensive green roofs. Because of decreasing of pore space, higher water retention and increasing nutrient loading, reducing medium depth over time may be caused. Changing of medium depth may cause change of the designed roof, adding the substrate and changing environment of planted vegetation. Depth of medium should be constant over a long period of time and highly organic medium makes it impossible.

Results
Plant establishment is the key to green roof´s longevity. If the establishment in the beginning is unsuccessful, time of the return of investments is going to be lengthened. It is very important and also much cheaper to ensure the plant establishment in the beginning or even before the realization of the roof. First weeks after installation are crucial. It is prudent to plant the plants early enough to allow plants to root in before the first frost. Trials performed at Penn State University on plant establishment showed that well-established plants were much more likely to survive winter and drought than plants that were poorly established (Thuring, 2014).
Proper care during establishment will provide achieving coverage in earlier date. Planting occurs regular irrigation. If planting occurs in areas with natural rainfall that is regular, irrigation may not be needed. On many installations on US East Coast, plants require no supplemental irrigation at all, not even upon planting. On the other hand, parts in North require care and every day irrigation. Irrigation can be achieved through several methods: built in irrigation systems, lawns sprinklers, garden hoses. Irrigation need should be ascertained and used for the specific plants, location and time of year when the roof is being installed (Snodgrass, 2006).

Seeds are first way of installing green roof. No wholly seeded green roof installations exist in North America, but it seems likely that they will eventually appear. Market pressures to decrease installation costs by direct sowing on green roofs that could become more viable and the least expensive method (Snodgrass, 2006).
Seeded green roof takes the most time to mature, generally two to three years for coverage. Limited numbers of species can reliably germinate on a roof. All require some supplementary irrigation during germination and establishment phase. Seeds are best sown in spring or fall, depending on climate. To achieve full coverage of a roof in a short time period, quicker maturing annuals could be mixed with perennial seeds.

Cuttings are the most used plants installed on green roofs. They are viable and increasingly popular method for establishing. They are quicker than seeds and depending on climate, place and time, they may not need any supplementary irrigation to help them to establish. Cuttings are more expansive than seeds, but they achieve coverage much earlier. They can cover the roof within a year after planting (Nakano, 2014).

Plugs are cuttings with established root system. They offer a compromise between cost and flexibility. They offer greater diversity, because fully rooted plugs store sufficient energy to allow for easy establishment. They are easily packed in boxes (Nakano, 2014).

Nursery containers are occasionally specified for extensive green roofs when more established plants are needed from the beginning. Where the medium is deep enough to accommodate the root system, vegetation will spread more quickly than of plugs. If the depth of the root ball is bigger than depth of soil, root ball needs to be broken, roots need to be shortened to fit into soil (Nakano, 2014).

Vegetative mats are long rolls of pregrown plants set in a thin layer of mesh and medium. They are fully mature upon installation. They are installed in strips on top of a base substrate, which provides eventual root support. Mats are heavy and bulky to transport, must be grown at least one year before installation (Snodgrass, 2006).

Modules are discrete vegetative systems of black plastic squares or rectangles. They are the most expensive green roof planting option. They share all advantages and disadvantages of mats, but they include more medium. They can be installed like pavers (Snodgrass, 2006).

Discussion

Hardy succulents are the workhorses of extensive roofs and the primary plants for systems using a medium of 10, or less centimeters. They have unsurpassed ability to survive drought and wind conditions, store water in their leaves for extended periods and conserve water through a unique metabolic process. Hardly succulents like *Sempervivum* Fig. 1, *Sedum, Talinum, Jovibarba, Delosperma* are the only choices for thin substrate, non-irrigated, extensive green gardens with the greatest survivability (Snodgrass, 2006).

Fig. 1: Sempervivum (http://en.wikipedia.org/wiki/Sempervivum_macedonicum)

Annuals should not be the dominant plant selection for extensive green roof, because they do not offer longevity required to make a project cost effective. They can be used as seasonal accents. They are required in places with regular rainfall, or in places with irrigation system. Annuals like *Phacelia Campanularia* Fig. 2, *Portucala, Townsedia Eximia* may be used on extensive green roofs as filters to provide quick color during first grown season (Snodgrass, 2006).

Fig. 2: Phacelia Campanularia (http://www.flickr.com/photos/naomi_bot/4431015374/)]

Herbaceous perennials are the most desired plants for aesthetic reasons. They offer great colors, textures and season variability. On the other hand, they require deeper substrate and moisture than are found on most extensive green roofs. Some of them work very well on extensive roof installations. *Dianthus* Fig. 3, *Phlox, Campanula, Teucreum, Allium, Potentilla, Achillea, Prunella, Viola, Origanum* and some other low growing and shallow rooted perennials can be used, however, medium depth must be greater than 10 cm and has to have adequate water source. Few herbaceous perennials are evergreen, so if winter interest is a major design consideration for a roof, alternative must be provided so the brown vegetation is not so visible during its dormant period (Snodgrass, 2006).

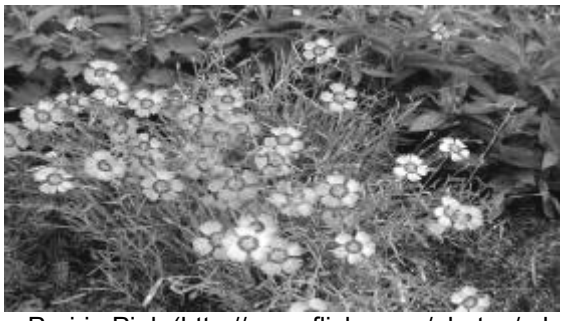


Fig. 3: Dianthus Dianthus Prairie Pink (http://www.flickr.com/photos/mbgarchives/4582179240/)

Short grasses are mostly popular for traditional intense green roofs and landscaping, but they still have their place in extensive green roofs. They do not have colorful bloomers like annuals and perennials, but they do have a lot of offer. They are more vertical, they add a texture and motion into a picture of roof, offer birds, insects habitat. They do need deeper depth of soil to accommodate their root system, some of them may have a Durant period during summer what means having a brown spot on the roof some time. Short grasses like *Carex* Fig.4*, Festuca, Deschampsia* are appropriate for extensive roofs.

Fig. 4: Carex (http://serenityinthegarden.blogspot.sk/2012/11/the-incredible-carex-sparkler.html)

Herbs as *Thymus, Origanum, Salvia* Fig. 5 and *Allium* have mostly their selected use on green roofs because of depth of soil that has to be more than 10 centimeters. On the other hand, their use is very specific because of their aroma, what is commonly used on buildings like restaurants, hospitals, residences, institutional buildings, they can be harvested for culinary, aromatic, therapeutic or educational purposes (Snodgrass, 2006).

Fig. 5: Salvia (http://georgeweigel.net/plant-of-the-week-profiles/perennials/salvia-may-night)

Conclusion

Groundcovers like hardly succulents should be predominant plants used on extensive green roofs with a limited amount of accent plants. Groundcovers provide a rapid, reliable and cost-effective spread over the roof. Accent plants like annuals, perennials, herbs and grasses while spectacularly during bloom, may not live more than five years on the roof. In addition, they do not spread as rapidly as groundcovers, more plants are required to cover an area, but they offer seasonal interest. Accent plants may be replenished by periodic resowing.

Clients and designers, everybody looking at made green roof wants it to be colorful. Wider plant palette is required because of many aspects. Aesthetical, psychological, people looking at the roof need to feel relaxed and free like in nature. Combination of these types of plants is the best way to come to this state. Choices among sedums are diverse, pink, yellow, green, differences

in height, some of them are terized by tight, some of them change colors from green to red with season. These combinations offer solution to make roof green all year long but with some colorful spots according to designed and used plants.

References

SNODGRASS, E. C., Green roof plants. Timber press, Portland*London, 2006
DUNETT, N., KINGSBURY, N., Planting green roofs and living walls, Timber press, Portland*Oregon, 2004
THURING, C. E., Green roof plant response to different media depth under various drought conditions. http://horttech.ashspublications.org/content/20/2/395.full (29-03-2014)
NAKANO, M., ROUSSEAU, N., HENDERSON, D., Green roof plants: Establishment, viability and maintenance. http://bclna.com/files/2013/05/Set-B-Green-Roof-Plants-Final Report_Kwantlen.pdf (29-03-2014)
http://en.wikipedia.org/wiki/Sempervivum_macedonicum (30-03-2014)
http://www.flickr.com/photos/naomi_bot/4431015374/ (29-03-2014)
http://www.flickr.com/photos/mbgarchives/4582179240/ (29-03-2014)
http://serenityinthegarden.blogspot.sk/2012/11/the-incredible-carex-sparkler.html (30-03-2014)
http://georgeweigel.net/plant-of-the-week-profiles/perennials/salvia-may-night (29-03-2014)

Acknowledgement

This work supported by VEGA 1/0450/12 Energy Balance Research on Rainwater Management in the Cities of the Future.

Souhrn

Člověk byl stvořen a bylo mu požehnáno, aby vládl rybám v moři a veškerému ptactvu ve vzduchu, veškerému hospodářství na celé Zemi a všem možným stvořením, jež zemi obývají. Člověk se rozhodl být též plodný, zaplnit zemi a podmanit si ji. Člověku byly dány semenné rostliny, jež zasadil do země – každý strom, jenž měl nést svoje ovoce. To vše se mělo stát člověku obživou. Veškerá zvěř žijící na zemi, všichni ptáci poletující ve vzduchu a všechny stvoření obývající zem, vše co dýchá včetně rostlin, to vše mu bylo poskytnuto. Cílem tohoto článku bylo ukázat možnost využití rostlin pěstovaných na nečekaných místech, jako jsou střechy. Návrh správné konstrukce, správné množství zeminy, pěstování rostlin na střeše a další nároky rostlin – to vše bylo obsahem předkládaného článku. Člověk dostal do rukou přírodu, aby jí vládl – využíval ji. V dnešní době se stále objevují informace o změně klimatu. Z toho popudu se lidé čím dál častěji obracejí k přírodním zdrojům, přírodě, atd. Proč? Lidem byla dána příroda a tak ji začali ničit. Nyní se snaží zachránit, co se dá zachránit, zlepšit, co se dá zlepšit. Zdá se to ironické, ale měli bychom najít rovnováhu. Materiál použitý na výstavbu budov, to vše jsme dostali od přírody. Zelené střechy jsou jednou z možností, jak přírodě vrátit, co jsme dostali a posílit tak celkovou rovnováhu.

Contact:
Ing. arch. Zuzana Poórová
Technical University of Košice, Civil Engineering Faculty
Vysokoškolská 4, 04200 Košice
zuzana.poorova@tuke.sk

FOREST ECESYSTEM IN PROTECTED LANDSCAPE AREAS OF THE CZECH REPUBLIC - AN IMPORTANT DESTINATION OF TOURISM

Ivo Machar, Vilém Pechanec, Jan Brus, Helena Kiliánová
Palacky University Olomouc

Abstract
Forest ecosystems in protected landscape areas are an important destination of tourism in the Czech Republic. Many of visitors of protected landscape areas (PLA) do not understand to activities in protected forest ecosystems in these areas. This paper deals with forest management strategy and practice in PLA, because its can be considered as one of the key tasks of the state nature conservation in the Czech Republic. In this context, great importance can be assigned to the strategy of forest management in PLA because this category of specially protected areas should be a model example of sustainable management of Central European cultural landscape. A brief case study dealing with the definition of zonation and forest management in the Protected Landscape Area of Litovelské Pomoraví serves as an example of applying these principles.

Key words: conservation, forests, tourism in protected areas.

Introduction

Protected landscape areas and its forest ecosystems are an important destination of tourism in the Czech Republic. Specially protected natural areas currently occupy 15.58% of the total area of the Czech Republic. The total acreage of forests in specially protected areas in the Czech Republic is approximately 750 000 hectares, representing 28.4% of the total acreage of all forests in the country. Area-wise, the forest ecosystems are the most important type of countryside use in national parks, national nature reserves and protected landscape areas. The provision of specific forest care in specially protected areas is considered as one of the key tasks of the state nature conservation in the Czech Republic. Inappropriate species composition with significant proportion of spruce monocultures, acidification and nutritive degradation of soils in mountain regions, excessive game populations preventing the natural regeneration of stands of geographically indigenous woody plants and insufficient application of close-to-nature forest management methods persist also in the forests of protected landscape areas (MOUCHA, 1999). This paper deals with forest management strategy and practice in PLA, because its can be considered as one of the key tasks of the state nature conservation in the Czech Republic. Formulating the strategy of forest management in the protected landscape areas is particularly important since this category of specially protected areas should serve as model example of sustainable management of Central European cultural landscapes (PELC 2001).

Definition of PLA in the Czech Republic

Within the IUCN international categorization of protected areas, the protected landscape areas in the Czech Republic are generally classified under Category V – protected landscape. This internationally recognized definition of protected landscape is used as basis for the Czech legislative definition of protected landscape area: a vast territory with harmoniously shaped landscape, characteristically developed topography, significant proportion of natural ecosystems of forest and permanent grass stands, abundant trees and possibly also with preserved historical monuments. The term “vast territory” used in this definition emphasizes that the subject of protection in this type of protected area is the landscape (MIKO et al. 2005). Simultaneously, a third of Czech PLA is also included in the international system of biosphere reserves and the List of internationally important wetlands. Protected landscape areas represent pilot territories for sustainable use of soil and landscape because the aim of nature conservation in PLA is, particularly, to maintain and develop a sensitive and territorially differentiated economic landscape use. The main objectives of PLA management include: (1) preserving harmonious interplay between nature and culture through the protection of landscape and the continuation of traditional methods of land use; (2) maintaining diversity of the landscape and its habitats; (3) supporting such forms of recreation and tourism that do not compromise the most important qualities of the area; (4) supporting scientific and educational activities aimed at the public in order to protect the nature; (5) benefits for local communities. PLA is, therefore, an area where, in the course of time, the interaction between Man and nature

created a territory of remarkable character with significant aesthetic, ecological and cultural values as well as high biodiversity.
Detailed definition of the protected landscape area is based on a comparison with a national park (PELC ET AL. 2000). In the protected landscape areas, the proportion of woody plants of native forest species composition is higher than the national average of the Czech Republic, but the proportion of forest in the total PLA acreage compared with the acreage of forests in the Czech Republic considerably varies from 9% (PLA Poodří) to 80% (PLA Jeseníky). The total average forest coverage of all protected landscape areas in the Czech Republic makes 51%, which is approximately 1.5 multiple of the national average. Approximately 80% of the total forest area in protected landscape areas of the Czech Republic is state property.

Management of forest ecosystems in PLA in the Czech Republic
Forest ecosystems in protected landscape areas should be managed according to the principles of sustainable forest management (POLENO 1997), the basic theses of which were specified at the Ministerial Conference of European Countries in Lisbon in 1998. Sustainable forest management is based on the site conditions of specific forest stands (PLÍVA 2000), the principles of forest durability (MÍCHAL et al. 1992), and emphasizes the application of ecosystem approach in line with the Convention on Biological Diversity. The long-term objectives in caring for forest ecosystems of protected landscape areas also include the preservation and reproduction of genetically valuable local populations of woody species and their use in restoring the stands.
The basis of the strategy of caring for forest ecosystems in protected landscape areas is a differentiated approach according to the zones of graded nature protection (MOUCHA 2006), as formulated in the plan of care of protected landscape areas (ANONYMUS 2004).
The aim of protecting the forest ecosystems in the first PLA zone is to preserve the close-to-nature assemblages and their species diversity. Protective conditions for this zone exclude any intensive forestry technology such as creating clear-cuttings, etc. Forest stands in the first PLA zone should be a forest of special purpose for reasons of nature conservation. The ecosystems of these stands can be most often considered as suitable for spontaneous development. In the case of such spontaneous development of forests not owned by the state, it is obviously necessary to take into account the legitimate requirements of their owners for payment of compensations regarding wood production. The decision about leaving the forest in the first PLA zone to spontaneous development must be supported by professionally well-founded justification that is permanently embedded in the plan of care as a strategic management objective. A professionally organized monitoring of spontaneous development of the ecosystem is absolutely necessary. In this context, it should be emphasized that the institute of the first PLA zone does not automatically mean that respective forest stands can be left to their spontaneous development (in contrast with national parks).
The aim of forest protection in the second PLA zone is to preserve and restore spatially as well as generically structured and habitat-wise corresponding forest stands when excluding the introduction of geographically non-indigenous species. Only small-scale forms of forest management should be applied in the second PLA zone in accordance with its protective conditions, preferring natural renewal and environmentally friendly forms of forestry interventions.
The basic condition for the close-to-nature forms of forest management in the first and second PLA zone is to apply the strategy for natural game numbers and close-to-nature game management (game management categories 1 and 2 according to MRKVA 1999). Regarding the protection of biodiversity in the forests of the first and second PLA zones, it is also necessary to actually increase the proportion of dead standing trees as well as wood rotting on the ground and maintain their high share in the future (VRŠKA 1999).
The third PLA zone usually includes economic forests that have significantly altered species composition. In the management of these forests, it is essential to gradually head towards sustainable forestry management with the intention of reducing the future share of artificial monocultures to zero.

Case Study: Floodplain forest management according to differentiated zonation in the Protected Landscape Area Litovelské Pomoraví
Within the Natura 2000 network, the area of Litovelské Pomoraví (hereinafter referred to as “area of interest”) is included in the national list of European important sites and defined as a bird area. Floodplain forests in the area of interest are part of the internationally significant

wetland Litovelské Pomoraví protected by the Ramsar Convention. Practically, the entire acreage of these floodplain forests belongs to the supraregional system of landscape ecological stability.
The first zone (Tab.1.) of the graded nature protection (core zone) represents the ecologically most valuable segments of the fluvial successional series of floodplain biotopes and is formed by the continuous complexes of close-to-nature forest stands with 1st degree of naturalness and high environmental stability. Stands in the core zone have a quite specific management, applied through detailed care plans for individual specially protected reserves. Fluvial processes in the core zone (erosion and accumulation geomorphological processes in rivers, development of meanders, changes in channel routing, etc.) are not anthropogenically influenced.
The second zone (buffer zone) of the graded nature protection includes floodplain forests where nature conservation interests are applied within the principles of sustainable forest management (Tab.2.). In the protective zone, any water-management intervention into the dynamics of fluvial processes can be only rarely permitted, and only when necessary due to flood protection measures (maintenance of dikes, maintaining flow profiles under bridge structures). All mentioned management principles for individual zones are subject to the updates of the PLA care plan and subsequently integrated into the respective forest management plan.

Discussion and Conclusion

Generally, it can be concluded for the third PLA zone that the development of sustainable forest management, basically secured already by adhering to the content of the Forest Act, should be sufficient. Forms of the close-to-nature forest management beyond the basic duty of forest owner, as results from the Forest Act, are adequate for the second and first zones.
Regarding the first and second zones, this above outlined general strategy of forest management in individual PLA zones still does not count with applying the historically defunct ways of management in lowland forests that tend to forms of coppice and coppice-with-standards forests (KADAVÝ et al. 2007). In particular, the silvicultural system of coppice forest required intensive forest management (repeated coppice harvesting with creating large clear-cuttings in short intervals of seven to ten years). Banning the application of intensive economic technology in the first and second CHKO zones is in clear contradiction with the requirements of reintroduction of coppice and coppice-with-standards silvicultural systems even in protected areas (KONVIČKA et al. 2006). The solution could be found in a professional consensus on redefining the concept of intensive technology and targeted application of coppice and coppice-with-standards forest shapes especially in the compositional elements of ecological networks (see MACHAR 2008). However, it is necessary to take into account that the conversion of high forest into coppice or coppice-with-standards forest is a very complicated matter, both organizationally and financially (UTÍNEK 2006).
Most of the forests in the Czech Republic emerged as a result of purposeful cultivation of forest of age classes with deliberate favouritism in support of the silvicultural shape of high forest, with a preference for management involving coupes. After 1989, the forest industry in the Czech Republic gradually showed the tendency to restore the ecological stability of forests based on species composition changes toward a natural structure (MÍCHAL et al. 1992). In addition to the species composition of tree layer, also the spatial structure of forest stands is crucial for the forest biodiversity. The current modern tendencies of ecologically grounded silviculture, therefore, tend to create richly structured forests (VACEK et al. 2007) including the “renaissance” of interest in historically defunct ways of farming in lowland forests that were based on the economic shape of coppice-with-standards and coppice woodlands (MACHAR 2009). In forest management practice, however, these pursuits of returning to close-to-nature farming methods (TESAŘ 1999) win recognition very slowly (KRIŽOVÁ & UJHÁZY 2007; PRKNOVÁ 2009). In terms of protecting the forest nature biodiversity, it is essentially needed to switch to the close-to-nature forestry management, particularly in specially protected landscape areas, in compositional elements of ÚSES and the sites of the Natura 2000 network. Differentiated management of forest ecosystems in protected landscape areas should be an example for the application of close-to-nature forms of farming in the forests of the Czech Republic within the European context (FANTA 1997). Institutions of nature protection promote their requirements for forest management through a number of legislative instruments; regarding specially protected areas, the most important instruments being the care plans as basis for the development of forest management plans and forest inventory curricula.
In the conservation literature, there was very extensive discussion on the optimal size of natural reserves (e.g. DIAMOND 1985; SOULE & SIMBERLOFF 1986) that primarily addressed whether the

species diversity of certain ecosystems is maximally protected in one large reserve or, vice versa, in several smaller reserves of the same total acreage (known under the acronym SLOSS – single large or several small). Although the importance of small-scale reserves is unquestioned (e.g. SHAFFER 1995), the conservation efforts are generally directed at large reserves that would include, if possible, the entire landscape ecosystems (PERES & TERBORGH 1995). However, this is usually infeasible in real situation, and the problem is therefore solved by a compromise through internal zonation of large protected territories (SUTHERLAND & HILL 1995), as it is in the Czech Republic regarding national parks and protected landscape areas.

Tab.1: Management of the core zone in the PLA Litovelské Pomoraví

Zone of graded PLA preservation	I. (core zone)
Characteristics of the area	Geobiocenoses of various types of alluvial forest in various seral stages from willow bushes on fluvial deposits to the Ulmi fraxineta carpini stands belonging to the first degree of naturalness. Active fluvial processes and dynamics of Fluvisol development.
Basic aims of care for the area	Protection of representative sample of fluvial seral series of alluvial biotopes. Protection of dynamics of landscape-ecological processes in an alluvial plain of a large river. Long-term aim: Geobiocenological "natural" laboratory enabling the study of natural development of various types of alluvial goebiocenoses.
Area	390 ha
Legal protection	National nature reserve
Natura 2000	Core area of the bird area and an important locality on the European level
Territorial system of ecological stability	Core area of supra-regional biocentre
Forest category	Forestry with a special assignment due to nature protection
Agricultural wood shape	Middle and high forest
Agricultural way of management and its form	Selective – individual selection, group selection when reducing geographically allochthonous woody species
Desired species composition	In accordance with the respective geobiocene types
Rotation period	Physical age – differentiated according to the space-forming tree species
Reproduction period	Continuous
Basic management principles	Natural development of the geobiocenosis without intervention.
Game management	Feeding of game excluded. Intensive hunting of cloven-hoofed game.
Deviations from the model	Selected stands with a composite forest character should be continuously managed with the aim of preserving this ecologically desirable stand state (reproduction period 15 – 30 years, leaving seed trees of common oak 15 – 20 ks/ha until the ultimate end of the life cycle). Removal of obstacles in the river Morava channel arising from fallen trees into the river bed. Maintenance of forest roads, bridges and pipe culverts in a proper state. Active reduction of geographically allochthonous woody species. Active removal of alien plants.

References

DIAMOND, A. W.: (1985). The selection of critical areas and current conservation efforts in tropical forest birds. In: DIAMOND A.W. & LOVEJOY T.E. (eds.) Conservation of Tropical Forest Birds. International Council for Bird Preservation, Cambridge: 33-48.

KADAVÝ, J., KNEIFL, M., SERVUS, M., KNOTT, R.: (2007). Střední les jako přírodě blízký způsob hospodaření. In: Význam přírodě blízkých způsobů pěstování lesů pro jejich stabilitu, produkční a mimoprodukční funkce. Sborník příspěvků z vědecké konference. ČZU Praha, Kostelec nad Černými Lesy, 17.-18.10.2007: 35-43.

KONVIČKA, M., ČÍŽEK, L., BENEŠ, J.: (2006). Ohrožený hmyz nížinných lesů: ochrana a management. Sagittaria, Olomouc.

MACHAR, I.: (2008). Floodplain forest of Litovelské Pomoraví and their management. - Journal of Forest Science, 54 (8): 355-369.

MACHAR, I.: (2009). Coppice-with-standards in floodplain forests – a new subject for nature protection. Journal of Forest Science, 55, 7: 306-311.
MIKO, L., BOROVIČKOVÁ, H., HAVELKOVÁ, S., ROTH, P., STLOUKAL, P., VOPÁLKOVÁ, A.:(2005). Zákon o ochraně přírody a krajiny: komentář. C.H.Beck, Praha.
MÍCHAL, I., BUČEK, A., HUDEC, K., LACINA, J., MACKŮ, J., ŠINDELÁŘ, J.: (1992). Obnova ekologické stability lesů. Academia, Praha.
MOUCHA, P.: (1999). Zásady začleňování lesů v chráněných krajinných oblastech do zón odstupňované ochrany přírody a krajiny a principy hospodaření v nich. In: MOUCHA P. (ed.), Přírodě blízké hospodaření v lesích chráněných krajinných oblastí, Sborník přednášek ze semináře 30.3.1999 v Průhonicích, Česká lesnická společnost: 41-46.
MRKVA, R.: (1995). Škody zvěří a jejich řešení. – In: Sborník z konference „škody zvěří a jejich řešení". MZLU, Brno: 3-15.
PERES, C.A. & TERBORGH, J.W.: (1995). Amazonian nature reserves: An analysis of the defensibility status of existing conservation units and design criteria for the future. Conservation Biology, 9: 34-46.
POLENO, Z., VACEK, S., PODRÁZSKÝ, V., REMEŠ, V., MIKESKA, M., KOBLIHA, J., BÍLEK, L.: (2007). Pěstování lesů I. Ekologické základy pěstování lesů. Lesnická práce, Kostelec nad Černými lesy.
SHAFER, C.L.: (1995). Values and shortcomings of small reserves. BioScience, 45: 80-88.
SOULÉ, M. & SIMBERLOFF, D.: (1986). What do genetics and ecology tell us about the design of nature reserves? Biological Conservation, 35: 19-40.
SUTHERLAND W.J. & HILL D.A. (1995). Managing habitats for Conservation. Vambridge University Press, Cambridge.
VACEK, S., SIMON, J., REMEŠ, J.: et al. (2007). Obhospodařování bohatě strukturovaných a přírodě blízkých lesů. Lesnická práce, Kostelec nad Černými lesy.
VRŠKA, T. & HORT. L.: (2003). Základní kriteria a parametry pro hodnocení přirozenosti lesních porostů. Pracovní materiál, Agentura ochrany přírody a krajiny ČR, Brno.

Acknowledgement
The paper has been supported by a grant TARMAG - Biodiversity and target management of coppice and coppice-with-standards forests in the frame of NATURA 2000 (supported by the Ministry of the Environment of the Czech Republic) and grant ABIONET – Platform for cooperation in the frame of creation of landscape No. CZ.1.07/2.4.00/31.0032 (supported by EU).

Souhrn
Zvláště chráněná území přírody zaujímají v současné době 15,58 % z celkové rozlohy České republiky. Celková výměra lesů ve zvláště chráněných územích v ČR činí přibližně 750 tisíc hektarů, což je 28,4 % celkové výměry všech lesů na území státu. Lesní ekosystémy jsou proto velmi významnou destinací cestovního ruchu v ČR. Velká část návštěvníků a turistů v chráněných krajinných oblastech zpravidla nechápe základní principy péče o lesní ekosystémy v těchto chráněných územích. Péče o lesy ve zvláště chráněných územích je přitom považována za jeden z klíčových úkolů státní ochrany přírody v ČR. Velký význam má v této souvislosti strategie péče o lesy v chráněných krajinných oblastech, protože tato kategorie zvláště chráněných území by měla být modelovým příkladem trvale udržitelného obhospodařování středoevropské kulturní krajiny. Základem strategie péče o lesní ekosystémy v chráněných krajinných oblastech je diferencovaný přístup podle zón odstupňované ochrany přírody, formulovaný v plánu péče o chráněnou krajinnou oblast. V tomto článku jsou prezentovány hlavní zásady pro formulaci strategie péče o lesy v chráněných krajinných oblastech Ceské republiky a příklad aplikace těchto zásad je demonstrován na případové studii o vymezení zonace a managementu lesů v Chráněné krajinné oblasti Litovelské Pomoraví.

Tab. 2: Management of the buffer zone in the PLA Litovelské Pomoraví

Zone of graded PLA preservation	II. (buffer zone)
Characteristics of the area	Alluvial forest rich in species, age structured.
Basic aim of the care for the area	Continuous production of wood mass while respecting the principles of environmentally friendly forestry management. Planting of multi-storeyed and species-rich stands, with the common oak and the common ash in the main storey and a rich sub-storey.
Area	1955 ha
Legal protection	II. zone of protected landscape area
Natura 2000	Bird area, sites important at the European level
Territorial system of ecological stability	Supra-regional biocentre
Forest category	Production forest
Agricultural wood shape	High forest (storeyed)
Agricultural management and its form	System involving coupes with shelterwood cutting to support the natural regeneration of ash (clear cutting of maximum area of 1 ha with consistent leaving of seed trees in the regenerated area; the minimum number of seed trees being 10 pcs/ha) Selective (group selection)
Desired species composition	According to the respective agricultural type. Implementation of geographically allochthonous woody species is excluded.
Rotation period	With oak seed trees (minimal number: 10pcs/ha), the rotation period is extended till the end of the life cycle.
Reproduction period	According to the respective agronomical stand type.
Course of reproduction	Where the group selection is realized, the regeneration elements (gaps) should be inserted into the natural regeneration points. Where regeneration by clear cutting is realized, oak seed trees should be left in place (minimum 10 pcs/ha).
Plantation	Artificial planting of the common oak and natural reproduction of the common ash (alluvial hardwood forest) and black poplar (alluvial softwood forest) by means of large saplings, in those areas where reproduction is ensured by means of clear cutting, acorn seeding should be used. The natural reproduction of the woody species in the substoreys should be encouraged: lime, hornbeam, maple, alder, willow.
Stand tending	Consistent protection by means of fencing to protect from the game. Check of the fencing state after each flood. Usage of natural sprouting capacity to create the lower storey.
Forest protection	
Improvement of land	Maintenance of the flow capacity of the periodical river channels (maintenance of bridges and pipe culverts in the forest roads). Systematic drainage of the forest is excluded. Systematic preparation of the soil during stand regeneration is excluded.
Game management	Intensive hunting of cloven-hoofed game. Do not establish a special assignment forest category in order to set up a pheasantry.
Deviations from the model for composite forest	Continuous management in order to preserve this ecologically desirable forest state (reproduction period 15 – 30 years, leaving seed trees of the common oak 15 – 20 pcs/ha until the end of the life cycle).
Deviations from the model	Small-scale natural monuments: plan of care. Seed trees intended for reproduction should be preferably chosen from the common oak, alternatively from viable ash or elm specimens. In case of a good year for common oak seeding, the promising areas of self-seeding should be fenced immediately and consistently protected against weeds. Selected specimens of older trees with hollows (nesting places), indicated with nature protection, should be left in place permanently. Stands with a willow alder carr character: elimination of hybrid poplars at the mature cutting age, otherwise without intervention, if possible exclude possibility of development of cleared areas. Bank protection stand: Intensive health-based selection, protection of rare woody species (black poplar, elm). Former hunting specific non-stocked forest land: reforest, in parts leave in the form of meadows.

Contact:
Assoc. Prof. Ivo Machar, Ph.D.
Palacky University Olomouc
Zizkovo nam. 5, 771 47 Olomouc, Czech Republic
e-mail: ivo.machar@upol.cz

FOREST RELATED ENVIRONMENTAL EDUCATION – A SUCCESSFUL STORY IN AUSTRIA AND EUROPE

Thomas Baschny
Federal Ministry of Agriculture, Forestry, Environment and Water-management, Austria

Abstract
Austrian and European Forester's invites school classes, tourists, adults, decision-makers, handicapped and retired people into the forest. They are offering a "half-day fieldtrip into the nature", a "day in a forest", "forest in four seasons" (project) and "a year in a forest" (10 times per year). Feel nature with all your sense!
Forest Pedagogics is forest related environmental education. It comprises all learning processes concerning the habitat forest enabling the individual and the society as a whole to act and thus to think on a long-term basis, holistically and committed to public welfare and in a future-oriented way.
One core message is "sustainability" Our European forests are the living evidence for the fact that it is worthwhile to think on a long term basis. The 2nd message is "Doctor Forest". When did you last observe the dance of the sunrays in the treetops lying on the forest ground or feel barefooted the cool of wet forest meadows, thinking of the wonderful fairy tales and stories of your childhood in which the forest was also home to fabulous creatures?
3rd message: "Forest set a precedent in terms of school". Many categories of forest pedagogical offers are first and foremost addressed to pupils. Schools teach in a two-dimensional way, forest pedagogics in a three-dimensional way.
The target groups:
Forest pedagogics is there for people of all age-group. However, in the interest of success target group orientation is necessary.

Key words: invitation to come into the forest; feel nature with all your sense guided by an educated forester (forest pedagogue);

Introduction

The forest pedagogue has to open your sense and eyes. He must be a good guide, he must explain forest related things, and he must have the knowledge and the "pedagogical feeling". It is necessary to have a good relationship to the visitors (group). So the introduction takes time and must be done very carefully. It is also important to explain sustainability.
Forest pedagogics is there for people of all age-groups. However, in the interest of success target group orientation is necessary.

Material and methods

The guiding principles of Forest Pedagogics are: a good human – forest understanding and a good human – forest relation. People acting in a responsible way.We use different materials from the forest and helpful things for our activities in the forest and in the nature.
Methods: use all your sense!
Useful materials:
(Rucksack with Rope, Safety pins, Black and transparent photographic film canisters,Measuring tape, Mirrors, Colour pencils or crayons, Magnifying glasses and hand magnifying glasses, White paper and/or recycled paper, Postcards of animals and plants, Slices of wood with natural cord, Simple thermometer,Blindfolds, First aid kit, rope for a spider-net, wooden-bowl, clothespins, skins, hunting-horn, …)

Results

FP in Austria and Europe already has:

- a lot of good pedagogical concepts, experienced methods and a huge variety of actors, to bring especially the children into the forests, as well as the forests to the children;
- sufficient proofs (results), that it has a lot of beneficial impacts on educational deficits;
- **recognized, that it is dealing with the future of the sector;**
- started the work together in networks with other actors from the forest-timber-sector, but also with other actors;
- tolearn from each others (different cultural background);

- **to explain sustainable forest management** (not with unfamiliar concepts, but showing that forestry is important for the future life of people, that its good for the things people need);
- to get more visible (for the society, in the media, for policy/for financing);
- to have more proofs, showing its contribution for education of sustainable development (ESD);
- to bring all the spheres of sustainability (economical, ecological, social, cultural) together, by using forests and the management of all their functions as an excellent model for sustainability;
- to include teachers;

Discussion

In Europe we have a lot of more or less certified forest pedagogues and also education centres. All are offering good programmes. It is up to us to develop these programmes further.
We have also to think about our aims in forest.
Sometimes we have a lack of money.
The role of forestry is not clear. Forest pedagogical activities are sometimes under estimated.
We have a lack of qualified Forest Pedagogues and also a lack of qualified research data's. (Lack/gaps of evaluation - methods and results)´
We have still not enough awareness in public.
Our networking is not well developed.

Conclusion

Forest Pedagogics is a nature-friendly way of tourism and leisure. If we are able to offer special programmes, it can be a new form and trend of rural tourism.
Forest Pedagogics is growing up. We need more educated actors from the Forest Sector. The framework conditions are sometimes not easy, but I am sure, we will master it step by step. And at the end we will get support.
A new form in Austria is **"Green Care Forest"**. It includes "Forest Related Environmental Education" (Forest Pedagogics), "Forest and Culture", "Forest and Tourism" and "Forest and Health". All four themes need engaged actors and we can also use all this activities in an innovative form for tourism and visitors.
Let us develop these things further. Welcome in Austria or to our 9th International Forest Pedagogics Congress in Lagow (West-Poland) 09th-12th of September 2014.

Fig. 1: Author of the article by the environmental education

Fig. 2: Example of the winter activities

Fig. 3: Example of the summer activities

Fig. 4: Picture made by one of the student

References

Publications and Working Document / Definitions UN-ECE-FCN Subgroup Forest Pedagogics – Leader (2008_2013) Ing. Thomas Baschny / Klaus Radestock (www.forestpedagogics.eu);
A Day of Adventure in the Forest (environmental activities for protected areas)– Bayerische Forstverwaltung (CD in different languages)
Meeting Point Forest – Forest Pedagogics for Foresters ("Treffpunkt Wald") Silviva – CH 8031 Zürich (Switzerland)
Lesni Pedagogika (www.lesnipedagogika.cz)–Member oft he Subgroup FP

Souhrn:
Lesní pedagogika je něco, co můžeme nabídnout široké veřejnosti. Právě je (les) v našich rukou. Nadešel čas, abychom ji dostatečně rozvinuli a vytvořili tak dobře fungující podmínky Lesnické pedagogiky. Už teď je jisté, že se obor lesnické pedagogiky v Evropě stále rozrůstá. Jsme na dobré cestě, ale ještě musíme ujít velký kus cesty, **protože oboru lesní pedagogiky je třeba, a to v celé Evropě!**

Contact:

Ing. Thomas Baschny
Forester and certified Austrian Forest Pedagogue
Federal Ministry of Agriculture, Forestry, Environment and Water-management - Department of Forestry -Division IV/3 "Forest Resources, Communication and Budget"
Marxergasse 2,A-1030 Vienna (AUSTRIA)
Telephone: +43-1-71100-7321 mobile phone: +43-664-6112808
Fax: +43-1-71100-7399
E-mail personal: thomas.baschny@bmlfuw.gv.at
Web office: www.lebensministerium.at

GEOSITE AND GEOMORPHOSITE ASSESSMENT FOR GEOTOURISM PURPOSE: A CASE STUDY FROM THE VIZOVICKÁ VRCHOVINA HIGHLAND, EASTERN MORAVIA

Karel Kirchner, Lucie Kubalíková
Institute of Geonics, Academy of Sciences of the Czech Republic, v.v.i.

Abstract
Geotourism can be understood at a broader sense as geographical tourism sustaining environment, culture, aesthetics, heritage and the well-being of residents of a place or in a more restricted sense as a form of nature tourism that specifically focuses on landscape and geology. Geological, geomorphological and pedological sites are the most important resource for the geotourism activities. It is evident that not every site can be used for geotourism purposes. To find out which site can be used, it is necessary to identify, describe and assess various sites using a suitable assessment methodology. Based on the definition and conceptsof geotourism and the assessment methods already used for geomorphosite assessment, authors propose five groups of assessment criteria. The method was used for assessing selected sites in the Vizovickávrchovina Highland (Eastern Moravia, Outer Western Carpathians). Thanks to the assessment of the sites in this region, some potential geotourism resources were identified. Although the proposed method is numerical which should reduce the subjectivity, there is always a degree of subjectivity due to the fact that the real value of some criteria cannot be measured and it depends on assessor's experience, knowledge and preferences.

Key words: geodiversity, geoheritage, numerical assessment, Outer Western Carpathians

Introduction

Geodiversitywhich is defined as the natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (land form, processes) and soil features, including their assemblages, relationships, properties, interpretations and systems (Gray, 2004) is the most important resource for geotourism. It is evident that all the geodiversity cannot be used for geotourism; tourist use of geodiversity is generally made through the exploitation of geoheritage (represented by the geosites and geomorphosites). For the detection of such sites, it is necessary to do the inventory and evaluation of potential sites – this can be achieved by using the concept of “geomorphosites” (Panizza, 2001; Reynard, Coratza, Regolini-Bissig eds., 2009). This concept includes inventorying, identification and assessment of suitable sites. Plenty of assessment methods for the evaluation of the geosites and geomorphosites from different points of view were developed within this concept (e. g. Coratza and Giusti, 2005; Bruschi and Cendrero, 2005; Pralong, 2005; Serrano and Gonzalez-Trueba, 2005; Pereira et al., 2007; Reynard et al., 2007; Zouros, 2007). The analysis of these methods and their suitability for geotourism purposes was made by Kubalíková (2013).
The assessment of the geosites and geomorphosites in the Czech Republic using the geomorphosite concept was already done in several areas (e. g. Žďárskévrchy Protected Landscape Area, Podyjí National Park, Deblínskávrchovina highland), but this assessment was aimed mainly at the geoconservation purposes (e. g. Kubalíková, 2011;Kubalíková, Kirchner 2013). The assessment of the geosites and geomorphosites for geotourism purposes was not done yet; this paper presents both methodology and its application on the selected area (Vizovickávrchovina Highland, Eastern Moravia).

Methods

Geotourism can be understood at a broader sense as geographical tourism or tourism that sustains or enhances the geographical character of a place – its environment, culture, aesthetics, heritage and the well-being of its residents(Stueve et al., 2002; National Geographic Society, 2005). This concept is similar to the geomorphosite concept – it does not include only the abiotic features, but it takes into account so-called added values: ecological, cultural, historical and aesthetic (Panizza and Piacente, 2008; Reynard, 2008). In a more restricted sense, the geotourism is defined as a form of nature tourism that specifically focuses on landscape and geology (Dowling and Newsome eds., 2006; Dowling and Newsome eds., 2010) and that includes the provision of interpretative and service facilities for geosites and geomorphosites and their encompassing topography, together with their associated in-situ and ex-situ artefacts, to constituency-build for their conservation by generating appreciation, learning and research by and for current and future generations (Hose, 2012).

Both broader and more restricted definitions include some key features of geotourism. According to the National Geographic Society (2005), they are represented by *integrity of place, international codes, market selectivity and diversity, tourist satisfaction, community involvement and benefit, protection and enhancement of destination appeal, land use and planning, conservation of resources, interactive interpretation and evaluation*; according toDowling and Newsome eds. (2010): *geologically based, environmentally educative, tourist satisfaction, sustainable, locally beneficial*.

Based on these definitions and principles, a suitable method for assessing the geotourism potential should consider these groups of criteria:

- Criteria which consider an assessment of the scientific and intrinsic values (e. g. diversity, integrity, scientific knowledge of the site) – based on the principles *"geologically based*" and *"integrity of place"* and geology/geomorphology-oriented definitions of geotourism.
- Criteria which consider an assessment of the exemplarity and pedagogical potential of the site (e. g. exemplarity, availability of the products that support education: leaflets, trails, information panels) – based on the principles *"environmentally educative",* "*protection and enhancement of destination appeal* ", "*interactive interpretation and evaluation"*.
- Criteria which consider an assessment of the accessibility and the presence of tourist infrastructure– based on the principles *"tourist satisfaction", "locally beneficial", "market selectivity and diversity", "community involvement and benefit".* It is also a very important group of criteria as the new definitions and new approaches (Dowling and Newsomeeds., 2010; Hose, 2012) emphasize the involvement of local people.
- Criteria which consider an assessment of the existing threats and risks, assessing conservation activities or existing legislative protection of the site – according to the principle *"sustainable",* "*land use and planning"* and *"conservation of resources"*
- Criteria which consider an assessment of the added values (ecological, cultural, historic, archaeological, artistic, religious value of a site, aesthetic, landscape and scenic value) – according to the definition of the National Geographic Society (2005) the geotourism does not consider only the natural aspects, but also cultural and aesthetic aspects of the site.

Based on the analysis of the principles and definitions of geotourism (Stueve et al., 2002; National Geographic Society, 2005;Dowling and Newsome eds., 2006; Dowling and Newsome eds., 2010; Hose, 2012) and coming out from the already existing and used methods of geomorphosite assessment (Coratza and Giusti, 2005; Bruschi and Cendrero, 2005; Serrano and Gonzalez-Trueba, 2005; Pralong, 2005; Reynard et al., 2007; Pereira et al, 2007; Zouros, 2007), the method for assessing the geosites and geomorphosites for the geotourism purposes is proposed (see Table 1). To every criterion, a value from 0 to 1 is attributed. Some of the criteria are based on Kubalíková (2013).

Tab. 1: Proposed method for assessing the geosites and geomorphosites for the geotourism purposes(source: authors)

1. scientific and intrinsic values	1.a integrity, rarity and Earth-science importance of the site
	1.b scientific knowledge of the site
	1.c morphology, genesis, age, diversity ofthesite
2. educational values	2.a exemplarity and representativeness of the site, clarity and visibility of the features and processes
	2.b presence of educational facilities (leaflets, web pages, information panels, guidedtours)
3. economical values	3.a number, distance and quality of tourist services
	3.b accessibility
4. conservation values	4.a conservation activities (legal protection, other types of protection)
	4.b risks and threats to thesite
	4.c current status of thesite, the level of disturbance or degradation
5. added values	5.a cultural (historical/religious/archaeological) values
	5.b ecological value (relationships to livingnature)
	5.c aesthetic/landscape/scenicvalue

Study area

Vizovickávrchovina Highland is situated on the Eastern part of the Czech Republic on the border with Slovakia. Geologically it belongs to the Flysch complex of the Outer Western Carpathians. The area is a part of MaguraFlysch Belt (Rača tectonic unit) that is formed by alternating layers of claystones and sandstones of the Mesozoic and Tertiary age. The area is characterized by the largely dissected relief of highlands and mountain ranges with intervening deep valleys and basins (Czudek ed., 1972; Demek andMackovčin eds., 2006).

The studied area (see Figure 1) forms the north-eastern part of the Vizovickávrchovina Highland and it is called Komoneckáhornatina Mountains. The area is built by FlyschPaleogene rocks of Zlín Formation and Soláň Formation of the Rača tectonic unit of the MaguraFlysch Belt. The central part of the area is formed of the geomorphological district Klášťovskýhřbet Ridge which reaches the altitude around 700 m a.s.l. (Vrátnice 683 m, Krajčice 730 m, Kopce 699 m) and it is drained by the Senice River (left tributary of the VsetínskáBečva River). Bedrock consists mainly of coarse grained sandstones of Luhačovice member of Zlín Formation of the Maguranappe. The tectonic setting of these sediments forms a part of the Čertovykameny–anticlinal zone with the anticlinal position of Flysch strata. The different rock resistance and the conditions of the strata position influence the structural-denudational relief of the Klášťovskýhřbet Ridge which is represented mainly by the steep hillslopes, isolated boulder accumulations, landslides and sandstone outcrops where the large amount of the mezoforms and microforms can be seen (pseudokarst caves, honeycomb weathering etc.). At the alluvial plain of the Senice River, the typical fluvial features can be found (Kirchner, 2004).

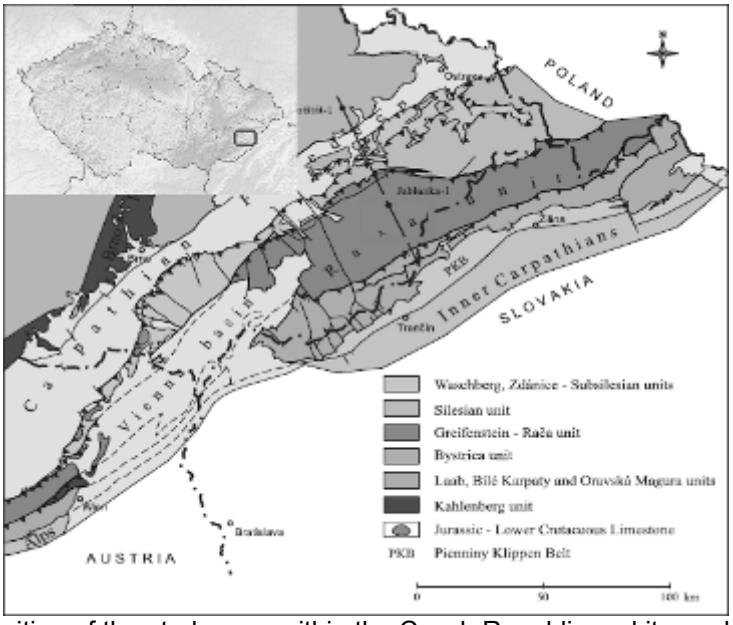


Fig. 1: The position of the study area within the Czech Republic and its geological context (adapted from the Czech Geological Survey).

Six sites were selected for the assessment and they represent the typical landform features of the area, localization of studied sites see at the Figure 2. Some of them are displayed at the Figure 3.

Site 1: Kopce -pseudokarst caves

The site is located in a landslide area and it includes both pseudokarst fissure caves and a rocky landslide (with dimensions of 200 x 250 m which is quite unique within the area) that are both of gravitational origin. There is 11 large pseudokarst caves created thanks to the deep seated landslide, the biggest of them reaches the depth of 14 m, another are around 7 – 10 m deep. The walls of the caves are covered by calcareous sinter. In the proximity of the caves there are some pseudo-sinkholes (maximal depth of 2 m) with an entry into the small debris cavern. The site has also a high added value due to the presence of the cultural-historic component (remnants of the Bronze Age settlement nearby, a quartz wall) and geomythological aspect (existence of various legends connected to the caves – especially about the treasures

hidden here by the bandits). As the caves are home to some species of the bats, the site has also a high ecologic value.

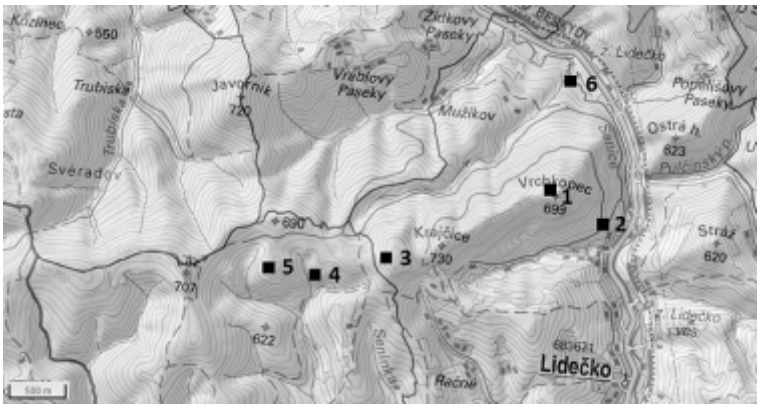


Fig. 2: Localization of the studied sites. 1 - Kopce- pseudokarst caves, 2 - Čertovyskály/Devil's rocks, 3 - Láz Hill, 4 - Horníškály Rocks, 5 - Dolníškály Rocks, 6 - Meanders of Senice River (map source -www1.cenia.cz)

Site 2: Čertovyskály (Devil's rocks)

The unique structural-denudation rocky wall is formed of the perpendicularly declined sandstone layers (Lower LuhačoviceMember of the Čertovykameny- anticlinal zone). The crag is divided into several regular thick-bedded sandstone blocks by the perpendicular fissures; along the system of the fissures some small pseudokarst caverns were formed. The total length of the wall is around 250 m, the height reaches 25 m. Its width in its upper part is around 3 m. The surface of this rocky rampart is covered by various microforms typical for sandstone weathering (honeycombs, tafoni, weathering pits). The site is protected by the law in the category of natural monument (the year of the declaration already in 1966). The cultural and historical aspect of the site is also very important – there are plenty of myths (mostly connected to the devil's activities) and aesthetical aspect of the site is also very significant (the wall dominates the surrounding landscape). The site is very often presented as typical site of the area and it is often presented in various tourist guides. It is also used by the climbers which brings some problems (the rope traces, surface abrasion).

Site 3: LázHill

An upper part of the southern structural – denudation slope of the elevation called Láz Hill has a character of the frost cliff (3 m high and 50 m long) and it is built by the rocks of the Lower LuhačoviceMember of the Čertovykameny – anticlinal zone (mostly quartzose sandstones). This natural outcrop was formed by cryogenic and gravitational processes and it exhibits many interesting weathering phenomena such honeycombs, weather pits and tunnels. The typical features for this site are the spherical cavities (maximal dimensions are 0,6 m in diameter, 0,35 m in depth). The cliff is divided by fissures in the north – south direction. Along these fissures, some deep clints were developed (maximal depth is 0,4 m, maximal width 0,6 m, length around 10 m). On the western part on the top of the frost cliff there are several weathering pits; the biggest is filled with water and it has a diameter of 0,6 m. On the eastern part of the cliff there is a tunnel leading into the rock (length of 3 m, diameter of 0,75 m). The nearly entire surface of the cliff is covered by the microforms of the honeycomb weathering. Thus, this site is very rich in the mezo- and microforms which represent its most valuable features (e. g. tunnel leading inside the cliff is a unique mezoform within the study area). From the geologic and educational point of view, the slope shows and documents the steep position of the LuhačoviceMember of the Čertovykameny – anticlinal zone.

Site 4: Horníškály Rocks

A morphologically significant frost cliff on the top of the VrátniceHill is developed on the forehead of the Paleogenequartzose sandstones and conglomerates of the Luhačovice Member of the Čertovykameny – anticlinal zone. The cliff is stretched in the north-eastern – south-western direction and it has a south-eastern exposition. Its length is around 90 m and the height up to 10,5 m. The cliff is divided into several blocks by fissures and the rock walls (which are partly pendent) are covered of the large number of the typical weathering microforms (especially honeycomb weathering), some of them have a character of tafoni with the depth of up to 0,5 m.

Other typical features are represented by the weathering pits with maximal diameter of 0,3 m and maximal depth of 0,25 m. On the base of the cliff, there are several niches (abri). Other important mezoforms of the site are represented by the pseudokarst cavern (depth 3,2 m, width 1,6 m, height 1,5 m) and cryoplanation terrace with blocks of sandstones. The site is used by the climbers, so it presents a source for recreational activities; on the other hand, the sandstones suffer from these activities.

Site 5: Dolnískály Rocks

A frost cliff on the lower part of the slope of VrátniceHill has a length of 70 m and its height oscillates between 6 and 14 m. The cliff was created by the cryogenic and gravitational processes; on the south-western part, there is an evidence of the influence of fluvial processes. The cliff is developed on the forehead of the Paleogenequartzose sandstones and conglomerates of the Luhačovice Member of the Čertovykameny – anticlinal zone and as the HornískályRocks site represents the typical steep position of the rocks. The cliff is exposed to the south-west and it is divided into several blocks by fissures and the rock walls (which are partly pendent) are covered of the large number of the typical weathering microforms (especially honeycomb weathering), some of them have a character of spherical cavities (or tafoni) with the depth of up to 0,7 m. The cavities are arranged along the main fissures and its large number makes this site unique within the area of interest. Other unique mezoform is represented by the small gorge (also unique in this area) developed on the south-western part of the site where the frost cliff meets the channel of the mountain creek.

Site 6: Meanders of Senice River

This site represents the fluvial phenomena within the study area and it documents an interaction between the vertical and lateral channel erosion and river channel migration. In the past, the alluvial plains were exposed to the human impacts, so they are relatively rare today. Especially valuable are the sections where the mountain river enters into the alluvial plain, it creates the initial turns and then starts to meander, but there still predominates side erosion and lateral shift of the river channel. The bedrock is constituted of the PaleogeneÚjezdMember where the sandstones and claystones predominate. The studied section is approximately 500 m long and here it creates the turns which pass to the meanders. An important and unique geomorphological feature of this site is the dynamic lateral erosion which undercuts the shores and then exposes the sediments. Regular natural flooding is also typical in this area; this processes influenced the water regime, soils and ecosystems in the alluvial plain. Thus, the site has also a relatively high ecological value. Within the site, the results of natural processes and different stages of the development of turns and meanders can be observed. Some morphologically remarkable mezoforms in the alluvial plain (e. g. remnants of the oxbow lakes or abandoned meanders) then prove the natural migration and shifting of the river channel in the past. This has a very high educational and scientific value (especially because of the possibility of palaeogeographic reconstructions).

Fig. 3: Selected geosites/geomorphosites: A – Čertovyskály/Devil's Rocks (unique structural-denudation sandstone outcrop with the perpendicular fissures), B – DolnískályRocks (typical weathering features as honeycombs and pits), C – Kopcepseudokarst caves (an entry to the one of the caves) (author: K. Kirchner, 2009).

Results

The above mentioned sites were evaluated using the method proposed above. It was supposed that the sites more suitable for geotourism purposes have to be both geologically/geomorphologically important and attractive from different point of view (historical, cultural, ecological etc.). The results are presented in the Table 2.

Tab. 2: The results of numerical assessment of the selected sites

Name of the site/ group of the values	Kopce pseudo karst caves	Čertovy Skály/Devil's rocks	Láz Hill	Horní Skály Rocks	Dolní Skály Rocks	Senice meanders
1. scientific values	2,75	2,25	2,25	2	2	2,5
2. educational values	1,75	2	1	1,5	1,5	1,75
3. ecomonical values	1	1	1	1	1	1
4. conservation values	2	1,5	1,25	1,75	1,75	1,25
5. added values	2	2,5	1	1,5	1	1,75
Total score	**9,5**	**9,25**	**6,5**	**7,75**	**7,25**	**8,25**

The highest scientific values were reached by the Kopcepseudokarst caves and the Senice meanders. It is especially thanks to the presence of the features that are rare within the area of interest (Kopce) and thanks to the presence of the actual processes (fluvial erosion at Senice meanders). Although the Čertovyskály/ Devil's rockshad a quite big score thank to the genesis and diversity of the landform, the integrity of the site was lower.

The highest educational value was reached by the Čertovyskály/Devil's rocksthanks to the both existence of the educational material and good visibility and clarity of the geosciences features. Other two sites were also evaluated quite well especially thanks to the exemplarity of the landform (Senice meanders – a possibility of the observing the natural fluvial erosion and typical fluvial landforms both in the channel and in the alluvial plain; Kopce – typical and well visible pseudokarst caves).

Economical value was the same for all the sites, because they are accessible by the tourist paths and the tourist infrastructure in the area is the same for all the sites as the study area is quite small.

The conservation value included both legal protection and possible threats to the site. Although the site Čertovyskály/ Devil's rocksis protected under the law, its score is not so high because of the climbing activities that disturb the site and also because of the larger number of the visitors that damage the outcrop. The site of Kopce is both protected by the law and there are not so intensive threats, so it reached the highest score. Relatively high score of the Horníškály Rocks and DolníškályRocks is given especially thank to the lower number of the visitors. Senice meanders reached relatively low score because of the presence of natural threats that can damage the site (on the other hand, these natural processes are the good educational source).

The highest added value was obtained by the Čertovyskály/Devil's rocks especially thanks to its geomythological aspect and a high aesthetical value. In the case of the Kopce site, the most important added values were represented by the ecological and historical values.

The highest total score was reached by the sites of Kopce, Čertovyskály/Devil's rocks and Senice meanders. These sites are not important only from the scientific point of view, but also they have the significant educational potential (Kopcesite and Senice meanders) and important added values (Kopce and Čertovyskály/Devil's rocks). On these examples can be seen that the sites suitable for the geotourism should be not only geologically and geomorphologically valuable, but they should include also some added values to be chosen as the possible sites for development of the geotourism.

Based on this assessment, some geotourism activities can be proposed (especially educational activities as the installation of the information panels, guided tours etc.)

Conclusions

Based on the analysis of the geotourism concepts and definitions and on the already existing geomorphosite assessment methods, the modified method for the geosite and geomorphosite assessment for the geotourism purposes was proposed. The assessment criteria were divided into five groups to cover all the key features of geotourism. The first group (scientific and intrinsic values) is based on the principles *"geologically based*" and *"integrity of place"* and geology and geomorphology – oriented definitions of geotourism. The second group of criteria

(educational values) comes out from the fact that most of the definitions of geotourism emphasize the educational issues; this group is based on the principles "*"environmentally educative",* "*protection and enhancement of destination appeal* ", "*interactive interpretation and evaluation".* The third group of criteria (economic values) considers the principles*"tourist satisfaction", "tourist satisfaction", "locally beneficial", "market selectivity and diversity", "community involvement and benefit".* The fourth group (conservation value) is based on the principles *"sustainable",* "*land use and planning"* and *"conservation of resources"* and partly on the geoconservation principles. The last group of the criteria (added values) comes out of the fact that geotourism does not consider only the natural aspects, but also cultural and aesthetic aspects of the site.

The method was firstly tested in the Vizovickávrchovina Highland to get the information about the geotourism potential of the selected sites. It was supposed that the sites that are geologically and geomorphologically important and that have also high added values (historical, cultural, ecological etc.) and educational potential are more suitable for the geotourism purposes and they are good for the future development for the educational activities.

Although the proposed method is numerical which should reduce the subjectivity, there is always a degree of subjectivity due to the fact that the real value of some criteria cannot be measured and it depends, for example, on assessor's experience, knowledge and preferences. So, the future improving and testing of the method is inevitable as well as the list of assessment criteria is not complete and it is a subject to further discussions.

References

BRUSCHI V. M., CENDRERO A., (2005). Geosite Evaluation; Can we measure intangible values? Il Quaternario - Italian Journal of Quaternary Sciences 18(1) - Volume Speciale, pp. 293-306.

CORATZA P. & GIUSTI C. (2005). Methodological proposal for the assessment of the scientific quality of geomorphosites. Il Quaternario, Italian Journal of Quaternary Sciences 18 (1), pp. 305-313.

CZUDEK T. ED. (1972): Geomorfologické členění ČSR. - Studia geographica 23, 1-140.

DEMEK J., MACKOVČIN P. EDS. (2006): Zeměpisný lexikon ČR: Hory a nížiny. Agentura ochrany přírody a krajiny ČR. 582 p.

DOWLING R., NEWSOME D. EDS. (2006). Geotourism. Elsevier. 260 p.

DOWLING R., NEWSOME D. EDS. (2010). Geotourism. The tourism of Geology and Landscape.

GRAY M. (2004). Geodiversity: Valuing and Conserving Abiotic Nature. John Wiley, Chichester, 434p.

HOSE T. A. (2012). 3G's for Modern Geotourism. Geoheritage 4 (1-2), pp. 7-24.

KIRCHNER, K. (2004): On distribution of slope deformations in the north-eastern part of the Vizovická vrchovina Highland in Eastern Moravia. Acta Universitatis Carolinae, Geographica, XXXIX (1), pp. 5-18.

KUBALÍKOVÁ L. (2011). Hodnocení geomorfologických lokalit v kontextu ochrany neživé přírody: případová studie ze západní části národního parku Podyjí a z okolí Maršovského žlebu. Manuskript. Geografický ústav PřF, Masarykova univerzita Brno. 147 p.

KUBALÍKOVÁ L. (2013). Geomorphosite assessment for geotourism purposes. Czech Journal of Tourism 2 (2), pp. 80-104.

KUBALÍKOVÁ L., KIRCHNER K. (2013). Relief assessment methodology with respect to geoheritage based on example of the Deblinska vrchovina highland. In Fialova J & Kubickova H. eds. (2013): Public recreation and landscape protection - with man hand in hand: conference proceedings, pp.131-141.

National Geographic Society (2005). Geotourism Charter. Retrieved 13th October 2012 from: http://travel.nationalgeographic.com/travel/sustainable/pdf/geotourism_charter_template.pdf

PANIZZA M. (2001). Geomorphosites: concepts, methods and example of geomorphological survey. Chinese Science Bulletin 46 – Suppl., pp. 4-6.

PANIZZA M. (2009). The Geomorphodiversity of the Dolomites (Italy): A Key of Geoheritage Assessment. Geoheritage 1(1), pp. 33-42.

PANIZZA M. & PIACENTE S. (2008). Geomorphosites and geotourism. Rev. Geogr. Acadêmica 2(1), pp. 5-9.

PEREIRA P. ET AL. (2007). Geomorphosite assessment in Montesinho Natural Park (Portugal). Geographica Helvetica 62(3), pp. 159-168.

PRALONG J. P. (2005). A method for assessing tourist potential and use of geomorphological sites. Géomorphologie: relief, processus, environnement 1(3), pp. 189-196.
REYNARD E. (2008). Scientific research and tourist promotion of geomorphological heritage. Geogr. Fis. Dinam. Quat. 31, pp. 225-230.
REYNARD E., CORATZA P., REGOLINI-BISSIG G. EDS. (2009). Geomorphosites. Verlag Dr. Friedrich Pfeil, Mnichov, 240 s.
REYNARD E. ET AL. (2007). A method for assessing the scientific and additional values of geomorphosites. Geographica Helvetica, 62(3), pp. 148-158.
SERRANO CAÑADAS E. & GONZÁLES-TRUEBA J. J. (2005). Assessment of geomorphosites in natural protected areas: the Picos de Europa National Park (Spain). Géomorphologie: relief, processus, environnement 1(3), pp. 197-208 .
STUEVE A. M. ET AL. (2002). The Geotourism Study: Phase 1 Executive Summary. National Geographic Traveller,Travel Industry Association of America.
ZOUROS N. (2007). Geomorphosite assessment and management in protected areas of Greece. Case study of the Lesvos Island - coastal geomorphosites. Geographica Helvetica 62(3), pp. 169-180.

Acknowledgements
This article was supported by long-term conceptual development support of research organisations RVO: 68145535.

Souhrn
Geoturismus je chápán jako udržitelná forma cestovního ruchu založená zejména na využívání geodiverzity, respektive geologických a geomorfologických lokalit. V širším smyslu lze do geoturismu zahrnout i aktivity, které se vážou ke kulturní, historické nebo ekologické stránce lokality. Ne všechny lokality však lze pro geoturistické účely využít. K ohodnocení potenciálu lokalit pro geoturistické účely byla na základě analýzy definic geoturismu a na základě analýzy metod používaných v rámci konceptu geomorphosites navržena upravená metoda, která umožňuje numerické hodnocení lokalit a jejich potenciálu. Hodnotící kritéria jsou rozdělena do pěti skupin v souladu se základními principy geoturismu: vědecké hodnoty, vzdělávací hodnoty, ekonomické hodnoty, ochranářské hodnoty, přidané hodnoty.
Metoda byla testována v atraktivním prostředí Vizovické vrchoviny, kde bylo vybráno šest lokalit reprezentujících typické geologické a geomorfologické prvky oblasti. Zahrnuty byly zejména tvary vzniklé gravitačními, kryogenními a fluviálními procesy (např. sesuvy, pseudokrasové jeskyně, skalní výchozy, mrazové sruby, meandry), významnou roli však hrály i mezoformy a mikroformy (voštiny, skalní mísy, drobné fluviální tvary v nivě). Bylo zjištěno, že vhodnější pro geoturismus jsou lokality, které vedle vysoké hodnoty geovědní mají i přidanou hodnotu, ať už se jedná o kulturní aspekty (např. existence pověstí), historické souvislosti (zbytky hradiště) nebo ekologickou hodnotu (výskyt chráněných druhů živočichů). Důležitou roli v hodnocení hrála i názornost tvarů a procesů a jejich viditelnost a zřetelnost. Na základě hodnocení může být navržen vhodný management lokalit a jejich racionální využití zejména pro vzdělávání.
Metoda jako taková je sice založena na kvantitativním hodnocení, což by mělo snížit subjektivitu, nicméně některá kritéria jsou stále těžko objektivně hodnotitelná, protože závisí jednak na zkušenostech a znalostech hodnotitele. Kritéria by tedy měla být dále diskutována a testována v dalších oblastech.

Contact
Doc. RNDr. Karel Kirchner, CSc.
Institute of Geonics, Academy of Sciences of the Czech Republic, v.v.i., Branch Brno
Drobného 28, 602 00 Brno
kirchner@geonika.cz
+420 545 422 730

HISTORICAL DEVELOPMENT IN FOREST ACCESSING

Petr Hrůza
Mendel University in Brno

Abstract
The forest road network is an integral part of the forest environment and the primary means for the forest management and it has its irreplaceable importance from the standpoint of recreational use and access to the landscape. The aim of this work was to assess whether and how the layout of forest roads has changed in relation to the density of forest road network and the gradual interconnection of settlements. For this assessment, maps of the area were created, specifically from the first half of the 19th century, the second half of the 20th century and the present day. Maps created by the 2nd Austrian-Hungarian military mapping, maps from the 1st Czechoslovakian military mapping and current maps of the Czech Republic were used. Thus we gained a temporal series of three map layers suitable for the analysis of the area using ArcGIS. Based on the analysis, we can say that access to the selected area was provided gradually, as regards gradual increase in the forest road density as well as reaching more distant parts of the area in relation to settlements. The layout of the forest roads constructed between 1826 and 1953 has not changed so a forest road once built seems to be a permanent construction in the landscape and the forest ecosystem.

Key words: forest road network, forest road network density, historical development

Introduction

To analyse the historical development of forest accessing, we selected the transport area "Žilůvecký potok" in the Training Forest Enterprise Masaryk Forest Křtiny in the cadastral area of Babice, Řícmanice and Kanice. The research plot has an area of 472.3 ha. Its forest roads represent the historical development of forest accessing and their variety characterizes the broad range of different surfacing methods. In these roads we can see the technology of corduroy roads as well as the technology of stone pitching - technologies were used in the 18th and 19th centuries, partially at the beginning of the 20th century. Further, the technology of bituminous surface, used in the second half of the 20th century, can be found in the plot as well as the currently used technology of mechanically reinforced aggregate (unbound mixtures - type 1) (Hanák 2002). The assessment of the historical development is based on the analysis detecting whether and how the layout of forest roads has changed in relation to the density of forest road network and the interconnection of the surrounding settlements. For this assessment, maps of the area were created, specifically from the first half of the 19th century, the second half of the 20th century and the present day. Maps created by the 2nd Austrian-Hungarian military mapping, maps from the 1st Czechoslovakian military mapping and basic maps of the Czech Republic were used. Thus we gained three map layers suitable for the analysis of the area using ArcGIS.

Materials and methods

The map used for the first historical layer was the imperial obligatory prints of the stable cadaster ordered by Francis I in his edict of December 23, 1817 for the purpose of just land tax assessment; the mapping of the cadaster in question was conducted in 1826. The data used for the second layer were the first aerial photos, obtained in the 1950s; the photos of the area in question were taken in 1953. The historical orthophotomap of the second layer was created by processing digital aerial photos from this period and is located in the CENIA map application. The map of the current state (year 2011), which forms the third layer for our analysis, was created by connecting and displaying the map layers in ArcGIS, from the CENIA portal, where the area orthophotomap was connected, and the map server of the Forest Management Institute. This map server provides map layers containing information on the forest road network from the Territorial Forest Development Plans.
Then a geodatabase was created in ArcGIS and the individual map layers were exported to it. Vector layers of the forest road network and forest boundaries were created in each of the map for the calculation of the forest road network density and analysis of the forest road network distribution in the accessed area. The density and the quality of the forest road network is an indicator of the forest managment progress. The density of forest roads is expressed as a ratio of the length of hauling roads in meters to the area to be accessed in hectares (Beneš 1986).

The forestry literature uses the density of roads as the basic criterion of forest accessing.

$$H_S = \frac{D}{S} \quad [m.ha^{-1}]$$

where: H_S - density of forest roads in m.ha^{-1}

D - road length in m

S - the area of the territory to be accessed

However, the density of the forest road network need not give information about the efficiency of the transport area accessing. If the forest road network is unsuitably distributed - forest roads are concentrated in a part of the area - the efficiency of the network is often low even with a high density. Therefore, we also analysed the distribution of the forest road network in the investigated area.

Results

Based on the analysis of the historical development of the area, we can say that the access to this transport area was provided gradually. The forest roads as we can see them today were not originally forest hauling roads serving for forest management purposes. Until 1826 they were built as links between municipalities. Their primary purpose was to connect the municipalities and forest management purposes were of secondary significance. The layout of the roads corresponds to this finding. They used simply accessible terrain and they represented the shortest possible link between the municipalities. The density of the forest road network was 8.6 m/ha. Only in the second half of the 19th century and the beginning of the 20th century, forest accessing gained significance. The density of the forest road network increased to 13.7 m/ha in 1953. The forest road layout met the needs of forest accessing based on a regular forest road network distribution within the forest stand. The original forest roads from 1826 were retained. In 2011 the forest road network density was 18.4 m/ha. Again, the forest road layout from 1953 remained unchanged; the forest road network was only extended to reach the areas that had not had access before and some forest roads gained status of 3rd class roads - district roads used as links between municipalities. These roads are not included in the calculations of the forest road network density any more. While between 1928 and 1953 the main focus was on new forest roads to be constructed, the period between 1953 and 2011 rather concentrated on the surfacing of the existing roads. A part of the forest road network that had originally been reinforced by stone pitching or corduroy in waterlogged places was then reinforced using unbound mixtures or bituminous surface. Currently, the trend of forest road surfacing continues using at least operational reinforcement or better, unbound mixtures – type 1. Only a few new forest roads are planned in the research plot as their current density approaches the demanded optimum density for uplands based on Beneš (1991) - 22 m/ha. The current state of forest accessing seems sufficient and the following forest road management will focus on maintenance, repairs, surfacing and an overall improvement of their parameters.

Conclusion

Based on the analysis we can say that a forest road once built seems to be a permanent construction in the landscape and the forest ecosystem. For this reason, it is important to devote maximum attention to the layout of forest roads and endeavour to include them in the forest ecosystem in a way that will ensure that the forest is damaged as little as possible. Further, it is necessary to meet the principles of layout designing mentioned below to include the forest roads in the landscape aesthetically.

Principles of the optimum design according to Beneš (1973):
a) the road layout should have at max. 10% longitudinal gradient;
b) if possible, the optimum longitudinal gradient of 5–8% should be designed;
c) the distance between hauling roads should not exceed 1000 m;
d) skid trails should be designed parallel to the contour line, if possible without a reverse slope
e) skid roads should not be constructed, except those that will be turned to hauling roads in the future;

f) the distribution of forest hauling roads in the accessed area should reach the maximum value of relative forest access, i.e. it should be as efficient as possible;
g) the forest area taken by forest roads should be as small as possible;
h) the forest road network should be designed to prevent forest soil erosion;
ch) the mean geometric skidding distance should be approximately the same (about 160 m) in all transport areas.

If these principles are met, forest accessing and construction of forest roads will be perceived by the public and forest visitors not only as a basic means for forest management but also as a positive activity leading to the usage of the roads for recreation purposes.

References

BENEŠ, J.: Vliv tvaru terénu na dopravní zpřístupnění lesa. In *Lesnictví*, 1973, vol. 19, no. 6, pp. 479-492.
BENEŠ, J.: *Předpoklady zpřístupnění lesa.* 1. ed. Brno: FOLIA VŠZ v Brně, 1986. 66 p.
BENEŠ, J.: Zpřístupnění lesů v pahorkatinách. In *Lesnictví*, 1991, vol. 37, no. 3, pp. 245-266.
HANÁK, K.: Zpřístupňování lesa: vybrané statě I. 1. ed. Brno: MZLU v Brně, 2002. 154 p. ISBN 80-7157-639-5

Souhrn

Lesní cestní síť je nedílnou součástí lesního prostředí, základním prostředkem k obhospodařování lesa a má svůj nezastupitelný význam i z hlediska rekreačního využití a celkového zpřístupnění krajiny. Cílem práce bylo posouzení, zda a jak se v průběhu vývoje tvorby lesní cestní sítě měnilo její trasové vedení v návaznosti na hustotu lesní cestní sítě a v návaznosti na postupné propojení sídelních útvarů. K tomuto hodnocení byly vytvořeny mapové podklady daného území, a to konkrétně z období první poloviny 19. století, z druhé poloviny 20. století a ze současné doby. Byla použita mapová díla 2. rakousko-uherského vojenského mapování, mapová díla 1. československého vojenského mapování a současné základní mapy České republiky. Tímto vznikla časová řada tří mapových vrstev pro analýzu řešeného území v počítačovém programu ArcGIS. Na základě provedeného hodnocení je možné konstatovat, že vybrané území bylo zpřístupňováno postupně, jak co se týká postupného zvyšování hustoty lesních cest, tak co se týká postupného rozložení cestní sítě do odlehlejších částí území ve vztahu k sídelním útvarům. Hustota lesní cestní sítě v roce 1826 dosahovala hodnoty 8,6 m/ha, v roce 1953 13,7 m/ha a v roce 2011 18,4 m/ha. Lze také konstatovat, že se trasy lesních cest vytvořených od roku 1826 nezměnily. Cestní síť byla pouze rozšířena do území, která ještě zpřístupněná nebyla a naopak, některé lesní cesty získaly díky dodatečným úpravám šířky a zpevnění statut silnic III. třídy, tzn. silnic sloužících k propojení obcí. Tyto postupně přestaly sloužit lesnímu hospodářství a nejsou již dnes do hustoty lesní cestní sítě, která patří vlastníkům lesa, započítávány. Na základě provedené analýzy je možné konstatovat, že jednou realizovaná stavba lesní cesty znamená z hlediska historického vývoje trvalý zásah do krajiny a lesního ekosystému, a proto je při jejím plánování nutné dbát na její vhodné začlenění.

Contact:
Doc. Ing. Petr Hrůza, Ph.D.
Department of Landscape Management
Faculty of Forestry and Wood Technology
Mendel University in Brno
Zemědělská 3, 613 00 Brno
Telephone: 00420 545 134 085, e-mail:petr.hruza@mendelu.cz

HISTORICAL WATER RESERVOIRS IN THE REGION OF BANSKÁ ŠTIAVNICA AND THE POSSIBILITIES OF THEIR RECREATIONAL, TOURIST AND EDUCATIONAL UTILIZATION

Matúš Jakubis
Technical University in Zvolen

Abstract
The report deals with the possibilities of the recreational, tourist and educational utilization of historical water reservoirs in the region of Banská Štiavnica (Central Slovakia) in Štiavnické vrchy Protected Landscape Area. In a relatively small territory of Banská Štiavnica and in its proximity is located a large number of interesting and valuable localities which can be the attraction for various recreational, tourist and educational activities for general public and the professionals, too. In the respect of recreation, tourism and education are particurlarly important the historical water reservoirs (called tajchs) in the region of Banská Štiavnica.The first of these water reservoirs (mining ponds) were built as early as 16th century and the last in the 19th century. Originally there were in this unique water – management system of 60 water reservoirs with total water supply of 7 million m^3. There are currently less than half of these water reservoirs. In the year 1993 was town Banska Štiavnica along with the technical monuments in the surrounding inscribed on the UNESCO World Heritage List.

Key words: mining ponds, protected erea, UNESCO

Introduction

In year 1993 was the historical town Banská Štiavnica and the technical monuments in the surrounding inscribed on the UNESCO World Heritage List. This area is located in Štiavnické vrchy Protected Landscape Area (Central Slovakia). In a relatively small territory of Banská Štiavnica and in its proximity is located a large number of interesting and valuable natural and cultural localities which can be the attraction for various recreational, tourist and educational activities for general public and the professionals, too.

Materials and methods

Štiavnické vrchy Protected Landscape Area (SV PLA) was declared in 1979 and covers an area of 76.630 hectares (ha). In this valuable and interesting field, there are **two National Nature Reserves** (Kašivárová – declared in 1926 with area of 49,80 ha and Sitno – declared in 1951 with area of 93,68 ha), **five Natural Monuments** (Sixova stráň - declared in 1985, Vhniansky travertín – declared in 1986, Žakýlske pleso – declared in 1986, Kapitulské bralá – declared in 1993, Putikov vŕšok – declared in 1997), **ten Natural Reserves** (Szaboóova skala – declared in 1907, Kamenné more – declared in 1923, Jabloňovský Roháč – declared iín 1950, Bralce – declared in 1965, Holík – declared in 1966, Holý vrch – declared in 1988, Kamenný jarok – declared in 1993, Krivín – declared in 1993, Kojatín – declared in 1997, Gajdošovo – declared in 2002), **four Protected Sites** (Arborétum Kyssihýbeľ – declared in 1950, Banskoštiavnická botanická záhrada – declared in 1958, Banskoštiavnická kalvária – declarted in 1986, Michalské rašelinosko – declared in 1997) and **nine Special Areas of Conservation** (Čajkovské bralie, Dolná Bukovina, Hodrušská hornatina, Klokoč, Sitno, Skalka, Stará hora, Suť, Tlstý vrch).
In the respect of recreation, tourism and education are particurlarly important the historical water reservoirs (called tajchs) around Banská Štiavnica. The first of these water reservoirs were built as early as 16^{th} century and the last in the 19^{th} century. Originally there were in this unique water – management system of 60 water reservoirs with total water supply of 7 million m^3. There are currently less than half of these water reservoirs. The essencial characteristics of the most important water reservoirs in the region of Banská Štiavnica are in the Table 1. The most attractive four tourism and recreation is water reservoir Počúvadlo (Fig. 1, Fig. 2., Fig. 3 and Fig. 4).
The historical unique water management system around Banská Štiavnica has more interestings. The first of these is the location of water reservoirs in the higher parts of valleys at higher altitudes. Another rarity is a mutual coupling of these water reservoirs through the connecting water ditches, tunnels and shafts. Unique is resolved the water supply of the reservoirs through the collecting ditches from the forest ecosystems around the ponds. Water into the reservoir can be supplied from another watersheds, too etc.

Recreational, tourist and educational utilization of the area

The possibilities of recreational, tourist and educational utilization of this area are very large. In the region are great options of accommodation and catering for demanding and less demanding customers.

a) Recreational utilization

In the region of Banska Štiavnica are various options of summer and winter recreation. In the summer there are the possibilities of bathing and various water sports in the water reservoirs. In the winter there are various recreational sports (alpine skiing, cross-country skiing, ski tourism etc). Near the town Banská Štiavnica are open all year round famous therapeutic spa Sklené Teplice with thermal springs and summer outdoor swimming pool for general public which is a favourite place for recreation. Very interesting and often visited is therapeutical bath with thermal water – the cave spa, called Parenica, is quite a rarity in Europe.

b) Tourist utilization

The surroundings of town Banská Štiavnica are magnificient for tourism in evera season of the year. The landscape in the region of Banská Štiavnica is ideal for tourism – walking and biking. In the region there are tens of kilometers of walking trails and more than 200 km of trails for mountain biking. The region has many interesting natural and technical atractions for tourists. Marked hiking trails linking various interesting sites and attractions.

c) Educational utilization

These valuable localities can be used for education for all levels of schools. Main topics of the educational utilization we mean a particular focus on forestry, water management, landscape protection and nature conservation. Proposed topics for education are:

- Origin and history of mining and forestry university studies
- Man and water
- Forest ecosystem and water
- Forest and water quality
- Hydrologic efficiency of forest ecosystem
- Watersheds management
- Water resources and management in the landscape
- Small water reservoirs construction
- Riparian stands of water reservoirs
- UNESCO World Heritage List
- Landscape protection
- Nature conservation
- Protection of flora and fauna
- Recreation, tourism and nature and landscape protection hand in hand

Fig. 1: In the region there are many possibilities of accommodation - Hotel Topky Počúvadlo (Source: author´s archive)

Fig. 2: Small wooden recreational objets in riparian stands on the banks of the water reservoir Počúvadlo (Source: author´s archive)

Fig. 3: Safety stone weir of the water reservoir Počúvadlo (Source: author´s archive)

Fig. 4 : The surrounding area of the water reservoir Počúvadlo and others reservoirs is a suitable environment for various species of animals (Source: author´s archive)

Recreational potential of the region

According to the methodology specified by BÍNA (2002) was informative determined the recreational potential of this region. Author evaluates the recreational potential in three levels according to the terms of localization of components of tourism. The highes possible point value of the recreational potential according to this method ranges by the level of conditions from 115 to 499. Evaluated region has the total number points of 359 which is a very high rating.

Conclusion

The region of Banská Štiavnica may serve as a good example of connection of recreational, tourist and educational use of the landscape and nature and landscape protection - hand in

hand. Banská Štiavnica´s history has shown the world, through some classical examples how water could be managed in a very sustainable manner during a time when there was complicated hydrological and landscape conditions. The history of water reservoirs around Banská Štiavnica paved the way in knowledges about hydrology, forest hydrology and management of water in the landscape

Tab 1: Most important water reservoirs in the region of Banská Štiavnica

Ser. No.	Water reservoir	Constructed	m a.s.l.	Dam (m)			Max. depth (m)	Volume (1000 m^3)
				Lenght	Width	Height		
1.	Bakomi	1735-1737	711,3	113,8	13,3	15,6	14,4	160
2.	Banky	before 1770	663,3	78	1,2	7,2	9,4	10,4
3.	Belianska	before 1747	556,8	130	9	19	18	146,3
4.	Červená studňa	1759	787,1	100	5	9	8,1	55,7
5.	Evička	1638	662,8	165	12,5	11,4	10,4	97,1
6.	Halčianska	before 1770	472,4	123	8,6	11,5	10,5	245,7
7.	Hodrušská dolná	1743-1744	528,2	199,1	5,7	21,7	20,3	432
8.	Klinger	1829-1833	682,8	127,1	6,3	22,4	21,3	132
9.	Kolpašská veľká	1730-1731	598,5	182,1	20,9	14,2	13,5	721
10.	Kolpašská malá	1763	598,5	79,9	15,2	6,8	6,6	107,4
11.	Komorovská dolná	before 1742	500,0	30	2	3	2,5	2,5
12.	Krechsengrund	1735-1737	740,0	45	3	7	6	5
13.	Michalštôlnianska	before 1651	650,0	25	2	3	5	2,4
14.	Moderštôlnianska	1740-1734	630,2	138	1,2	16,6	9,4	52
15.	Ottergrund	1751	801,3	43,6	5,3	7,2	6,6	25,3
16.	Počúvadlo	1775-1779	677,6	195,3	19	29,6	20	922,3
17.	Richňavská veľká	1738-1740	725,5	568,9	24,7	23,4	21,1	769,9
18.	Richňavská malá	1746	725,5	187,8	6,3	17,3	16,5	26,5
19.	Rozgrund	1743-1744	703,8	138,4	7,6	27	22,3	575,7
20.	Vindšachtská veľká	1712-1715	687,5	231,7	14,5	15,2	14,2	305,8
21.	Vodárenská veľká	1510	704,5	87	18	10	8,5	22,9
22.	Vodárenská malá	before 1551	733,5	20	5	9	8	5,3

References

BÍNA, J. 2002: Hodnocení potenciálu cestovního ruchu v obcích České republiky. Urbanizmus a územní rozvoj, V (1), pp. 2 – 11.

JANSKÝ, L., JAKUBIS, M. 2005: The mining ponds of Banská Štiavnica: Large-scale technology transfer 300 years ago. Tokyo, New York: United Nations University, p. 13 – 19.

KLADIVÍK, E., KLADIVÍK, P. 2005: Water reservoirs round Banská Štiavnica. Banská Bystrica: KB press, s. r. o., 12 p.

LICHNER, M. A KOL. 1997: Banskoštiavnické tajchy. Banská Bystrica: Harmony, 111 s.

LICHNER, M. A KOL. 2005 : Banskoštiavnické tajchy. Banská Bystrica: Harmony, 127 s.

EAGLES, P. F. J., MCCOOL, S. F., CHRISTOPHER, D. A. 2002: Sustainable Tourism in Protected Areas: Guidelines for Planning and Management. Gland, Switzerland, Cambridge, UK: IUCN Publication Servis Unit, xv + 183 pp.

JAKUBIS, M., RUSKO, I. 2003: Návrh využitia edukačného potenciálu vybraného územia Národného parku Veľká Fatra prostredníctvom náučného polygónu. Acta Universitatis Matthiae Belii, Séria environmentálna ekológia, roč. IV/V., (1), pp. 5–21.

JAKUBIS, M., JAKUBISOVÁ, M. 2010: Návrh revitalizácie, rekreačného a edukačného využitia Komorovských jazier v katastrálnom území Banská Štiavnica. In: Fialová, J. (ed.): Rekreace a ochrana přírody. Zborník z konferencie. Brno: LDF MZLU, pp. 92 – 95.
JAKUBIS, M. 2011: Návrh turisticko-edukačného polygónu v Národnom parku Veľká Fatra. In: Fialová, J. (ed.): Zborník referátov vedeckej konferencie Rekreace a ochrana přírody – ruku v ruce. Brno: MZLU, FLD, pp. 88-90.
JAKUBIS, M., JAKUBISOVÁ, M. 2012: Návrh edukačno – ekoturistického polygónu v Račkovej doline (Západné Tatry) v Tatranskom národnom parku. In: Fialová, J. (ed.): Rekreace a ochrana přírody. Zborník z medzinárodnej vedeckej konferencie. Brno: LDF MZLU, pp. 58-62.
JAKUBISOVÁ, M. 2013: Proposal of educational touristic polygon for visitors with dasabilities in protected site Borova Hora Arboretum. In: Fialová, J., Kubíčková, H. (eds.): Public recreation and landscape – with man hand in hand, Conference Proceeding, Brno: Mendel University in Brno, p. 115-120.
JAKUBISOVÁ, M. 2014: The Proposal of recreational and educational trail for disabled people in wheelchair arend the historici water reservoir Počúvadlo. In: Fialová, J. (ed.): Public recreation and landscape – with man hand in hand...., Conference Proceeding, Brno: Mendel University in Brno, in press.
PRICE, M.F., MOSS, L. A. G., WILIAMS, P. W. 1997: Tourism and amenity migration. In: Messerli, B., Ives, J. D. (eds.): Mountains of the World – A Global Priority. New York, London: The Parthenon Publishing Group, pp. 249-280.
WOOD, M. E. 2002: Ecotourism: Principles, Practices & Policies for Sustainability. Paris: UN Environment Programme Division of Technology, Industry and Economics, Burlington: The International Ecoturism Society, pp. 32.

Souhrn
Příspěvek poukazuje na široké možnosti rekreačního, turistického a edukačního využití historických vodních nádrží (tajchů) v regionu Banské Štiavnice (střední Slovensko) v chráněné krajinné oblasti Štiavnické vrchy (CHKO SV). Město Banská Štiavnica bylo v minulosti známé především hornickou činností s těžbou zlata, stříbra, mědi atd. Nachází se přibližně uprostřed CHKO SV, která byla vyhlášena v roce 1979 a má rozlohu 76 630 ha, resp. v geomorfologickém celku stejného názvu na středním Slovensku. Na relativně malém území Banské Štiavnice a v jejím blízkém okolí se nachází velké množství zajímavých a cenných lokalit, které mohou být atraktivní pro různé rekreační, turistické a vzdělávací aktivity pro širokou veřejnost a odborníky. Vzdělávací aktivity, zejména se zaměřením na lesnictví, vodní hospodářství, ochranu přírody a krajiny, jsou vhodné pro všechny stupně škol. Na území CHKO SV se nacházejí dvě národní přírodní rezervace (Kašivárová a Sitno), pět přírodních památek (Sixova stráň, Vyhniansky travertín, Žakýlske pleso, Kapitulské bralá, Putikov vŕšok), deset přírodních rezervací (Szabóova skala, Kamenné more, Jabloňovský Roháč, Bralce, Holík, Holý vrch, Kamenný jarok, Krivín, Kojatín, Gajdošovo), čtyři chráněné areály (Arborétum Kysihýbeľ, Banskoštiavnická botanická záhrada, Banskoštiavnická kalvária, Michalské rašelinisko) a devět území evropského významu (Čajkovské bralie, Dolná Bukovina, Hodrušská hornatina, Klokoč, Sitno, Skalka, Stará hora, Suť, Tlstý vrch). V souvislosti s rekreačními, turistickými a vzdělávacími aktivitami jsou zvlášť významné historické vodní nádrže (tajchy) v regionu Banské Štiavnice. První z těchto nádrží byly vybudovány již v 16. století, poslední v 19. století. Z nádrží postupně vznikl celosvětově unikátní vodohospodářský systém se 60. nádržemi a objemem zadržených vody 7 milionů m^3. Voda v nádržích sloužila jako zdroj energie pro stroje na odčerpávání vody ze zaplavených dolů, ale i pro jiné účely. Vodohospodářský systém má mnoho jedinečných řešení, mezi které patří umístění nádrží ve vyšších částech dolin ve vyšších nadmořských výškách, vzájemné pospojování některých nádrží vodními příkopy, zásobování nádrží vodou pomocí sběrných struh z lesních ekosystémů, možnost přítoku vody do nádrží i z jiných povodí atd. Do současnosti se zachovala necelá polovina z uvedeného počtu nádrží, které mají dnes převážně rekreační využití. V roce 1993 bylo město Banská Štiavnica a technické památky jejího okolí zapsáno do Seznamu světového kulturního a přírodního dědictví UNESCO.

Contact:
prof. Ing. Matúš Jakubis, PhD.
Technical University in Zvolen, Faculty of Forestry
Department of Forest Harvesting, Logistics and Amelioration
T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic
Phone: +421 45 520 6272, e-mail: jakubis@tuzvo.sk

CHANGES OF RECREATIONAL HIGH MOUNTAIN LANDSCAPE ENVIRONMENT IN THE SELECTED AREA OF BELIANSKE TATRY MTS. IN 1949-2013

Martin Boltižiar
Constatantine the Philosopher University in Nitra

Abstract
The paper is focused on mapping, analyse and evaluation of the landscape structure changes in high-mountain environment within 50 year time period, with a special respect on subalpine and alpine belt of the selected part of the Predné Meďodoly valley in the Belianske Tatry Mts., belonging to the Tatra National Park. The territory was strongly influenced by humans till 1954, especially by means of cattle and sheep grazing and also toutists activities. The aim was to record changes in the landscape in two time series, starting since the year 1949 and 2013, as well as to evaluate them qualitatively and quantitatively. Another aim was to analyse causes of these changes with the exploration of human and natural factors as well. For this purpose a set of aerial photographs scanning the study area, namely from the year 1949 and 2013, was used and processed by GIS tools. The map outputs were processed digitally in vector format at the large-scale 1:1500.

Key words: landscape changes, tourist activities, high-mountan landscape, Belianske Tatry Mts.

Introduction

Landscape as an open system, created by synergy of natural as well as anthropogenic factors, belongs in the last decades among important objects of landscape-ecological research. However, this phenomenon is under continual development and changes, so it is difficult to specify his latent state. According to Feranec et al. (1997) the analysis of landscape changes is especially important from the viewpoint of evaluation of natural as well as socio-economical processes, their dynamics, reasons and stability of up-to-date state, but above all of possible trends of further development. Land use by humans means always its certain destabilisation. This phenomenon is strikingly observable not only in the most intensively used parts of the Slovak lowlands, but also in such types of landscape where as a consequence of historical but partly also current anthropogenic impact we observe during the last 50 years relatively increased intensity of changes of various elements of landscape structure. To a such type of landscape we range also the Tatra high-mountain landscape where environment above the upper timber line have been in the past commercially used (mining activity, pastures, logging of dwarf pine to gain tanin oil a.o.) till the declaration of the Tatra National Park (TANAP). The landscape is currently used only for recreation.

Landscape structure (LS – meant as secondary landscape structure) is composed of landscape elements – basic spatial and at the same time mapping units. According to a methodology of landscape planning LANDEP (Ružička, Miklós, 1982) elements are selected following the way of lands use and in the case of high mountain landscape primarily on the base of characteristic physiognomy. Considering analogy of LS with land cover, besides physiognomic there is significant also visible morpho-structural (content) character or biophysical substance.

In this paper we are giving partial results of mapping and evaluation of changes of landscape structure of high mountain landscape in the selected part of the Predné Meďodoly valley in the Belianske Tatry Mts, belonging to the TANAP. The aim of this work is to map and evaluate state of landscape elements in this area in the past as an example of disturbed landscape (pastures and with it connected drastic intervention into landscape structure) and to compare it with the current state. Aerial photos from two time periods (1949, 2013) are used for interpretation of LS changes (dynamics).

Materials and methods

Parts of current development in the field of geoinformation technology are remote sensing (RS) and geographic information systems (GIS), which belong to the most progressive alternatives of mapping of LS and its changes in different scales – from global to local (Feranec et al., 1997). Its particular manifestation are mapping and multitemporal analysis applied in works of different scales and orientation (Falťan et al., 2011, 2000; Feranec, Oťaheľ, 2001; Feranec et al., 1996, 1997; Lipský, 1995; Olah, 2003, Oťaheľ et al., 2003, Michaeli, Ivanová, 2005 e. g.)

Preparatory stage included obtaining and study of aerial photos as well as preliminary recognoscation of terrain. Production of large-scale thematic maps of LS of study area was carried out by PC software Arc GIS 10.2 and included following operations:

• preparation of aerial photos and georeference of image from 1949 in module ERDAS Imagine 8.3 module Orthobase.
• identification of individual classes of LS by means of analogue (visual) interpretation of aerial photos
• digitising of spatial data by method „on screen" – creation of thematic maps of LS (1:1500) from 1949 and 2013
• creation of flexible database, in which are saved all relevant information and which will enable to realise all further needed operations
• evaluation of LS changes by overlay method and comparing of vector thematic maps from individual time periods and subsequent statistic processing
• creating of database of changes of individual classes of LS (1949-2013) and its statistic(numeric and graphic) analysis
• cartographic figuration of information layers in analogue output form – thematic maps of LS from 1949 and 2013.

In 1949 was the whole territory of Slovakia taken aeril photographs by the Army of the SR. The so far last scanning of the Tatra area in 2013 was carried out by company EUROSENSE Ltd. Bratislava. As a result there are vertical aerial orthophotos at scale from 1:10 000 to 1:15 000 Individual homogeneous classes (their patterns) of LS were identified by analogue (visual) interpretation of the photos. The smallest identified polygon has area 5 m^2. Digitisation of spatial data – individual elements of LS was carried out manually by method „on screen" at scale 1:1000 to 1:1500, because aerial photos from both time periods present very high resolution and thereby also good readability. Resultant vector maps of LS are at scale 1:1500 (Fig. 3, 4) without any generalisation, while readability of map is sufficient. Thereby we pursue maintenance of the all spatial attributes of LS, respectively its individual elements. We ranged them into 7 classes: scrub, dwarf-pine stands, tallus-herbaceous stands, debris cover, rocks, disturbed areas, water areas and settlements (huts, sheepfolds). Content characteristics of the majority of the classes is obvious, so we won't deal with it in more detail. We will focus only on the class of disturbed areas – we mean by them physiognomically remarkable areas (in terrain as well as on panchromatic or infrared photo), that differ also morphostructurally from other classes mainly by different composition. According to works of Midriak (1972) they are mainly uncovered soil-mantlerock stricken by various types of destruction, which arose under influence of anthropozoogenic factors as well as by intensive activity of natural geomorphic processes in extreme environment of Tatra high mountain landscape (avalanches, debris shift, eolic, nivation and fluvial erosion a.o.).

By evaluation of changing landscape structure we used method „overlay" of creating thematic maps from individual time periods on the basis of analysis and comparation of areal changes (in ha and %) of individual landscape structure clasess and present results through GIS in map and numeric (statistic) form together with brief evaluation of landscape development in context of socialohistorical changes.

In this paper we are giving just partial results of analysis and evaluation of changes of landscape structure (1949-2013) in chosen square (80 ha), that part of studied territory - south slopes under Zadné Jatky (2019.8 m.n.m) and Predné Jatky (1950.4 m.n.m.)

We registered changes of landscape elements also by direct methods, concrete throught interpret schemes, which we found out by comparation by historical and present terrestrial photos and by their evaluations with the help of graphic programms.

Results

Landscape structure till 1949

From the very beginning had smooth south slopes of Belianske Tatry attract attention because of their great condition for pasture. By Holub-Pacewiczowa (1931) were here from 13th century pastures. It existed here several sheepfolds (in Predné Meďodoly valley: 3 Belianske, 3 Kežmarok, 1 Rakusy). Here has been mostly grazed sheep, cattle, but also horses and sows. From those days became to expressive changes of land structure and area of individual elements. It was influence of deforestation, wood-cutting, burning of dwarf-pine (lowering of upper timberline for about 200-300 m) because new pastures, new paths for people, sheep,

cattle and the obtaining of tanin oil. This is why the area expressive lowered at the other hand erosion accelerated and also arised new disturbed areals, which were influenced with different forms of destruction (by water, wind, frost and so on). Deforestation in a upper timber-lines had influence on more frequency avalanches. Pastures had influence on changes of species composition of talus-herbaceous stands (Šmarda, 1963). It came to arise of sheep paths and dense network of paths in the surroundings of watering places and to trampling of soil. This state was lasting until year 1954, when was pasture in TANAP forbiden. In this year was for example by Harvan (1965) 1970 sheep on south slopes of Belianske Tatry grazed.

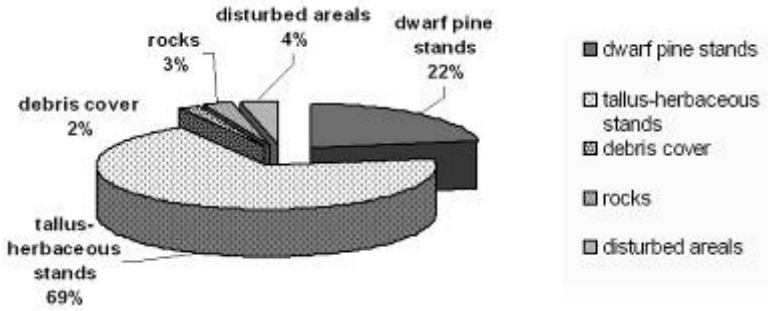


Fig. 1: Graph of classes area (in ha) in the selected part of Predné Meďodoly in 1949

Another factor that influenced landscape structure from 15th century was mining (copper, silver, gold). That also played role in destruction of surface (vegetation and soil), especially in area of Kopské saddle (south-east slope of Jahňací peak, Belianska kopa peak) Jatky peak.
During few centuries until of establishing of TANAP economical human interests without respect of natural laws, caused extence of changes. Intensity of anthropogeneous influence as follows changed the whole character of Belianske Tatry landscape.
By visual and following statistic analysis of chosen square in thematic maps of landscape structure from 1949 (Fig. 1, 3) we came to these conclusions. The biggest part took talus – herbaceous stands areas (69 %). They covered more than half of selected area. Relatively big area took dwarf-pine stands, respectively rest of them (22 %). Much smaller area (under 10 %) took rocks (3 %) and disturbed areals, which arise was mostly conditioned by sooner mentioned factors (4 %). Smaller parts took debris talus (to 2 %).

Changes of landscape structure in 1949-2013
Landscape structure of Belianske Tatry Mts, respectively arranging of landscape structure elements in last century was determined by a lot of natural and partly also anthropogenic factors. After the pastures were in 1954 prohibited started the stands to regenerate and come to native communities. But a lot of native communities were replaced with poor secondary stands. Natural succesion of dwarf-pine and also her planting on several places caused again incease of ecological stability of landscape system and deceleration of destruction processes.
At present (2013) in our researched square is area of dwarf-pine stands (30.2 ha – that is 38 % of our analysed square.) (Fig. 2, 4, 5). Change opposite to year 1949 makes 13 ha, which is biggest difference from all observationed classes. Area of talus – herbaceous stands had lessed 10 ha and has value 45.5 ha (56 %). Like a consequence of succesion proceses of vegetation had debris cover class lessed 0.1 ha. Area of rocks formations did not change, they are relatively the most stable element of our area. Very favourable is, that for the area of disturbed areals had lessed for 3% (2 ha). Part of it is consequence of economical utility and also of negative influence of hiking, for example destroying paths and as follows quiclier erosion and big changes in vegetation (Barančok, 1996).
Landscape structure at present is not constant. There are unconstitutional changes in time, that depend on changing of seasons, but also on phenomena of absolute altitude and with it connected phenomenous (temperature, precipitation, evolution of soils, changes of relief and e.g.). By our present terrain observations plays the key role geomorphic processes (Hreško, Boltižiar, 2001), that have not long-termed character, but strong relative short-termed morphodynamic disturbations (avalanches, debris flows). Landscape structure is so in state of dynamic stability, this means, that it is an object of two against each other comming powers – evolution and disturbation (Forman, Godron, 1993).

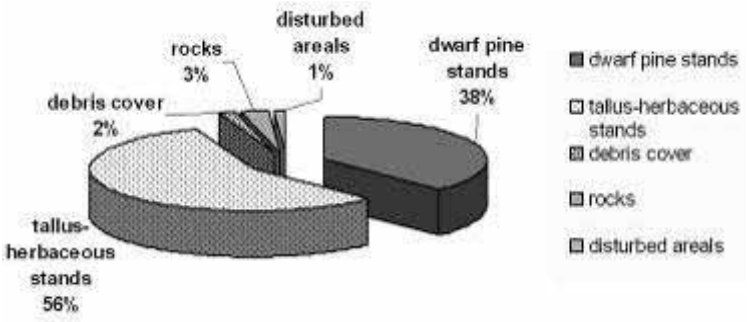


Fig. 2: Graph of classes area (in ha) in the selected part of Predné Meďodoly in 2013

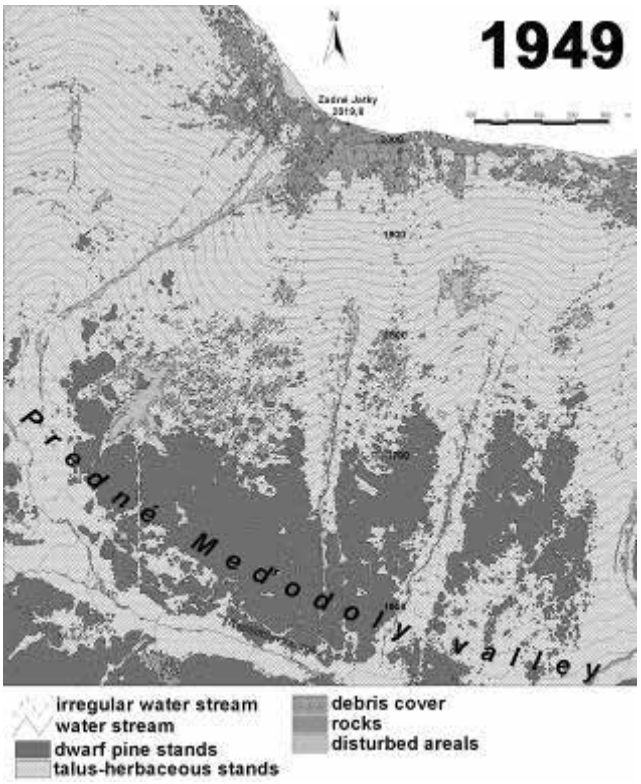


Fig. 3: Map of landscape structure in the selected part of Predné Meďodoly in 1949

Conclusion

The aim of this paper was to document possibilities that come with used of historical and present aerial photos, that can be used for identification of landscape by application of GIS and to present them in forms of large scale thematic maps (1:1500), tables and also in graphic forms.

Analysis of landscape structure changes, maps from this analysis and also statistic evaluation document expressive dependence between individual classes (especially vegetation) and socialoeconomical interests (mining, pastures), socialoegislation changes (establishment of TANAP) and also with natural factors influence-geomorphic processes. This type of analysis helps by respecting of landscape structure-ecological principles, to improve solitude of high mountain Belianske Tatry landscape. In this sence can information from this research bring important contributions for development, management and planning.

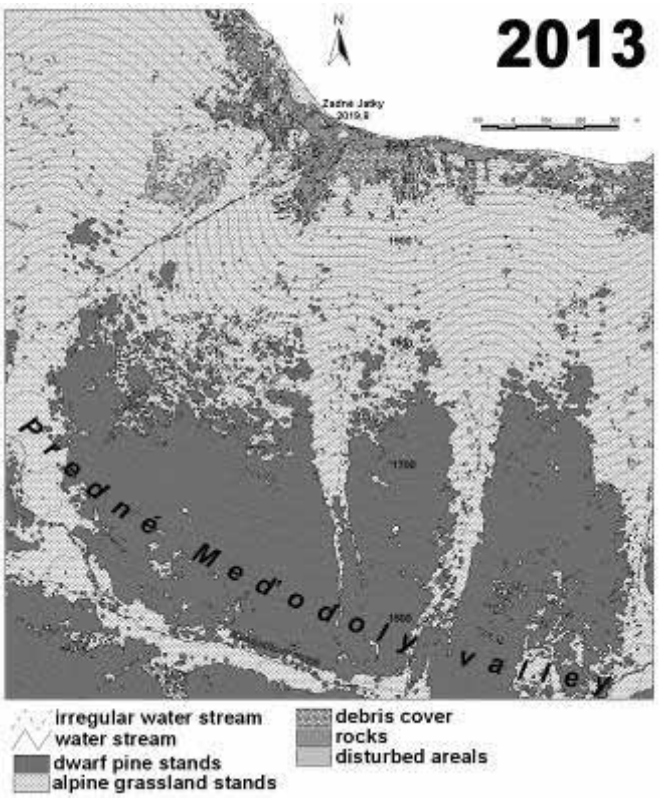


Fig. 4: Map of landscape structure in the selected part of Predné Meďodoly in 2013

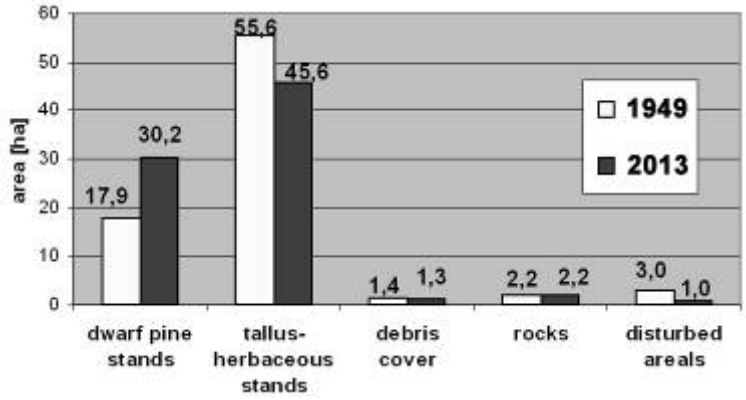


Fig. 5: The comparison between year 1949 and 2013

References

Barančok, P., 1996: Zmeny v zastúpení vybraných druhov rastlín na zošľapávaných miestach okolia turistického chodníka v Belianskych Tatrách (in Slovak). In: Plant Population Biology IV, ELIÁŠ, P. (ED.). Bratislava: SEKOS pri SAV, p. 90-93.

FALŤAN, V., BÁNOVSKÝ, M. & BLAŽEK M. 2011: Evaluation of land cover changes after extraordinary windstorm by using the land cover metrics: a case study on the high Tatras foothill. Geografie, 116(2), 2011. 156–171.

FERANEC, J. ET AL., 1997: Analýza zmien krajiny aplikáciou údajov diaľkového prieskumu země (in Slovak). Geographia Slovaca 13. Bratislava : Geografický ústav SAV, 64 pp.

Feranec, J., Oťaheľ, J., 2001: Krajinná pokrývka Slovenska (Land cover of Slovakia) (in Slovak). Bratislava: VEDA, 124 pp.

FORMAN R. T. T., GODRON, M., 1993: Landscape ecology (in Czech). 1. vyd. Praha: Academia, 583 s.

HARVAN, L., 1965: Ako sa vyriešila pastva v TANAP (in Slovak). In: Zborník prác o TANAP 8, Martin: Osveta, p. 231-253.

HOLUB-PACEWICZOWA, Z., 1931: Osadnictvo pastierskie i wedrówki v Tatrach i na Podtatrzu (in Polish). Práce komsii geograficznej Nr.1, Kraków: NPAU, 508 pp.

HREŠKO, J., BOLTIŽIAR, M., 2001: The influence of the morphodynamic processes to landscape structure in the high mountains (Tatra Mts.). Ekológia (Bratislava), roč. 20, Supplement 3, p. 141-149.
LIPSKÝ, Z., 1995: The changing face of the Czech rural lanscape. Landscape and urban planning, 31, p. 39-45.
MIDRIAK, R., 1972: Deštrukcia pôdy vo vysokohorskej oblasti Belanských Tatier (in Slovak). Lesnícke štúdie 11-12. Bratislava: Príroda, 207 p.
MICHAELI, E., IVANOVÁ M. 2005. Regional geoecological structure of landscape and primary development potential of the Prešov self-governing region (in Slovak). Folia Geographica, 18(8), s. 116-142.
OLAH, B., 2003: Vývoj využitia krajiny Podpoľania – Starostlivosť o kultúrnu krajinu prechodnej zóny BR Poľana (in Slovak). Vedecké štúdie 1/2003/B. TU Zvolen, Zvolen, 111 pp.
OŤAHEĽ, J. ET AL., 2003: Mapovanie zmien krajinnej pokrývky aplikáciou databázy Corine Land Cover (na príklade okresu Skalica) (in Slovak). In: Kartografické listy. Kartografická spoločnosť SR a GÚ SAV, Bratislava. Vol. 11, p. 62-73.
RUŽIČKA, M., MIKLÓS, L., 1982: Landscape ecological planning (LANDEP) in the process of territorial planning. In: Ekológia (ČSSR). roč. 1, č. 3, s. 297-312.
ŠMARDA, J., 1963: Druhotné spoločenstvá rastlín v Tatranskom národnom parku (in Slovak). Bratislava: Šport, 219 pp.
PUCHEROVÁ, Z. 2004. Development of land use on the boundary of Zobor and Žitava hilland (on example of selected villages). Nitra: UKF, 2004. (in Slovak).
SOLÁR, V. 2012. Changes of the city of Poprad from the point of view of landscape structure. In H. Svobodová (ed.). Proceedings of 19th International Conference Geography and geoinformatics: Challenge for practise and education Brno, 2012. pp. 19-24.
ŠOLCOVÁ, L. 2012. Development of the landscape with the dispersed settlements in Novobanska stalova area. Nitra: UKF, 2012 (in Slovak).
VOJTEKOVÁ, J. 2013. Trends in development of mining landscape in the upper Nitra region. Nitra: UKF, 2013 (in Slovak).

Acknowledgement
The paper was supported by project of Slovak Research and Development Agency APVV No. SK-PL 0035-12 Geomorphological research as a base for knowing of present high-mountain landscape changes and project of Cultural and Educational Grant Agency KEGA 025PU-4/2012 Georelief and landscape structure.

Souhrn
Cílem příspěvku bylo zdokumentovat možnosti využití historických i současných leteckých snímků na identifikaci změn krajinné struktury atraktivního rekreačního prostoru vybrané části Belianských Tater. Analýza změn jako i její mapové a statistické vyjádření dokumentují výraznou závislost změn jednotlivých tříd (především vegetace) od poslečensko-hospodářských a vlastnických zájmů (těžba, pastva), od vlivu turistických aktivit, od vlivu přírodních činitelů (geomorfologických procesů) a v neposlední řadě i od společenské legislativní změny. Takovýto typ analýzy umožňuje na základě respektování krajinnoekologických principů řešit další směřování péče o vysokohorskou krajinu Belianských Tater a v tomto smyslu se získané informace stávají významným přínosem pro její další vývoj, management a plánování i v kontextu rekreačních aktivit.

Contact:
Doc. PhDr. RNDr. Martin Boltižiar, PhD.
Katedra geografie a regionálneho rozvoja, FPV UKF v Nitre Trieda A. Hlinku 1, 949 01 Nitra, Slovenská republika
Telefon: +421 37 6408 632
e-mail: mboltiziar@ukf.sk

INCREASING THE POTENTIAL OF RECREATION - THE POSSIBILITY FOR THE DEVELOPMENT OF THE WHOLE REGION (CASE STUDY HODRUŠA - HÁMRE, SLOVAKIA)

František Petrovič[1], Zlatica Muchová[2], Katarína Baťová[1], Erika Zűsová[1]
Constantine the Philosopher University[1], Slovak University of Agriculture[2]

Abstract
Tourism is the fastest growing sector in Europe. Rural dispersed settlements- small settlements in mountain areas provide ideal conditions for rest and vacation in peaceful natural surroundings. One of them is the village Hodruša - Hámre. In the immediate natural environment and surroundings of the village itself there are many remarkable natural attractions and landmarks that are closely tied to the mining history of the region. Even though the sites are interesting as natural monuments inscribed in the UNESCO World Heritage List (the cadastral area Hodruša - Hámre is located in the territory of the World Cultural and Natural Heritage - BanskáŠtiavnica and the Technical Monuments in its neighborhood) the area isn´t really promoted as attractive. Therefore, our aim was to create a design route Nature Walk (NW). The objective of the designated routes NW is to show the functioning of the forest ecosystem,objects of the site in terms of natural monuments inscribed in the UNESCO World Heritage List, pointing out the major technical mining sites that are maintained in the locality. Stimulating interest in shaping tourism plays a role in aspect of science and environmental awareness and thus makes theenvironment of the village more attractive.

Key words: cultural landscape, mining forms, dispersed settlement

Introduction

At present, cultural landscape is under influence of various modern trends distorting and drastically transforming its appearance (Blažiket al. 2011, GAŁAŚ et al. 2013, Havlíček et al. 2012, Mojses, Boltižiar 2011, Skokanová et al. 2012, Špulerová, Petrovič 2011, Štefunková, Dobrovodská 2009, Tarasovičová et al. 2013). Many cultural monuments and mining objects have been turned into dilapidated ruins. Through the creation of NW and the promotional material itself we want to show respect for the mining values left behind by our ancestors, but especially to contribute to preservation of cultural and historical values and thus increase their protection through disseminating information. It is up to each of us how we can use the potential of the village Hodruša-Hámre and the potential of the dispersed settlement in favor of current and future prosperity of the whole society. In order for cultural heritage in such locality to transmit its message, it is necessary to include it into the life of society. This is why its presentation is necessary. The value of human life alone is not based on income, wealth and power, but on its biological existence and ability to create and protect. We should realize that it is easy to use nature to our advantage. However, it is important to know how to do it without destroying it. The village and the entire surrounding region breathes with mining history, and therefore, we should be able to treat it with dignity.

Materials and methods

Nature walks (NW) in a landscape are variously marked hiking and excursion routes of different lengths and orientations, which are created in areas which are interesting or typical in terms of nature, landscape, but also culture and history. They actually represent the educational use of a protected area, but they are also created in wild or unprotected nature (Bizubová, 2001). Nature walks are now a part of presentation of micro-regions and municipalities, their history, culture and natural conditions, as well as promotions of activities of various organizations and associations. NW as a relatively independent content and program whole installed in a landscape is not only some kind of walk through terminology concerning nature, culture and history, but also a supplement of knowledge from different scientific and professional publications and a demonstration of the relationship between men and nature in a broader context (Bizubová, Nevřelová, 2005). Based on the evaluation of natural, cultural and historical and other potentials, the village Hodruša-Hámre has not only a rich history, many mining technical monuments, but also a favorable inclusion of the village into landscape scenery and favorable conditions for development of tourism. Proposing a route of mining NW should point out the major mining technical monuments in the village Hodruša-Hámre and thus highlight the values of animate and inanimate nature in the area, and especially the selected mining objects

in the local districtKopanice. The choice of the route of the NW began with map documents. The choice was made from several alternatives of new trails and existing hiking trails.
The draft of the mining (montane) NW in the village Hodruša-Hámre in the local district Kopanice was created using the following methodology based on the methodology of explanatory description. The initial phase of the project addressed the route selection, choice of age category which should be the target group of the montane NW, and choice of its overall content, specification of the number of information boards and more detailed specification of each stop of the NW and their content. Ten we specified the marking of the individual stops, boards and their design. For the purpose of designing the information panels and marking of the individual stops with oak poles with sequence numbers we took several hikes, first in summer and in winter. We wrote down notes on the most important mining objects that are located on the route of the NW. We gradually chose names of the stops according to the occurring mining objects and pinpointed the spots for markers of the NW stops. The objective was to check attractions of the route and based on the obtained results reveal information gaps. Notes in the notebook collected information on the individual mining objects and information which tourists may obtain during an excursion. An important factor was also noticing of individual communities and ecosystems on the planned route and to design it so that the trail goes through the most interesting parts of the ecosystem without disturbing the natural environment. We completed the whole NW route several times. At the same time we measured the time it took us to complete it, length of the route and with map documents thus obtained also elevation gains (or losses) in the individual parts of the NW. A suggested guide through the mining (montane) NW became one of the processed documentations and it also became a part of a tourist help tool for closer specification and necessary information on the individual boards and stops of the NW. A map with the route of the NW with photos also became a part of the NW guide.

Results

The village Hodruša-Hámre was selected as an area of interest for the paper. Although the first indications of a settlement Hodruša-Hámre are registered only in 14th century (1352), first mentions are known from the 13th century (1228). By the end of the 13th century there already existed mining companies. Mining in Hodrušaalready in Middle Ages played the most important part in the development of the locality in terms of politics, economy and culture. The village Hodruša-Hámre with its own cadastral areas (Banská Hodruša, Dolné Hámre and Kopanice, fig. 1), though going through separate historical development, had a common denominator – mining. Hodruša-Hámre as an integrated village was established only in 1971 through administrative merging of formerly independent municipalities DolnéHámre and BanskáHodruša. In 1980, this newly established village added also the municipality Kopanice. This is how one of the municipalities with largest area in Slovakia was established (Priesol, 2005). Currently, the village has a population of 2217 (31.12. 2013). According to the territorial and administration division it belongs to the Banská Bystrica region, region, Žarnovicadistrict. The municipality Hodruša-Hámre is located about 5 km in the southeastern part from the district town Žarnovica. The cadastral area of the village has a total area of 4631 ha (46,3 km²). The largest part of it is taken by grounds, gardens, meadows, pastures, roads, watercourses, but mostly forests and other areas.
The studied area is located in the HodrušaHighlands part of the Štiavnicke Mountains and belongs to the PLA BanskáŠtiavnica. The cadastral area of the municipality borders the cadastral area of the district town Žarnovica in the northwest, cadastral area of the municipality Voznica (Žarnovica district) in the southwest, the cadastral area of the district town BanskáŠtiavnica in the east, the cadastral area of the municipality Vysoká (Banská Štiavnica district) in the south, the cadastral area of the municipality Štiavnické Bane (Banská Štiavnica district) in the southeast and the cadastral area of the municipality Vyhne (Žiar nad Hronom district) in the north.
The surface of the village can be classified as an area with foothill-highland relief. The main feature of the village is a deep “V”-shaped valley stretching from east to west that gives the built-up area of the village its main characteristics. The hills have a slope of 6-24 degrees, suggesting that the landscape of the cadastral area is especially suitable for hiking and skiing. The settlement in the Hodrušskávalley consists for the most part of houses of simple miners. The core of the village and its central part with churches, civic buildings, buildings ofmining administrations and officials have been created in the valley part at the crossroad of the main part to BanskáŠtiavnica and adjacent valleys.

Houses of miners were built on steep slopes close to job opportunities (mines) without claim for agricultural area. Mining houses are cut into the ground in the hilly area and are accessible only by narrow paths. Only in 18th centuryoccurred favorable conditions for development of Hodruša closely associated with increased mining and processing of gold-silver ores. That is when the village Hodruša-Hámre has become one of the major centers of central Slovakia mining (Priesol, 2005).
Mining nature walk's draft is situated into the village Hodruša-Hámre (the cadastral areas of Dolné Hámre, Banská Hodruša, Kopanice) in the district Žarnovica (Appendix 1, Map 3). It belongs to the oldest mining towns in Slovakia. Together with its historical objects it creates a unique set of high cultural and historical value, which is also set in the wonderful environment of the Štiavnica Mountains. The route of the mining nature walk is designed especially for students, small school excursions and interest groups. There was also an effort to design it in a way suitable for all age groups (including the older generation), but particularly so that the trail is engaging, interesting also for individuals or family trips. The information panels serve to point out the functioning of a forest ecosystem, flora and fauna, interesting facts from the area, incidence of stopes, mouths of shafts, water tanks (tajch) and ditches, treatment plant tunnel stairs, which are preserved in the area. Participants may see the impact of human activities and land-use at one of the stops Banište, at the top of the trail enjoy beautiful view of former settlements Dedina, Dômky, Baňa, now belonging to Kopanice, and Sitno. The written text on the main information panels has to be adjusted for the target group of the nature walk. The NW will be marked by signs of a nature walk. Information are complemented with color pictures, photographs and a detailed text in the NW guide. Every stop will be numbered and marked with brown oakrod with a label. Numbers of the stops will be identical with numbers of the stops in the text guide, which will provide more detailed information. We propose the NW text guide in Slovak language. It is intended for visitors who are looking for more information. We have proposed a total of 17 stops in the area.

Names of the stops:
Stop no. 1 The local district Hodruša-Hámre, Saw: Basic information board of the mining (montane) trail
Stop no. 2 End ofUškrtovavalley
Stop no. 3 Mouth of the Moderštolianska drainage adit
Stop no. 4 Treatment plant tunnel stairs Moder II
Stop no. 5 Transport trench to the stairs Moder II
Stop no. 6 Stairs Moder I.
Stop no. 7 LowerModerštolnianskytajch
Stop no. 8 UpperModerštolnianskytajch
Stop no. 9 Henrichadit
Stop no. 10 Mouth of the adit Mária Viktória
Stop no. 11 Kopanice Moderadit – Dômky
Stop no. 12 Mining surface stopes in Baništi
Stop no. 13 Hutmanská – miner house
Stop no. 14 AditModer (UNESCO)
Stop no. 15 Moderštoliansky tajch
Stop no. 16 Adit Michal
Stop no. 17 Local district Kopanice, Dômky: Second big information board of the montane nature trail.
Length of the whole route: 6 km
Length of the excursion route: 6 km
Elevation: 322 m.a.s.l.
Time: 2 hours7
Number of stops: 17
Difficulty of the trail: medium

After completing this NW to the local district Kopanice– Dômky, you have more possibilities to follow routes of existing NW, namely: SedloPleso, Tanád, Sklené Teplice, HavránkovaMeadow. There are several trails at the end of the village leading through a forest to the lakes belonging to BanskáŠtiavnica. It is approximately 3 km from the well-known Richňavské Lake and 5 km from Evička's Lake. This is where we get to the main road that leads from the west to Levice and from east to Počúvadlo and directly to the historical center of BanskáŠtiavnica. In the

village Kopanice is situated Moderštolianskytajch, which was in the past used in mining and was a part of the mining system, currently it is used for recreational activities. So you can rest also near water, this valley after 100 m below the dam narrows into only several meters wide valley and steeply falls to the Richňavská Valley. The surrounding of Kopanice has many sacred monuments which we can also visit and thus learn more about their history. With every step it breathes with mining history and you may await many unforgettable views into the valleys. Winter recreation is supported by lifts in Banište. Hiking trails allow connection to Richňavské lakes andKohútovo – Banská Hodruša, where are also built winter trails for skiers. The focus of recreational activities is not only hiking, but also hunting, fishing, boating and cottages. To increase your activity you can also ride a horse, as the settlement Dômky offers also agro-tourism, and during winter you can experience sleigh riding.

Discussion

In the studied area of the village Hodruša-Hámre we focus on mining equipment sights and surroundings, which is under the protection of monuments included in the World Heritage List (UNESCO). In the village itself there are 20 historical objects and many protected mining areas. The village Hodruša-Hámre has a tremendous potential to create forms of tourism and recreation. Several years ago, in the local district Kopanice began the process of turning houses into holiday cottages. Mainly people from cities search for relax in an attractive natural environment and therefore are becoming a majority in this part of the village. Also the surrounding area of Tajchy is used not only for summer, but also for winter tourism and the newly built areas offer accommodation and sporting facilities. The newly opened Ski Salamander Resort offers skiers its slope for skiing, but also many cultural events and relaxation in the hotel. The field research and mapping of this locality pointed out the current state and contributed to the improvement of output data for small areas. The natural component of the landscape potential, respectively natural potential, is given by the landscape. By designing the NW and creating the promotional material we want to show respect for miner's values that are left behind by our ancestors, but mainly the dissemination of information should lead to preserving cultural and historical values. Route design of the montane NW should point out exploring of pleasant natural environment and highlight the fact that even in modern times, there are places where you can spend a nice weekend and experience rural life.

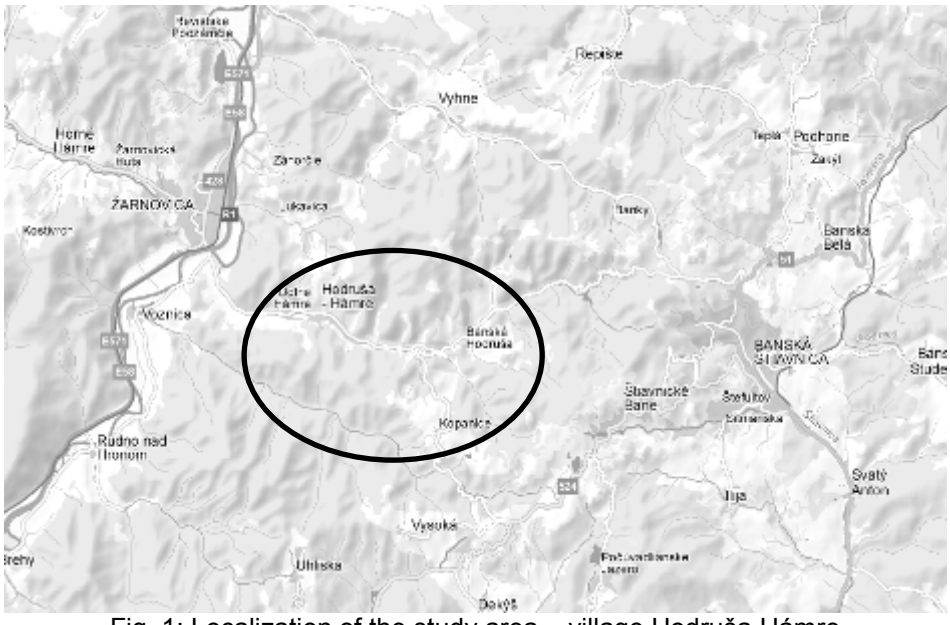


Fig. 1: Localization of the study area – village Hodruša Hámre

Conclusion

At present, cultural landscape is under influence of various modern trends distorting and drastically transforming its appearance. Current trends in landscape development confirm gradual disappearance of historical landscape structures and change of landscape of marginal areas towards homogenization of landscape(Boltižiar 1999, Hájek et al. 2012, Jakab, Petluš 2012, Olahová, Boltižiar 2009, Šolcová 2012, Špulerová 2008, Tomčíková 2011). The project of mining NW should highlight not only the identity of this environment, but also create conditions

for increasing the number of visitors to the area, to arouse an interest in cultural tourism. Through leisure and tourism they come to know “genius loci” of this village and discover its beauty.

References

BIZUBOVÁ, M., (2001). Geografické informácie v systéme náučných chodníkov Slovenska a ich didaktické využitie. Acta FacultatisRerumNaturalium UMB. Geografické štúdie Nr. 8. Premeny Slovenska v regionálnom a didaktickom kontexte. Banská Bystrica, 2001. P. 269 – 272

BIZUBOVÁ, M., NEVŘELOVÁ, M., (2005). Náučné chodníky pre environmentálne vzdelávanie a výchovu. Zborník referátov a posterov zo 4. národnej konferencie "Environmentálna výchova a vzdelávanie na školách v Slovenskej republike“. Nitra. 15.-17. decembra 2004. MŠ SR, UKF v Nitre, Fakulta prírodných vied. Nitra, 2005. P. 43-45.

BLAŽIK, T., FALŤAN, V., TARASOVIČOVA, Z., SAKSA M. (2011). Land use changes in chosendistrictsofvariousproductiveagriculturalregions in thecontextoftransformationalprocesses (in Slovak). Geografický Časopis, 63(4), p. 301—323 .

BOLTIŽIAR, M. (1999). Ekologická únosnosť vysokohorskej krajiny (na príklade Velickej doliny vo Vysokých Tatrách). In: Geografické informácie č. 6: 40 rokov geografie na UKF v Nitre. A. Dubcová, H. Kramáreková (Eds.). Nitra: Katedra geografie FPV UKF, 1999, p. 52-59.

GAŁAŚ, S., GAŁAŚ, A., ZVIJÁKOVÁ, L., ZELEŇÁKOVÁ, M., FIALOVÁ, J., KUBÍČKOVÁ, H., ŠLEZINGR, M., HÁZI, J., PENKSZA, K. (2013).Environmental impact assessment process in the field of recreation in the V4 countries. In: Journal of Landscape Management (2013) Vol.: 4 / No. 1. Brno. p.12-18.

HÁJEK, V., KOŇASOVÁ, Z., NIŽNANSKÝ, B., POPKOVÁ, K., ŠMÍDA, J. (2012). Využití starých planů při studiu současného území Liberca. TU Liberec, 107 p. ISBN 978-80-7372-928-8

HAVLÍČEK, M., KREJČÍKOVÁ, B, CHRUDINA, Z., SVOBODA, J. (2012) Long-term land use development and changes in streamsoftheKyjovka, Svratka and Veličkariverbasins (Czech Republic). MoravianGeographicalReports, 20(1), p. 28–42.

JAKAB, I., PETLUŠ P. (2012). Developmentof a program toolforthedeterminationof the landscape visual exposure potential. In F. Jordan & S. E. Jorgensen (Eds.), Modelsoftheecological hierarchy: from molecules to the ecosphere Amsterdam, NL: Elsevier. p. 375—390.

MOJSES, M., BOLTIŽIAR, M. (2011) Usingspatialmetricsforassessmentofthe landscapestructurechangesoftheBeša dry polder. JournalofLandscape Ecology, 9(2), p. 415–428.

OLÁHOVÁ, J. BOLTIŽIAR, M.(2009). Ochrana prírody v Nitrianskom kraji. Roč. 5, č. 1, 2009, Nitra: Univerzita Konštantína Filozofa Fakulta prírodných vied, Katedra geografie a regionálneho rozvoja. p. 105-111

PRIESOL, V., 2005. Najstaršie dejiny obce Hodruša-Hámre.Tlač: Aprint s.r.o. Žiar nadHronom, 182 p. ISBN: 80-968914-5-6

SKOKANOVA, H., HAVLIČEK, M., BOROVEC, R., DEMEK, J., EREMIAŠOVA, R., CHRUDINA, Z., MACKOVČIN, P., RYSKOVA, R., SLAVIK, P., STRANSKA, T. & SVOBODA J. (2012): Developmentofland use and mainlandusechangeprocesses in theperiod 1836–2006: case study in the Czech Republic. JournalofMaps, 8(1), p. 88—96.

ŠOLCOVA, L. (2013): Landscapedevelopmentofdispersed settlement in theNovobanskáštálová area (in Slovak). Nitra, SK: UKF Nitra. 208 p.

ŠPULEROVA, J. (2008): Land use changes in theVeseloviankarivercatchment in the Horna Orava region. Ekológia(Bratislava), 27(3), p. 326—337.

ŠPULEROVA, J. & PETROVIČ F. (2011). Historicalagriculturallandscape as a subjectoflandscapeecologicalresearch.HrvatskiGeografskiGlasnik, 73(2), p. 155—163.

ŠTEFUNKOVA, D. & DOBROVODSKA M. (2009). PreservedEuropeanculturalheritage in agrarianlandscapeofSlovakia.TájökológiaiLapok, 7(2), p. 283—290.

TARASOVIČOVÁ, Z., SAKSA, M., BLAŽÍK, T., FALŤAN, V. (2013) Changes in agriculturalland use in thecontextofongoingtransformationalprocesses in Slovakia.
Agriculture (Poľnohospodárstvo), 59(2), p. 49–64.

TOMČIKOVA, I. (2011). TheriverlandscapestructureofSmrečiankariver (in Slovak). Ružomberok, SK: VERBUM. 150 p.

Souhrn

V současnosti na kulturní krajinu působí různé novodobé trendy, které ji narušují a a její vzhled výrazně transformují. Mnohé kulturní památky a důlní objekty se proměnily na chátrající ruiny. Současné trendy vývoje země potvrzují postupný zánik historických krajinných struktur a změnu země marginálních oblastí směrem k homogenizaci země. Projektem důlního naučného chodníku v obci Hodruša Hámre chceme zvýraznit nejen identitu tohoto prostředí, ale i vytvořit podmínky pro zvyšování návštěvnosti do této oblasti. Vzbudit u nich zájem o turistický cestovní ruch. Prostřednictvím volného času a turistiky poznají,, genius loci" této obci a objeví jeho krásu.

Contact
František Petrovič, doc. RNDr., PhD.
Department of Ecology and Environmental Science, Faculty of Natural Science, Constantine the Philosopher University in Nitra
Tr. A. Hlinku No. 1, 949 74 NITRA, fpetrovic@ukf.sk

INFLUENCE OF URBANIZATION FOR RUNOFF CONDITIONS

Martina Zeleňáková
Technical University of Košice

Abstract
The impact of land-use change impacts on runoff generation is presented based on a study composed of generation of spatially explicit land-use conditions in part of Košice City, catchment of Myslavský creek. We were analyzed the drainage conditions of river basin Myslavský creek in the paper. Drainage conditions of the reference area were compared on the basis of two time periods, for year 1980 and for 2010. Two maps of land use area were processed for the both years. Total runoff coefficients were calculated based on processed maps, which differed, because in 1980 the territory was not so built as currently. Today the situation is different, because in 30 years the enormously increased number of built and paved areas and all rainwater is collected and discharged through rainwater drainage discharges into the watercourse Myslavský creek. Rainwater from new built objects, mainly hypermarkets, increases the flow in Myslavský creek, and thus its flow capacity for amount of drained rainwater is poor.

Key word: Myslavský creek, runoff coefficient, urban area

Introduction

The development of urban areas is accompanied by the increase of insulation level of catchment area that leads to the intensification of surface flows of storm water. In the case of large number of sewage systems, the available hydraulic capacity of canals is not sufficient to receive storm water flows from new catchment areas or increased wastewater inflow connected with the change of zoning plane (Dziopak, 2006, Slys, 2006, Slys, 2009, Louckova, 2010, Šlezingr, 2012, Galas, 2008, Junáková, 2013).
The recent shift in complex hydrological problems, such as real-time flood and drought forecasting, management of water resources, pollution transport and soil water infiltration, necessitates accurate modelling of the rainfall-runoff process in a region (Markovič, 2014, Vranayová, 2011, Rejdovjanová, 2012, Harbuláková, 2013, Harbuláková, 2013). Even though, the past few decades witnessed the proposal of a wide variety of approaches and the development of a large number of models to understand the dynamics of the rainfall-runoff process, a unified approach to the problem is still missing. This is due to, the considerable temporal and spatial variability exhibited by the rainfall-runoff process; and the limitation in the availability of appropriate mathematical tools to exploit the dynamics underlying the rainfall-runoff process (Sivakumar, 2000).
Runoff conditions in the catchment are influenced by water management in the area mainly with a focus on hydrology and flood protection. The paper presents the current state of drainage situation in the study area taking into account the existing outlets of rainwater drainage of the newly built constructions – buildings, hypermarkets etc.. The goal of the study was an evaluation of surface condition, calculation of the runoff coefficient and design of potential measures to stabilize conditions in the drainage basin of Myslavský creek on the degree of flood protection in low-lying areas.

Materials and methods

The methodology of research consists of the following steps:

1. Characteristics of the river basin of Myslavský creek.
2. Getting input data from the Department of the Chief Architect in Košice (DCAK) and Slovak Water Management Enterprise, s.c. branch office Košice (SWME), specifically:
    - Maps of land-use in the scale 1:5 000 and 1:2 000 → DCAK,
    - Maps of land-use in digital form in .dwg form → DCAK,
    - The situation of basin in the scale of 1:50 000 → SWME,
    - Study of drainage conditions of Myslavský creek catchment → SWME,
    - Water right decision → SWME.
3. Processing of input data:
    - Calculation of runoff coefficients,
    - Calculation of the total runoff.

4. Proposed measures to stabilize the drainage conditions in the basin of the stream Myslavský creek.

Myslavský creek is the right-hand tributary of the Hornád, which mouths into the southern part of Košice. Basic characteristic of the catchment are presented in Table 1.

Tab. 1: Basic characteristic of the catchment (Dobrotka, 1997)

Basin area	The highest point	The lowest point	Runoff from the basin	Maximum flow stream
59.67 km^2	940 m asl.	188.90 m asl.	9.5 $l.s^{-1}.km^{-2}$	52 $m^3.s^{-1}$

It flows through the village Myslava, Nižný Klatov and through shelter - gardening area in the administrative area of Myslava and Nižný Klátov. Myslavský creek was regulated mainly within the boundaries of the city of Košice and Myslava (Dobrotka, 1997). A number of unilateral purpose bank reinforcement and many different types of bridges were made by landowners in shelter - gardening area. As the mentioned regulations and bridges were built without addressing horizontal and vertical alignment and frequent change of trough-shaped cross section of river bed, they become barriers in water stream in the time of increased water levels.
A large part of the basin is located in urbanized area, which may significantly alter hydrological conditions.
Two maps, for two different time periods – for 1980 and 2010, were prepared from provided materials – maps of land use of the area. Both maps were processed in a graphic program ArchiCAD version 12. In particular maps was marked the borders of land, such as roads and streets, roofs, lowns, unimproved areas and cemeteries. These land boundaries are marked in the maps in different colors and are also listed in the legend for each map.
The Rational method runoff coefficient (*C*) is a function of the soil type and drainage basin slope. The values are taken from Urcikán, 1991. The runoff coefficient (*C*) is a dimensionless coefficient relating the amount of runoff to the amount of precipitation received (Urcikán, 1991). It is a larger value for areas with low infiltration and high runoff (pavement, steep gradient), and lower for permeable, well vegetated areas (forest, flat land).
The Rational equation is the simplest method to determine peak discharge from drainage basin runoff. Rational equation is as follows (Urcikán, 1991):

$$Q_{\max} = C \cdot i \cdot A \quad (l.s^{-1}) \qquad (1)$$

Where
Q_{max} = peak discharge ($l.s^{-1}$),
C = rational method runoff coefficient (-),
i = rainfall intensity ($l.s^{-1}.ha^{-1}$),
A = drainage area (ha).
Runoff coefficient for the whole area was calculated as weighted average

$$C = \frac{\Sigma(C_i . A_i)}{\Sigma A_i} \quad (-) \qquad (2)$$

The rainfall intensity (*i*) is typically found from Intensity/Duration/Frequency curves for rainfall events in the geographical region of interest. The duration is usually equivalent to the time of concentration of the drainage area.

Results and Discussion

There were prepared two maps for years 1980 and 2010 for the whole catchment of the Myslavský creek. The maps of the selected area of the catchment, exactly the area of Košice city, where land use changes and human activity are manifested the most are presented at Figures 1 and 2.

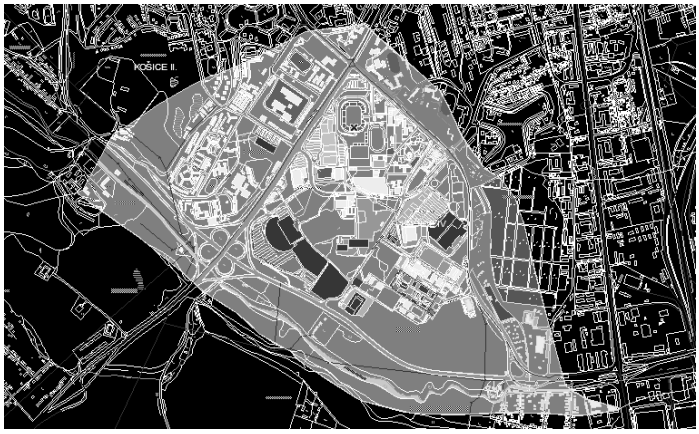


Fig. 1 The selected area of Myslavský creek catchment – land use in 2010

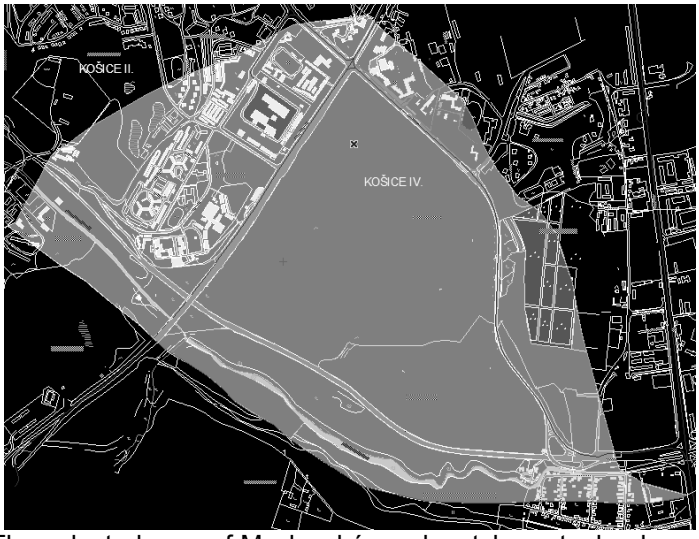


Fig. 2: The selected area of Myslavský creek catchment – land use in 1980

According to equation (2) were calculated runoff coefficients for the two time periods for significantly influenced locality by human activity, with different area of different land use of Myslavský creek catchment.

$$C_{(2010)} = \frac{\Sigma\left(C_i.A_i\right)}{\Sigma A_i} = \frac{\Sigma\begin{pmatrix}473427.26\cdot 0.8 + 962407.09\cdot 0.9 + 174441.46\cdot 0.15 + \\ +2649908.00\cdot 0.15 + 59425.98\cdot 0.3\end{pmatrix}}{4319609.79} = \underline{\underline{0.3404}}$$

$$C_{(1980)} = \frac{\Sigma\left(C_i.A_i\right)}{\Sigma A_i} = \frac{\Sigma\begin{pmatrix}139978.60\cdot 0.8 + 391895.15\cdot 0.9 + 140911.91\cdot 0.15 + \\ +3587398.15\cdot 0.15 + 59425.98\cdot 0.3\end{pmatrix}}{4319609.79} = \underline{\underline{0.2412}}$$

The value of runoff coefficient is changed by 0.10 over the 30-years.
Based on the calculated total runoff coefficients *C*, the drainage area of Myslavský creek and for a specific amount of rainfall were calculated maximum runoff for both time periods year 1980 and 2010 according to equation (1).
In the following Table 2 are given the values of maximum runoff for the entire river basin Myslavský creek for the both time periods for the duration of rain 15 minutes.

Tab. 2: Determination of the maximum runoff *Q*

Year	*C* (-)	*i* ($l.s^{-1}.ha^{-1}$)	*A* (ha)	*t* (min)	*Q* ($l.s^{-1}$)
2010	0.3404	139.8	431.9609	15	20 556.12
1980	0.2412	139.8	431.9609	15	14 565.62

The above values indicate that by the duration of rain at 15 minutes the maximum runoff *Q* is in 2010 for selected part of Myslavský creek river basin 20 556.12 $l.s^{-1}$. This value is 70% higher compared to the same drainage area in 1980.
Proposal of measures for runoff condition stabilisation with aim of flood protection of lower laying areas are following:
a) organizational → water management decision,
b) technical and environmental:
→ directing the stream flow by removing sharp meanders
→ removal of islands and random obstacles
→ creation of longitudes slope of stream, which corresponds to most steady-state of river bed
→ creation of a stream cross section trough such a size and shape to harmlessly diverting flow prior to such fortification which would prevent the erosion and flush out the banks.

Conclusion

There are several indications that changes in land cover have influenced the hydrological regime of various river basins (Pfister, 2004, Weng, 2001, Bronstert, 2002). In addition, the effects of climate change on the hydrological cycle and on the runoff behaviour of river catchments have been discussed extensively in recent years. However, it is at present rather uncertain how, how much and at which spatial scale these environmental changes are likely to affect the generation of storm runoff, and consequently the flood discharges of rivers.
This paper gives an overview of the possible effects of climatic and land-use change on storm runoff generation. It discusses the hydrological response to climate and land-use changes. The analysis of drainage conditions of the studied area prove that runoff from the studied area of Myslavský creek river basin is 70% higher compared to the same drainage area in 1980. It is caused by human activities in the area. The evaluation of obtained knowledge and proposals of potential measures to stabilize the drainage conditions in the basin Myslavský creek will improve level of flood protection in low-lying areas.

References

BRONSTERT, A., NIEHOFF, D., BÜRGER, G. Effects of climate and land-use change on storm runoff generation: present knowledge and modelling capabilities. *Hydrological Processes*. Special Issue: The Future of Distributed Hydrological Modelling. Vol. 16, No. 2, p. 509–529, 2002.
DOBROTKA, S. ET AL.: Study of drainage conditions of Myslavský creek catchment. Košice: SWME, s.c., 1997.
DZIOPAK, J., SŁYŚ, D.: Physical and mathematical model of gravitation-pump storage reservoir in sewage system, *Environment Protection Engineering*, Vol. 32, No. 2, 127–137, 2006.
GALAS, S., KROL, E.: Indicators for environmental-spatial order assessment on the example of the Busko and Solec Spa communes. Gospodarka Surowcami Mineralnymi-Mineral Resources Management. Vol. 24, No. 2, p. 95–115, 2008.
JUNÁKOVÁ N., BÁLINTOVÁ M.: Revitalization of small water reservoir for its future use. In: Journal of Landscape management. Vol. 4, no. 1, p. 67–71, 2013.
LOUCKOVA, K., FIALOVA, J.: The accesing of the landscape and recreational activities for seniors and disabled people. In: Conference on Recreation and Conservation Location: Kritiny, p. 194-197, 2010.
Map of Myslavský creek catchment. Slovak Water Management Enterprise s.c., branch office Košice
MARKOVIČ, G., KÁPOSZTÁSOVÁ, D., VRANAYOVÁ, Z.: The analysis of the possible use of harvested rainwater in real conditions at the university campus of Kosice, In: Recent Advances in Environmental Science and Geoscience: Proceeding of the 2014 International Conference on

Environmental Science and Geoscience (ESG´14): March 15-17, 2014, Venice, Italy, p. 82–88, 2014.
ONDREJKA HARBUĽÁKOVÁ, V., HOMZOVÁ E.: Possibilities of rainwater from runoff harvesting (in Slovak). In: Proceeding from 3rd international conference Environment – Problems and solutions: air - water - soil: Nový Smokovec, 8.-10.4.2013. Košice: Elsewa, p. 135–142, 2013
ONDREJKA HARBUĽÁKOVÁ, V., HRONSKÝ, P.: Whitewater courses in landscape. In: Journal of Landscape Management. 4(1) 26-33, 2013.
PFISTER L., KWADIJK J., MUSY A., BRONSTERT A., HOFFMANN L.: Climate change, land use change and runoff prediction in the Rhine–Meuse basins. River Research and Applications, Vol. 20. No. 3, p.229–241, 2004. DOI: 10.1002/rra.775
REJDOVJANOVÁ, G., ZELEŇÁKOVÁ, M.: Hydrological and hydrogeological conditions for rainwater infiltration and percolation. In: Colloquium on Landscape Management 2012: Brno, 3th february 2012. Brno: Mendel University in Brno, p. 30-33, 2012.
SIVAKUMAR, B. - BERNDTSSON, R. - OLSSON, J. - JINNO, K., KAWAMURA, A.: Dynamics of monthly rainfall-runoff process at the Gota basin: A search for chaos. Hydrology and Earth System Sciences, 4(3), 407–417, 2000.
ŠLEZINGR, M., FIALOVÁ, J.: An examination of proposals for bank stabilization: the case of the Brno water reservoir (Czech Republic). Moravian Geographical Reports. 2012. Vol. 20, No. 2, p. 47–57. URL: http://www.geonika.cz/EN/research/ENMgr/MGR_2012_02.pdf
SŁYŚ, D.: Potential of rainwater utilization in residential housing in Poland, *Water and Environment* Journal Vol. 23, No. 4, p. 318–325, 2009. DOI: 10.1111/j.1747-6593.2008.00159.x
SŁYŚ, D.: Simulation model of gravitation-pump storage reservoir, *Environment Protection Engineering*, Vol. 32, No. 2, 139–146, 2006.
URCIKÁN, P. ET AL.: Sewerage and waste water treatment (in Slovak), part I. Sewerage. Bratislava: ES STU, 1991.
VRANAYOVÁ, Z., KARELOVÁ, Z., OČIPOVÁ, D.: Precipitation Monitoring Methodology at the Campus of Technical University of Košice. In: Selected Scientific Papers. Journal of Civil Engineering. Vol. 6, No. 2, 2011.
WENG, Q.: Modeling Urban Growth Effects on Surface Runoff with the Integration of Remote Sensing and GIS. Environmental Management, 28(6), 737–748, 2001.

Acknowledgement
This work has been supported by the Slovak research and Development Agency SK-PT-0001-12.

Souhrn
Cílem práce bylo analyzovat odtokové poměry sledovaného povodí Myslavského potoka. Odtokové poměry sledovaného území byly srovnány s daty z roku 1980 a 2010. Ze zpracovaných map využitelnosti území byli zjištěni celkoví odtokoví součinitelé, které se výrazně lišili. V roce 1980 totiž nebylo dané území zastavěno jako v současnosti. Za 30 let se enormně zvýšilo množství zastavěných a zpevněných ploch a veškerá dešťová voda je zachycována a odváděna dešťovou kanalizací přes výpusti do vodního toku – Myslavského potoka. Na základě změněných odtokových poměrů Myslavského potoka je nutné navrhnout možné opatření na stabilizaci odtokových poměrů v povodí Myslavského potoka, a tím zvýšit protipovodňovou ochranu v níže položených územích. Opatření mohou mít charakter jak environmentální (odstranění překážek), tak organizační (dodržování vodoprávních rozhodnutí, návrh retenčních prostor).

Contact:
doc. Ing. Martina Zeleňáková, PhD.
Technical University of Košice, Faculty of civil engineering, Department of Environmental Engineering, Vysokoškolská 4, 042 00, Košice, Slovakia; +421 55 602 4270, martina.zelenakova@tuke.sk

LANDSCAPE AS AN EDUCATIONAL SPACE

Helena Kilianová[1], Jiří Šmída[2], Vilém Pechanec[1]
Palacky University Olomouc[1]; Technical University of Liberec[2]

Abstract
Czech primary and secondary schools rarely apply the methods and technologies of geoinformatics in the education of geography. The reasons vary from objective and subjective. The essential objective barriers of introducing geographic information systems (GIS) in primary and secondary classes include insufficient methodology for teachers who might realise such lessons with its help.
Geographic information systems can be used in classes to organise a field data collection and creation of analytical maps. The landscape – both urban and natural – is best to introduce by means of active infolvement in data collection supported with lessons in the field. The pupils becomes an active user of spatial data, he learns to identify it in the landstape, to collect, evaluate and use it to understand his attitude. Thus he develops from the lowest degrees of learning (i.e. Remembering) to understanding and applicationsd. His attitude to the landscape is reinforced by the ability to think spatially.
A possible methodology is demonstrated in the task where the students of grammar school in Liberec mapped parks (public green areas) in the city and used the attributes to describe their quality.

Key words: education of geography, geographic information systems (GIS), using GIS in classes, data collection, ability to think spatially

Introduction

Landscape represents a human´s wide range of needs realised – from sourcing raw materials for subsistence, clothing and shelter, building settlements, for recreation and aesthetic experiences, for sport and inspiration (Cílek, 2002). It is also a place of possible learning and education. Landscape is the object of learning at the same time: pupils and students learn to know its essential elements (relief, soil, water, climate, flora, fauna and humans), relationships and bonds. These terms are included in cuticular documents.
Education of geography at primary and secondary Czech schools provides an example of applications of new knowledge and modern technologies in geoinformatics in the classroom. Pupils and students are introduced to field work, to collecting data outside of school in the landscape, to its subsequent processing, evaluation and interpretation (Alibrandi, 2003; Malone at all., 2002).
Cuticular documents for preschool, primary, secondary and special education – so-called framework educational programmes (hereinafter FEP) determine the general framework of education at individual stages of school. The primary education FEP (PE FEP) as well as the secondary education FEP (SE FEP) contain geography as a separate branch within the education field The Human and the Nature. As to the PE FEP, the topics of geography are contained in other fields, such as natural history (inanimate nature) or physics (universe, energy).
The FEP includes the individual topic of geographic information systems and geographic information for primary education called “Geographic information, data sources, cartography” which does not directly use the term geographic information systems. However, the item “geographic cartography and topography” includes “practice and application with available cartographic products both in print and the electronic form” as an essential requirement on the curricular range. The description of the expected outcomes is extended for example for GIS applications in lessons. The involvement of basic terminology, for example GIS and other geoinformatics terms, may be understood as a reaction to the other expected outcome formulated as “the student uses and understands basic geographic, topographic and cartographic terminology.”
Applying GIS at primary and secondary school has to reflect the introduction of GIS into science and everyday areas of the human life, online services, etc. which can be seen in pupils and students´ preparation to using the GIS applications and including such skills and knowledge in the primary and secondary curriculum. Pupils are motivated to be active and creative in the use of space information represented by achieving the ability to search, sort and analyse information, i.e. to discover specific relations between them. This aspect of applying GIS in

education is pointed out for example by W. Lloyd (2001 in Dolanská, Šmída, 2005) who supposes that making GIS available to pupils and students changes their attitude to active users of space information. Thus equipped student of regional geography should be better prepared to analyse local issues, similarities as well as differences between individual regions. Such a student will then be able to search information of residences of authorities, banks and sights in online public electronic maps. The application of GIS methods at primary and secondary schools also fulfils the requirement to improve the use of multimedia in teaching and better involvement of information technologies especially through their active use as a tool to work with information in all taught subjects.
Introducing GIS applications as a new element in teaching changes and the character of such changes reflects the didactic character of GIS and its influence on "states other than optimal" of the teaching process at current primary schools.

Materials and methods

The proposed method of the educational project for students of primary and secondary schools applies methods of problem-solving tasks which are characteristic for research-oriented teaching. Moreover, if the students are presented with a problem in the form of an interesting GIS project appropriately formulated with respect to the content of education, applying the rules of research-oriented teaching, the student is then active in its solution and the topic of the lesson. He usually remembers more and the memory is also usually permanent. If the student understands the topic he achieves the second degree of the cognitive objectives during the process of solution, i.e. he understands the meaning of the communication in image or symbolic formats.
If a GIS project is appropriate, the students apply their knowledge, i.e. the result of the first degree of cognitive objective in new situations where the student applies the new abstract and general knowledge. Using GIS, the third degree of the cognitive objective opens up – the application which according to Kasíková (1992) is the most significant one.
The landscape in all its forms – natural, agricultural, urbane – provides many objects and stimuli for the educational process especially in the area of scientific education. Using appropriate GIS tasks with field data collection facilitates students´ interest in applying GPS location devices, movement outdoors, processing, analysis and interpretation of space data, and at the same time it helps the development of their spatial orientation and imagination, it improves their interest in animate and inanimate nature, it introduces them into many natural phenomena, and last but not least, it provides students with real experiences in today´s expansion of virtual reality.
Protected landscape areas appear to be the appropriate environment for the topics of GIS tasks; they are special places visited by people looking for spiritual, cultural and physical refreshment whose educational potential is enhanced by voluminous information available about the area, plants and animals (Machar at al., 2013). If the school is in an urban or rural landscape which is too distant from protected landscape areas, it is appropriate to aim the field project teaching at those natural elements provided by the near surroundings of the school. Forest parks and city parks, alleys, watercourses and water areas as well as gardening colonies provide suitable space.
An important part of the proposed method is field work. It should hold for geography classes especially, that field classes are an irreplaceable form of education. A "geographic lab" is just outside the school. The student learns the knowledge and skills which he tested in the classroom using textbooks, lectures and maps.
All stages support spatial thinking whose concept is based on a set of cognitive skills. In the case of a space-educated person, they manifest themselves through understanding the meaning of space and using the features of space as means to structure a problem, to search answers and to express and present solutions (National Research Council, 2006). A space-educated student is used to thinking in space terms (the student knows when and why it is advantageous to think spatially). On a higher level of the competence, the student further develops spatial thinking using memorable space concepts and methods of space representation. He uses appropriate tools and technologies such as achieving space data through a wide range of methods (online search, field data collection, mapping, work with GPS, web maps and GIS). The student achieves the highest quality competence as soon as he is capable of verifying the quality of space data (based on the assessment of the credibility of their sources and methods of their origin) and the correct arguments created on the basis of the acquired space information.

Results

The objective of the proposed method is to develop a student´s abilities and skills in the competence of spatial thinking through field research of urban public green areas. The student´s task is to gain geographic data describing urban public green areas, to sort the data and to visualise the data in a map using an appropriate method of thematic cartography. The student then uses the map to interpret the spatial pattern in the placement of parks and their quality. The student then proposes possible measures to improve the condition of the studied phenomenon, e.g. creation of new public green areas, an improvement of care of selected areas, or an improvement in their availability. The student then presents his findings to his classmates.

The duration of the proposed method assumes extensive involvement in the educational unit. We propose project classes (project days), geography seminar or a school-leaving-exam seminar as appropriate forms. A great part of field data collection may be assigned as independent work of students which will take place outside the lessons. The total time required for direct teaching can be expected to approximate 6-8 lessons.

The method may be divided into seven steps (Table 1). The lesson will be held in the field in only one part; the other parts are realised in the classroom or a computer lab.

Tab. 1: Method of field education with GIS support (source: authors of the article)

1	Identification of the studied phenomenon and its theoretical study
2	Training of the field data collection method
3	Field data collection
4	Data processing using GIS
5	Data visualisation through creation of a map in GIS
6	Analysis of spaciousness of the phenomenon (naming the patterns of the current expansion of the phenomenon)
7	Proposal of changes and presentation of results

1. Identification of the studied phenomenon and its theoretical study: this stage represents introducing the topic of public green areas to students. It uses their experience with utilising such areas. The students formulate their attitudes, they assess the quality of green areas. The teacher prepares basic facts of the role of urban public green areas and how to take care of them. A suitable accessory is a short presentation of the theme by a representative of the city. His presence makes the atmosphere more serious and the task more realistic. The teacher formulates the problem-solving task to the students (ideally in cooperation with the representative).

2. Training of the field data collection method: a training of necessary skills precedes the data collection itself. The teacher explains the differences between quantitative and qualitative features describing the studied objects and phenomena in space. Then, methods of field mapping using a black-and-white copy of the city map and a notebook with a prepared structure of an attribute table to fill in the identified properties are trained. Other appropriate methods of field work are questionnaires, surveys and guided interviews. The student obtains safety training of field work.

3. Field data collection: it is suitable to use the time outside of school for field work. However, a joint outing should always precede; the teacher will demonstrate methods of field mapping in a selected example of a park.

4. Data processing using GIS: the data acquired by field collection is digitised in the GIS program. Following the scale and the focus of the task, either point representations of phenomena and objects (parks in the city, trees, benches in the park) or line and planar representations (tracks, the area of the park). Appropriate GIS programs may be selected among Open Source solutions (e.g. QGIS) or a commercial solution. Orthophotomaps are a suitable source for data digitisation in which aerial photographs combined with basic orientation elements of the city and their description (central streets, important buildings, schools, watercourse) provide the best ability to orientate n the displayed space. The elements´ properties are edited by the student in the attribute tables.

5. Data visualisation through creation of a map in GIS: digitise data in vector formats of GIS are used by the student to prepare a thematic map. Sets of maps prepared for individual sheets as well as compositions comprising in more map fields are suitable. If the teacher has the opportunity and intends to print the resulting maps, he will adjust the task so that the students prepare the maps in an appropriate paper format. The students learn about the principals of

cartography and about the choice of methods of thematic cartography. Appropriate methods must be selected according to the abilities of the GIS software used. However, in general it is possible to recommend making a map with space limits of the studied phenomena (a basic map) and a set of maps represented the selected features (the area of parks, the number of trees, the number of benches, the accessibility from the closest public transport stop). The methods applied could be a cartogram, map diagram, of methods of point character, and others. The greatest attention has to be paid to preparing the legend, which is the most complicated part of this stage. We also have to pay attention to the correct formulation of other composition elements of the map (the title, the scale, the imprint).
6. Analysis of spaciousness of the phenomenon: analytical data processing can be seen in two parts of the whole method. The first one appears in the map before the visualisation when the student has to choose an appropriate method and a scale of data. The second opportunity to apply analytical thinking appears in the stage after creating the map outcomes. The student learns to name the patterns of phenomenon distribution and to the interpretation of its properties. The student should write his evaluation. It is desirable that the written statement be part of the map sheet.
7. Proposal of changes, assessment and presentation of results of the current phenomenon: the student applies his knowledge in the final stage of the project and proposes changes which he presents and defends together with the results. The student formulates the conclusions expressing whether his assumptions (hypotheses) in the first stage of the project proved to be correct. It is again suitable to involve a representative of the city who will discuss the findings and recommendations with the students. The student uses his own map to present the results; an interactive board is a suitable presentation tool.

Verification of the method

The method was verified in the forth grade of grammar school where it was integrated into a seminar of geography (Grammar school F. X. Šaldy Liberec). The lessons were organised in 90-minute blocks, the field data collection was assigned as individual work realised in the students´ free time. The second verification of the method was realised in the second grade of primary school (primary school Sadská), where it also took place in a seminar of geography (2010-2012); the form of a project day was also tested (2013). 12 grammar school students and 25 primary school students were involved. The ArcGIS version 9 software from ESRI was used in both cases to work in the GIS environment. The students perceived its main advantage in the number and quality of tools form cartographic creations. The students´ work was based on instructions in the prepared worksheets. The topics processed by the students included distribution and quality of parks (Fig. 1), solitary trees and groups and trees in the city, and alleys. While the primary school students applied simple methods of imaging the properties of a point phenomenon and their map legends contained a number of shortcomings in choosing the shape, colour and font size, the students of higher grades of grammar schools were successful in visualising both the quantity and the quality of the mapped phenomena. However, the presentations of results in both cases showed a lack of spatial thinking competences. The students had difficulty verbally expressing spatial behaviour of the mapped phenomenon and using appropriate terms to describe the distribution in space. We identified the greatest difficulty in their inability to discover the reasons of spatial distribution and quality of parks or trees. The time demands of the lesson made a project day unsuitable to use at primary school. The tasks required for the solution were demanding on the students´ concentration, mainly due to a high number of higher cognitive objectives. However, if the work with a group of students was more intense (seminar of geography), the improving skills necessary in recognition of spatial phenomena and their properties, data processing in the GIS environment and interpretation of achieved results proved the time demands to be decreasing.

Discussion

The aim of the proposed method was to offer primary and secondary teachers of geography another method which develops students´ spatial thinking. A significant part of the method should provide space for learning activities from higher cognitive objectives (in accordance with revised Bloom´s taxonomy, Fig. 2). Other competences expected by the FEPs are also developed, mainly the communicative and civil competences.

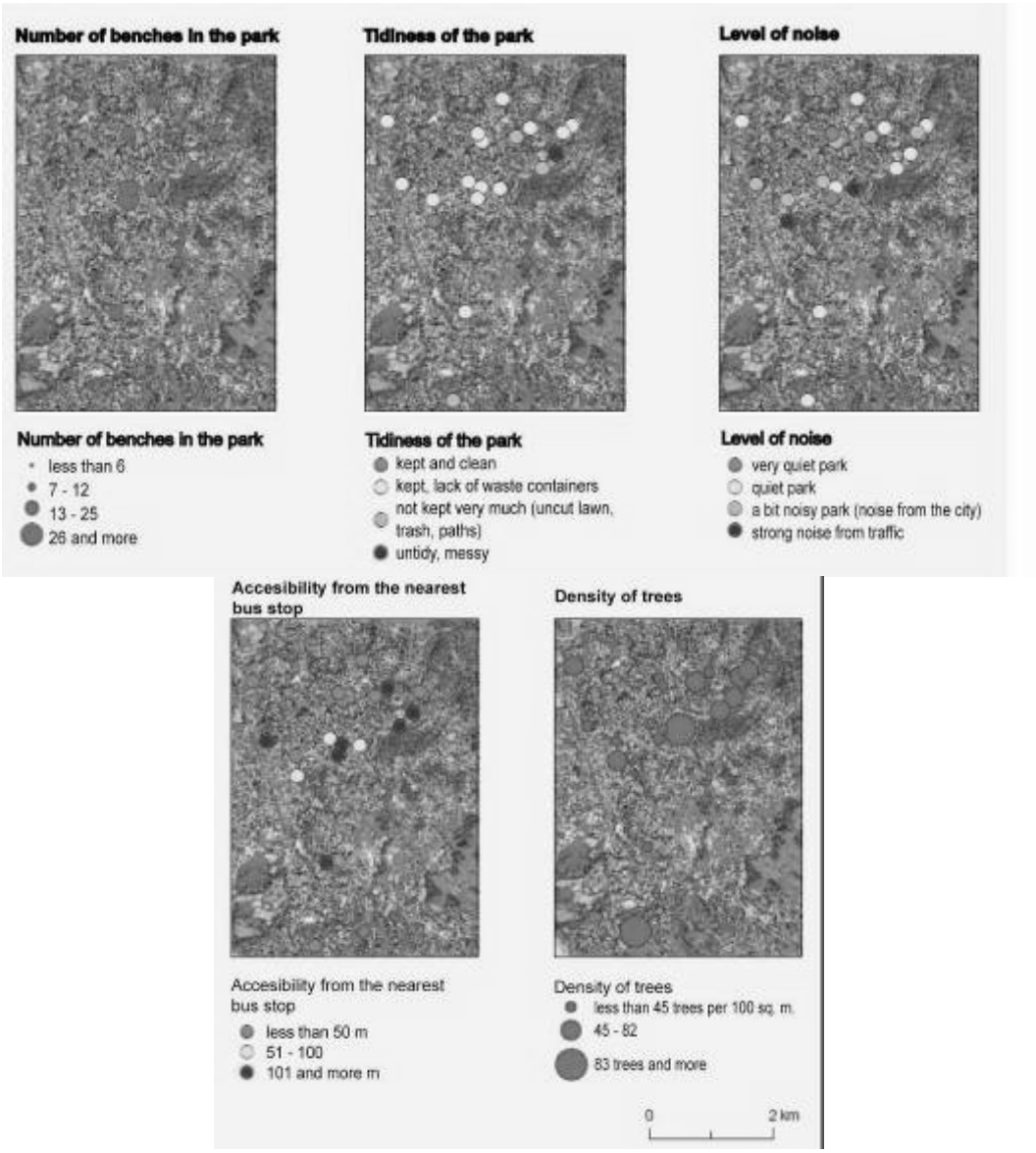


Fig. 1: Map outcomes (selection) of practical verification of the method of mapping and evaluation of public green areas in Liberec; the authors are fourth grade students at grammar school

The tools to support students´ motivation and the development of spatial thinking are geoinformatics technologies. Their appropriate purpose is data digitisation of a studied phenomenon, in this case of areas and elements of urban public green areas. Geographic information systems are further utilised to create map outcomes. It is possible to identify one of the barriers in the application of the proposed method, which is its financial demands although commercial software with a paid licence may be replaced with freeware software; the best example is the QGIS program. Another possibility is to use the tools for creation web maps. The best current example may be the platform for web map creation, ArcGIS online of ESRI (www.arcgis.com). Its advantages are the simplicity of map creation and the basic version of the tool free of charge; on the other hand, the necessity of internet connection may be a possible disadvantage for some schools.

Another opportunity of involving geoinformatics technologies in the proposed method may be in including tablets with GPS in field work classes. A suitable freeware program is Collector which was released by ESRI in 2013. This program, however, presents the necessity of internet connection at least in the beginning stages of including tablets in classes at primary and secondary schools, which means a serious weakness.

On the other hand, it is not good to overestimate the involvement of digital technologies at the expense of classical technologies. An example of desired methods developing a student´s spatial thinking is working with a map: field mapping and reading a map.
The proposed method may be successfully applied in mapping random spatial phenomena from the local through regional to global measure. The necessary adjustments of the field work stage do not impose demands on the method or time. An important advantage is the possibility to involve other subjects taught at school which study the spatiality of social, economic or physical-geographic elements of the real world. The involvement of mathematics may be proposed for the application of statistical methods (quota sampling for a survey, statistical evaluation), sciences – physics, chemistry or biology, using the methods of measurement of properties of natural environment, the Czech language, and history to follow the space-time of the phenomena. Thus the method may become a suitable tool to reinforce the inter-subject relations at school.

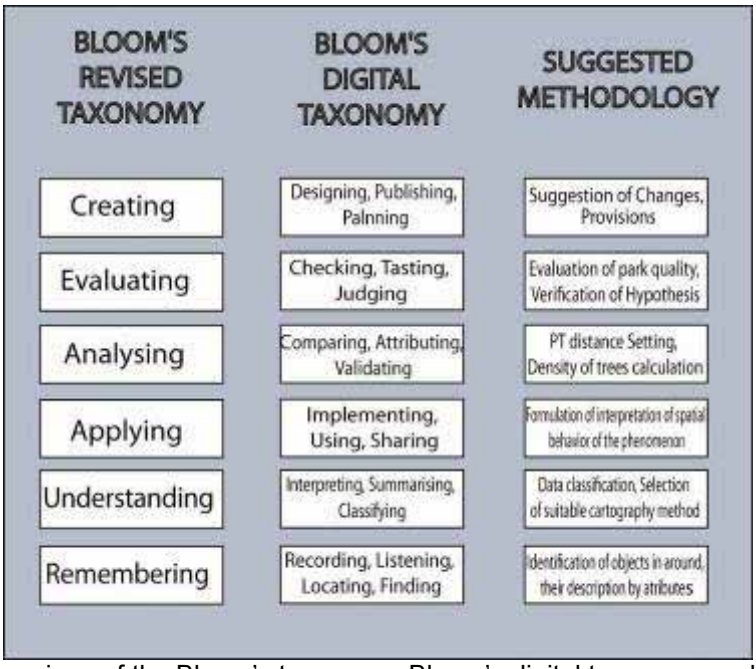


Fig. 2: Comparison of the Bloom's taxonomy, Bloom's digital taxonomy and suggested methodology. Sources: based on Churches, 2009, Anderson - Krathwohl, 2001 compiled by authors of the paper

Conclusion

Landscape is a suitable environment to realise the process of education as it supports an achievement of higher cognitive objectives with respect to the higher activity of students, and their more intensive experiences outside of school. Inclusion of GIS tasks to subjects such as geography, biology, history, and as supportive tasks in mathematics, physics and chemistry appears to be advantageous mostly in the development of spatial thinking, independence, active involvement of students, and also the inter-disciplinarity of GIS tasks which develop key competences and increase the future employment of students in the society

References

CÍLEK, V. (2002): Krajiny vnitřní i vnější. Dokořán, Praha.
MALONE, L., PALMER, A. M., VOIGT, C. L. (2002): Mapping Our World: GIS Lessons for Educators. ESRI Press, ISBN: 1-58948-022-8, 564 s.
ALIBRANDI, M. (2003): GIS in the Classroom. Using Geographic Information Systems in Social Studies and Environmental Science. Heinemann, ISBN: 032500479X
DOLANSKÁ, M., ŠMÍDA, J.: Pozveme GIS do škol. [on line] [cit. 25.1.2014] Dostupné z: http://gisdoskol.fp.tul.cz/index.php/vyuzitigisvevyuce
KASÍKOVÁ, E. (1992): Pedagogika pro učitele. PedF ZU, Plzeň
MACHAR AT AL. (2013): Chráněné krajinné oblasti a jejich výchovně vzdělávací potenciál. Skriptum. VUP, Olomouc

CHURCHES, A. (2009): Bloom's Digital Taxonomy. [on line] [cit. 26.1.2014] Dostupné z: https://edorigami.wikispaces.com/file/view/bloom's+Digital+
taxonomy+v3.01.pdf
ANDERSON, L. W., KRATHWOHL, D. (EDS.) (2001): A Taxonomy for Learning, Teaching and Assessing: a Revision of Bloom's Taxonomy of Educational Objectives. Longman, New York
National Research Council (2006): Learning to Think Spatially: GIS as a Support System in the K-12 Curriculum. The National Academies Press, Washington.

Acknowledgement
This article has been written for purpose of Science Education Center project, no. CZ.1.07/2.3.00/20.0166 which is co-financed from EU funds and the state budget of Czech republic.

Souhrn
Studie přináší informace o konkrétní na úloze, při které žáci Gymnázia v Liberce mapovali parky (plochy veřejné zeleně) ve městě, metodě mapování a následného zpracování a poznatcích, jež si osvojili. Metodika této úlohy je přenositelná do vzdělávání dalších oborů přírodních věd, s výhodou pro uplatnění moderního přístupu badatelsky orientované výuky. Při jejím uplatnění dochází k rozvoji klíčových kompetencí žáků, jež žákům poskytují spolehlivý základ všeobecného vzdělání orientovaného zejména na situace blízké životu a na praktické jednání.

Contact:
Ing. Helena Kilianová, Ph.D.
Palacky University Olomouc
Department of Geoinformatics
17. listopadu 50, 77146 Olomouc
+420 585 634 519, helena.kilianova@upol.cz