Conclusion

Presently the requirements for well-equipped recreational facilities by forest visitors are constantly growing. It is necessary to create conditions for recreation in forest environment that suit most of the of visitors requirements.

The result of this work is to use the already existing transport and recreational infrastructure for its further development and the increase of attractiveness of the interest area by designing and constructing 6 new trails and routes with the total length of 33 km, 3 starting points, 2 rest areas and forest trainer track equipped by small recreational buildings structures.

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Souhrn

Zájem obyvatel měst o využívání příměstských lesů pro rekreační účely v současnosti neustále narůstá. Znakem hospodaření v lesích s rekreační a zdravotní funkcí je tvorba esteticky působícího lesa a podmínek, které vyhovují požadavkům návštěvníky lesa, při zpřístupnění lesů v zájmovém území lesní cestní sítí a jejím následným využitím pro rekreační účely. Oblast zájmu je lokalizována na lesní celek Čermeľ, který patří do území Městských lesů Košice. Terénními pracemi byly zmapovány a následně analyzovány dopravní zpřístupnění vybraného území a aktuální stav rekreačního využívání a vybavenosti území rekreačními prvky. Nejdůležitějšími zjištěnými poznatky bylo, že území je dobře vybavené lesní cestní sítí a stav území z hlediska rekreačního využívání je také na dobré úrovni. Na základě zhodnocení těchto a dalších výsledků uvedených v práci byly provedeny jednotlivé návrhy tras a zařízení pro různé formy rekreace, které by doplnily zájmové území o další možnosti. V zájmovém území byla navržena cyklostezka, čtyři trasy pro jízdu na koni, trasa pro kolečkové bruslení o celkové délce 33 km, dále nástupní místa, odpočinkové místo na stávající turistické značené trase a cvičná dráha nedaleko rekreačního střediska. Jednotlivé návrhy jsou uvažovány jako možné perspektivy na zvyšování atraktivity zájmového území.

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RECYCLED ASPHALT AS A SUITABLE ALTERNATIVE TO QUARRY AGGREGATES FOR COMPACTING UNBOUND CONSTRUCTION LAYERS OF CYCLING AND HIKING PATHS

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Abstract
The idea of access to land for the purpose of recreational use should not only entertain socio-economic aspects but also the technical solution. One suitable environmental-friendly alternative is the use of recycled materials in the actual implementation of the project. The presented technical arrangement deals with the possible use of recycled asphalt for reinforcing cycling and hiking paths instead of natural quarry aggregates. For this purpose three test sections were constructed using differing technological reinforcement variants on the existing forest road near the popular tourist location of Brno city. The first section was created by mechanical chip seal technology (MCS), the second section was constructed by vibrated gravel technology (VG) and the third section was created by removing the original upper structural layer and replacing this with recycled asphalt according to operational reinforcement technology (OR). For each section of technological reinforcement deformation the characteristics of the pavement layer construction were monitored by using the static load test. This demonstrated whether recycled asphalt can be a suitable alternative for the reinforcement of recreational trails. This solution is technically simple, efficient, ecological and realisable for small owners.

Key words: cycle paths, recreational trails, recycled asphalt, bearing capacity, static load test, forest roads

Introduction

Recycling waste materials usually means the re-use of materials which have already been used (De Bier et al. 2010). The primary motive is the best possible saving of material resources, materials, fuel, energy and waste reduction, in other words, environmental economy (Cipnam et al. 2015). A secondary motive is that the materials can be recycled, preserving the environment, but we can also talk about the prevention of pollution (Jagannadha Rao 2015).
Due to the increasing volume of demolition work, building companies are under ideological pressure because society needs and supports the reuse of demolition waste (Jagannadha Rao 2015). In civil engineering there has been increasing consumption of recycled materials (Leite 2011). During road building recycled materials are frequently used in the lower layers of the road construction (Wen et al. 2014). Technological, environmental and economic aspects of asphalt recycling for road construction are presented in the study by Liu et al. (2016).
Recycled asphalt means a homogenized mixture of aggregate with asphalt obtained by milling, demolition, crushing and sorting of the upper layers of roads which is intended for further use in road building (Wen et al., 2013). Recycled asphalt mixtures can be frequently used for the construction of sidewalks, greenways and paths which together with slag, can replace crushed stone (Wu et al. 2014).

Materials and methods

The aim of the research is to verify the possibilities of using recycled materials instead of conventional crushed stone for the reinforcement of cycling and hiking paths. Research is being carried out in the territory of the Forest Training Enterprise "Masaryk Forest" Křtiny near Mendel University in Brno. A test polygon section of reinforced recycled materials was created on a forest hauling road Babidolská, north of Útěchov village, under the district forest administration of Vranov (coordinate system S-JTSK -596627, -1149535 m). The Babidolská forest road is primarily intended for seasonal transportation of logs. Local forests are near Brno city. The road is used all year round by recreational cyclists, pedestrians and also by the nearby stables riding Útěchov club, for horse riding.

In the test polygon which was created on the forest road, 3 different types of construction reinforcement layers were used. The constriction layers of recycled asphalt were formed using cold mix technology. For each section of technological reinforcement the deformation characteristics of the pavement structural layers were monitored using static load tests according to CSN 72 1006 (1998). Overall five measurements were carried out over a two month period. The first two measurements were made in November and December 2015. The third, fourth and fifth were conducted in April, June and September 2016.

The first measured section is created by a technology similar to the mechanical chip seal (MCS), from mixture fractions 0/80 but without water. The second section is constructed according to the vibrated gravel technology (VG), when a small fraction of recycled material 0/12 was vibrated to create a skeleton from a course recycled material of fraction 32/80. The third section is created by removing the original upper structural layer to half its thickness and replacing this with recycled asphalt fraction 0/12, according to the operational reinforcement technology (OR). This layer was operational reinforced and compacted. Every technology described in this solution is created with asphalt recycled layers.

The static load test carried out using the static load desk EMC – Static according to ČSN 72 1006 (1998), is used to determine the deformation characteristics described in documentation and indirectly determines the degree of soil compaction for a rigid and solid consistency of gravel fractions of loose material. To determine the level of deformation, the plate settlement modulus from the second load cycle (*Edef2*) was used. As standard required values for determining the degree of compaction ratio considering the modulus of the second and the first load cycle. As required standard values for determining the degree of compaction is considered as a ratio between the modulus of the second and the first load cycle (*Edef2/Edef1*). According to ČSN 73 6126-1 (2006), the ratio must be less than 2.5 (*Edef2/Edef1)*.

The static load desk is installed directly onto the forest road rut. The device EMC - Static automatically writes the value of the contact pressure (MPa) and pushing desk (mm).

Results and Discussion

At first the values of the plate settlement modulus from the second load cycle (*Edef2*), obtained by the static load test for individual construction variants according to ČSN 73 6126-1 (2006) Road building – Unbound courses – Part 1: The construction and conformity assessments, were compared. Partial results had been showing that the best variant of reinforcement was variant No. 1 – resemblance of mechanical chip seal technology (MCS), formed by mixtures fractions 0/80 without water. The values of the plate settlement modulus from the second load cycle were

between 81,6 – 98,4 MPa. The variant No. 2 – vibrated gravel technology achieved a range of values from 64,5 to 91,8 MPa.
The degree of compaction as per the ratio of modulus of deformation (*Edef2/Edef1*), based on an all test section polygon reinforced by recycled materials in values below the standard limit of 2.5. These values can be regarded as satisfying the requirements for common construction layers created by unbound aggregate according to ČSN 73 6126-1 (2006). However, the maximum values of the plate settlement modulus from the second load cycle (*Edef2*) were measured immediately after the first mechanical chip seal (MCS) and second vibrated gravel technologies (VG), were utilized.
The results indicate that recycled asphalt materials are a suitable solution for forest roads, cycling trails and hiking paths where this is the primary recreational land use. In particular, recycled asphalt can be used for building cycling trails because it does not exhibit such high dust levels as compared with conventional materials of unbound mixtures. They also provide greater wheel adhesion to the road surface. Fewer particles of the recycled materials are ejected when the roads are being used by cyclists. Sharper or bound materials such as recycled asphalt tends to lock together to provide a more stable and resilient surface. Recycled asphalt better encloses a reinforcing pavement. Recycled asphalt can be used for building footpaths in the upper vertical alignment instead of the rigid stabilizing elements.
However, negative phenomenon were observed in all variants of the solution which except for slight deviations increased gradually the ratio of the plate settlement modulus. In practice this means that as with classical crushed stone, regular maintenance is required using a compaction vibrating roller.

Conclusion
The construction, reconstruction and repair of bike paths and hiking trails offer a range of possibilities in which secondary recycled materials can be used. The use of recycled materials positively reduces the use of natural non-renewable stone sources. It also reduces waste from the repair or reconstruction of roads and works, and has overall environmental benefit. In addition, the cost of buying recycled materials is economically advantageous compared to quarry aggregates. Of course, it is ultimately necessary to comply with applicable legal standards, especially the Decree of 11 July 2005 no 294/2005 Coll., The Conditions of Depositing Waste in Landfills and Its Use on the Surface of the Ground and Amendments to Decree No. 383/2001 Coll., on Details of Waste Management.

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Souhrn
Myšlenka zpřístupnění krajiny za účelem rekreačního využití by se neměla zaobírat pouze socioekonomickými aspekty, ale i samotným technickým řešením. Jedna z vhodných ekologicky šetrných variant je využití recyklovaných materiálů při samotné realizaci projektu. Využití asfaltových recyklátů příznivě omezuje čerpání přírodních neobnovitelných zdrojů kameniva, snižuje objem odpadu z oprav a rekonstrukcí vozovek. Představované technické řešení zkoumá možnosti využití asfaltových recyklátů pro zpevňování cyklostezek a turistických pěšin, namísto přírodního drceného kameniva. Za tímto účelem byly vybudovány celkem tři zkušební úseky technologických variant zpevnění na stávající lesní cestě v blízkosti turisticky vyhledávaných lokalit města Brna. První úsek je tvořen obdobou technologie mechanicky zpevněného kameniva (MZK) bez vody, druhý technologií vibrovaného štěrku (VŠ) a u třetího úseku došlo k sejmutí původní svrchní konstrukční vrstvy, která byla poté doplněna o asfaltový recyklát technologií provozního zpevnění (PZ). Pro každý úsek technologického zpevnění lesní cesty byly sledovány deformační charakteristiky konstrukčních vrstev vozovky pomocí statické zátěžové zkoušky, které ukazují, že asfaltový recyklát může být vhodnou alternativou pro zpevňování rekreačních stezek. Statická zátěžová deska byla instalována přímo do koleje lesní cesty. Za směrodatnou charakteristiku pro nestmelené konstrukční vrstvy dle ČSN 72 1006 (2015) u pozemních komunikací je uváděn modul přetvárnosti (*Edef2*). Za směrné požadované hodnoty pro určení míry zhutnění, uvažujeme poměr modulu přetvárnosti z druhého a prvého zatěžovacího cyklu (*Edef2/Edef1*). Pokud srovnáme hodnoty modulu přetvárnosti (*Edef2*) jednotlivých variant zpevnění, lze dospět k závěru, že nejlepších hodnot dosahovala varianta č. 1 – obdoba mechanicky zpevněného kameniva (MZK) bez vody.

Hodnoty modulů přetvárnosti variant č. 1 (MZK) se pohybují v rozmezí 81,6 – 98,4 MPa. Dosažené hodnoty vypovídají o využitelnosti materiálů pro rekreační využití. Z pohledu realizace je navrhované technologické řešení technicky jednoduché, účinné a ekologické, realizovatelné i malými vlastníky a provozovateli cest.

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REVITALIZATION AND RECREATIONAL PROPOSAL OF THE VÁH RIVERBANK

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Abstract
Water, as a recreational element, is, in any form, an attractive feature in the landscape. It has high aesthetic qualities and offers many possibilities for passive or active recreation and social interaction. There are many rivers flowing through urban areas that have been channelized, but there are also many positive examples of riverbank revitalization and integration into urban green infrastructure. There are a few examples in Slovakia, where rivers and their waterfronts are an important recreational hub for citizens. In Šaľa the river Váh represents a valuable 'blue ribbon' with important natural qualities (semi-natural riparian woodlands) and social ecosystem services (sand beaches along the river). There is a large green area, with no definite open space conception. There are only a few paths and small fishing locations. This paper focuses on current trends in waterfront design, which are strongly influenced by existing and potential recreational activities connected with rivers and riverbanks. Several design solutions have been elaborated for the river Váh and its waterfront in the city of Šaľa. The main idea and philosophy of this design project demonstrates that accessibility, inclusiveness, and good design practices can improve the relationship between urban residents and the urban riverfront.

Key words: water based design, green infrastructure, trends in recreation, Slovakia

Introduction

The functions of water in the landscape are broad. In the rural areas, the river can flow freely, and river banks do not need to be so strictly regulated to fulfill the tasks of protection against flooding and their ecological and landscape functions become more important. Revitalization of the river banks are different in urban areas due to the need for optimal flood protection. The ecological, aesthetic, and environmental functions are inhibited, but the recreational function could be supported (Halaj, 2010). Components of the green and blue infrastructure provide health-improving benefits like fresh and cleaner air and better water resources (Tóth, Halajová, Halaj, 2015).

The principal users of the green and blue infrastructure in urbanized areas are humans, therefore these sites should focus on them. The waterfronts are places for stress relief, mental rejuvenation, education, contemplation, social contact and inspiration (while they still have ecological and environmental importance) (Lorzing, 2001 Hodaň, Dohnal 2008; Flekalová 2015).

Design guidelines for recreational use of water surfaces and streams has been the focus of several authors (Supuka, Vreštiak, 1984; Bell,1997; Lozring, 2001; Štěpánková, Bihuňová, Kabai, 2012). The main principle has been the safety of the visitors, creation of interesting landscape compositions using vistas, the mirroring of the water, the protection of habitats, and therefore a minimum negative impact of recreational activities on the environment. Recreational activities along the

waterfront is dependent on maintaining the hygienic quality of the water, which should be regularly monitored.

Material and methods

The City Šaľa is located on the banks of the Vah river, which flows from the Northwest to the Southeast, on the plane of the fertile lowlands, and has an area of 4,497 ha. According to the 2015 census, the town has 23,554 714 inhabitants. The climate is warm with an average of 50 summer days per year and is one of the warmest and driest areas of Slovakia. Warm summers, early onset of spring, and long sunny autumn months, predetermine the region as particularly suitable for summer recreation with its most significant attributes - swimming and water sports.

Tourism in the region of Šaľa is focused around the thermal water springs. The thermal pool Diakovce is one of the largest and the oldest ones in the region. In the village of Kráľová nad Váhom, the Váh river is dammed, and there's a large lake with a length of about 12 km and a width of about 2 km. There are opportunities for swimming, sailing, windsurfing, water skiing, and fishing. Near the village of Kráľová nad Váhom, about 3 km from Šaľa, there is a children's farm called Humanita, which offers a tour of more than 20 species of animals, a school for horseback riding for children and adults, various events for companies, and all-day school trips. There are 2 protected areas nearby Šaľa, including six natural monuments.

Several methods were used to elaborate the landscape architectural proposal for the bordered bank of the river bank of Váh, which is dedicated as a recreational hinterland for Šaľa citizens. The evaluation methods included a terrain survey, an inventory of the greenery (forest inventory with marking and evaluation of the most significant trees), a study of literature and historical sources, and finally questionnaires with users and municipality representatives. The office work was completed, including the preparation of the analytical maps, a landscape architectural proposal, and construction details.

Results

The researched area is in the central part of the cadastral area of the Šaľa city, on the west side of the Váh river bank. The territory is bordered from the Northwest side to the Southeast side by the river Váh and the rest of the borders are the urban structure of the city (private houses and gardens, blocks of flats, 3 hypermarkets, sports fields and allotment gardens). The city centre is a walkable distance of 600 m. The area is accessible from several points: from the city centre and residential zone, along the river, and from the bridge, which is in the middle.

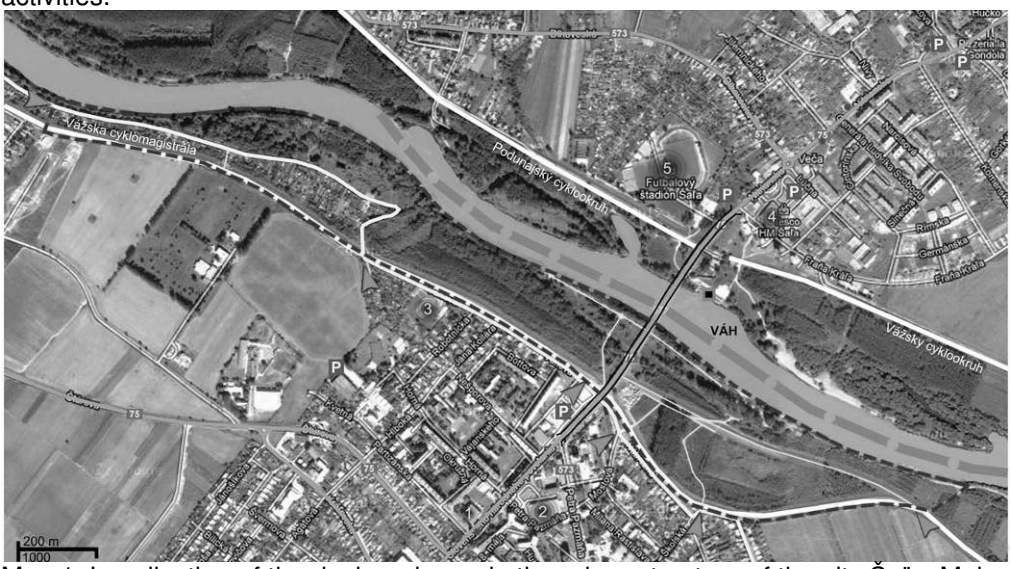
Functional and equipment analyses

The area is defined by a designated flood zone which protects the town from the outpouring of river Vah. The secondary use of the locality is recreation, because it represents a huge green overgrown shoreline with interlaced paths (for walking, running, cycling, horse riding). There are places for sports and volleyball games, fireplaces and big meadows. The waterfront is used mostly for fishing, and partly for swimming. The thermal spring is located on the upper part of the shoreline, near the allotment gardens.

Landscape analysis and potential of the site

The landscape surrounding the city Šaľa is characterized by fertile land, which is used for agricultural purposes. The Bio-corridor of the Váh river and Kráľová reservoir are significant elements from a landscape and an ecological point of view in this flat landscape. There are many water birds - gulls, wild ducks, swans, and

Gray Herons. The area is an important nesting place for Black-crowned Night-Heron. The reservoir behind the water dam has an important role, especially during the migration of water birds.
The designed area has the potential to be a main recreational park for Šaľa citizens with good access and infrastructure. Variability of open and shaded spaces in the area will serve as ideal conditions for recreation, relaxation, education, and sports activities. The area near the garden allotments, away from the busiest and overcrowded parts, could be a peaceful corner for fishermen. There is a possible space for dog lovers that would be sufficiently distanced and isolated from other activities.



Map 1: Localization of the designed area in the urban structure of the city Šaľa. Main entrances to the site are marked.


Map 2: Landscape architectural proposal with six thematic centres: 1. Prehistory, 2. Great Moravia, 3. Fortification in Šaľa, 4. Conquest of Šaľa, 5. The city Šaľa, 6. Atom park.

Vegetation analysis
The territory belongs to the Pannonian region, south Slovakian district and the Danube zone. This integration means that the species of flora and fauna that prevail are especially thermophilic, and often steppe species. Water and wetland vegetation are in smaller areas, but are extremely significant. The most important areas occur along the Váh river ecosystems, especially in the arms of the river, the lakes in the

inundation area, the dead arm outside the river banks area, and terrain depressions and their associated side slopes.
Non-forest woody vegetation has developed on the boundary bank of the river and in the areas which are not used for forestry management. The dominant native species of trees are willows (*Salix fragilis, Salix alba* and their hybrid *Salix x rubens*), white poplar (*Populus alba*), black poplar (*Populus nigra*). There are also large populations of non-native species such as acacia (*Robinia pseudoacacia*), walnuts (Juglans regia), *Negundo aceroides* and American ash *(Fraxinus americana*).

Landscape architectural proposal
The proposal for the River Váh waterfront is based on two ideas: "Š-A-Ľ-A" – "Šťastie Ako Ľudská Alternatíva" (Happiness as a man´s alternative) and "looking for the history". Our inspiration was the water, nature, the name of the city and its rich history, which we represent in six different functional sites.
The idea "Š-A-Ľ-A, happiness as a man alternative," represent life, recreation, water and the city Šaľa. The sentence and the idea, where the first letter of each word is the same as in the name of the city (Šaľa), became a motto of our proposal. It says that man always has a choice to make. Everybody can have an experience with nature, relax, have opportunities for entertainment and education in this area and can find something to make them happy. **Šaľa River Park** offers the possibility of meaningful leisure time and would help all users to break away from their everyday worries. The area is designed as a place for recreation year-round for all ages.
The second idea of the proposal, based on history and transformed into "looking for the history," creates a system of sites with historical themes, located along the boundary banks. The educational and interactive elements as well as elements for games invite users of all ages. The uniqueness of each area is shown through the features and stories according to the historical period connected with the city Šaľa: 1. Prehistory, 2. Great Moravia, 3. Fortification in Šaľa, 4. Conquest of Šaľa, 5. The city Šaľa, 6. Atom park.
The roads and paths are based on a functional division of the area and proposed zones. All of them should be comfortable and safe to pass according to the sports activities: running, cycling, in-line skating, walking or horseback riding. The material of the paths will have a natural character, as mechanically reinforced stones, forest trails and grass paths. One road with concrete blocks on the boundary bank is proposed for occasional vehicle access. The proposed social activities will create many possibilities to interact with other people.
There is a proposed amphitheater, a small buffet, and sanitation facilities. Near the amphitheater is an open-air gallery, which would occasionally serve as an exhibition for various artistic activities. Within this section are two proposed thematic areas: Great Moravia and Atom park. This area offers more open spaces, with a lot of solitary and small tree groups, enriched with perennial flower beds to bring color to the site throughout the seasons. Through the open meadows are several vistas to the surrounding landscape.
The west side of the bridge was kept as dense greenery in its natural character, and some new vistas were created and bird boxes proposed. There are several educational elements for the children – to learn the differences between tree barks, tree growth, age determination through tree rings, identifying plant and animal species that are in the soil and in the tree crowns.
The river bank of the Váh has been used for sports activities in the past, that's why we have kept or modified some of the sports grounds. The northern part of the park, near the garden allotments is proposed for fishing.

We propose the planting of native species of trees, representing the floodplain forest: *Fraxinus excelsior, Fraxinus angustifolia, Tilia cordata, Ulmus laevis, Ulmus carpinifolia, Quercus robur, Acer platanoides, Acer campestre, Carpinus betulus, Alnus glutinosa or Salix caprea, Populus alba, Populus nigra, Populus canescens, Populus tremula,* Padus racemosa, Sambucus nigra, Cornus sp.,Swida sanquinea, Viburnum opulus.

Conclusion

In European countries, the rivers flowing through the cities have high value from several points of view. They are a distinctive ecological and environmental element as well as a potential space for passive or active recreation. Many great examples can be seen in Vienna, Lyon, Warsaw, Madrid, Budapest, in almost every city in the western and northern Europe. There is some good revitalization happening in the Czech Republic (Kadaň) and in Slovakia (small section of the river bank in Bratislava). The interest of the City Municipality of Šaľa is the first step to improve the quality of life in this urban environment and a wise use of this natural resource.

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Souhrn

Řeka Váh protékající městem Šal'a se stala důležitým rekreačním prvkem a to především pro pěší návštěvníky, běh, plavání i rybaření. Tam, kde je řeka nejširší, Magistrát města nechal vypracovat architektonický návrh právě pro tuto lokalitu. Z hlediska rekreace bylo nejdůležitější vytvořit rekreační základnu pro obyvatele města. Zájmová lokalita je přístupná hned z několika směrů: směrem od centra města (to je vzdáleno cca 600 m), z obytné zóny, podél řeky od severu a z jihu přes most, který spojuje obě městské části. Návrh úpravy břehu řeky je založen na dvou

myšlenkách „Š – A – L‘ – A“ – „Štěstí Jako Lidská Alternativa“ a „hledání historie“. Bylo navrženo 6 různých míst, doplněných o vzdělávací a interaktivní prvky: 1. Pravěk; 2. Velká Morava; 3. Opevnění Šal'a; 4. Dobytí Šal'a; 5. Město Šal'a a 6. park Atom. Navrhujeme zde výsadby původních dřevin reprezentující lužní les: jasan ztepilý *(Fraxinus excelsior)*, jasan úzkolistý *(Fraxinus angustifolia)*, lípa srdčitá *(Tilia cordata)*, jilm vaz *(Ulmus laevis)*, dub letní *(Quercus robur)*, javor mléč *(Acer platanoides)*, habr obecný *(Carpinus betulus)*, olše lepkavá *(Alnus glutinosa)* a střemcha obecná *(Padus racemosa)*. Krajinná kompozice je založena na diverzifikaci otevřené polootevřeného prostoru a stinných míst, která budou tvořit rekreační, sportovní a sociální centra a úseky určené k rekreaci a poznávání. V návrhu je začleněno několik zastávek zaměřených na faunu a flóru daného místa, zaměřené na poznávání stromů, ptačí domy a též zmíněné zastávky věnované historii města. Část lokality od mostu s hustější zelení by měla být podle návrhu zachována, ale měly by zde být vytvořeny nové průhledy a relaxační zóny. Úsek nacházející se poblíž zahrad by měl být využíván rybáři. Silnice a cesty by pak měly rozdělovat daný prostor dle daných funkcí a dále by měly sloužit zejména pro běh, jízdu na kole, in-line bruslení, pěší či jízdu na koni.

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RISK ANALYSIS IN ENVIRONMENTAL IMPACT ASSESSMENT

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Abstract
The aim of this paper is to develop a methodology for the analysis and evaluation of environmental impacts of proposed activities for territorial development using a risk-analysis method. The application of developed methodology for the environmental impact assessment (EIA) process will produce indications for improvements, or for more effective implementation and performance of this process. The authors have determined that a risk-based approach may be applied in the EIA process in Slovakia. It is assumed that this process will be applied during the scoping phases of the EIA and will include consideration of potential impacts of developments on the environment and humans. To integrate risk analysis within EIA, it is appropriate that the criteria used within the EIA risk-based approach are consistent with the terminology and understandings used mainly within the water-management sector. The process of risk analysis according to the proposed methodology consists of four activities: creation of a set of risk factors ($A - Z$), determining the relative importance (weight) of the risk factors (w_i), creation of risk criteria for risk factors and determination of criterion scores (0.2 – 1.0).

Key words: Environmental Impact Assessment, risk analysis, multicriteria analysis

Introduction

While there are some studies in the literature considering risk analysis in construction projects (Zavadskas et al., 2010) studies of risk analysis regarding water management constructions, especially assessment of flood protection structures, are very limited. In classical project risk-analysis techniques, risk-rating values are calculated by multiplying probability and impact values, but direct analysis of the linguistic factors involved is often neglected (Dikmen et al., 2007). Various approaches for integrating risk analysis into the EIA process has been suggested e.g. (Kwiatkowski, 1998; Demidova and Cherp, 2005; Catchpole and Moreno, 2012). The applicability of risk analysis in the Slovakian EIA system has also yet to be tested (Zvijáková and Zeleňáková, 2013; Zeleňáková and Zvijáková, 2016; Zeleňáková and Zvijáková 2017). In our opinion this country could benefit from trying out the risk-analysis method, and we understand the importance of providing examples of its application. At the same time though, the risk-analysis technique must conform to the general impact-assessment approach on which the Slovakian EIA system is abused.
This paper introduces a new approach to environmental assessment of activities using risk analysis.

Methodology

The primary step in the initiation of the impact assessment of the proposed activity is a comprehensive understanding of the alternatives of the proposed activity. Considering alternatives is a critical aspect of the environmental assessment

process. Its purpose is to provide a framework for sound decision-making based on the principles of sustainable development (DEAT, 2014; Galas et al. 2013; Galas et al. 2015). It is important to know the characteristics of the current state of the environment, which is the main task in defining the context. For further steps in the procedure, it is necessary to know the current state of the environment in the area where the proposed activity is to be carried out.
The effort to produce an empirical description of several factors simultaneously leads to multiparametric risk description (Tichý, 2006). Environmental parameters are indicators of impacts/effects of structures (Zvijáková et al., 2014). The function of parameters is to enable relatively easily quantifiable measurement of the impact of the proposed activity on the environment. In the set of parameters, not all elements of the set Pa_i have the same relative importance in relation to the particular problem under consideration. This relative significance or importance is simply referred to as a weight parameter w_i [15]. For a summary of recommended methods for determining the weights of parameters, the criteria are clearly stated for example in (Říha, 2001) or (Křupka et al., 2012).

Results and Discussion
Each parameter (A – Z) then has a designated criterion for risk analysis (Table 1), divided into five levels. Each level of criterion has a score assigned (0.2, 0.4, 0.6, 0.8 and 1.0), which is entered into the calculation of risk indices.

These risk criteria were defined based on field studies and basic hydrological knowledge and experience as well as resources (Dub, 1969; Mosný 2002). For each parameter Pa_i (*A–Z*) is proposed the characterization of its determination (Zeleňáková and Zvijáková, 2017). Allocation of scores for each of the proposed parameters is performed in the application of the proposed methodology for a specific proposed activity. The assessor assigns one score Pa_i (0.2, 0.4, 0.6, 0.8 and 1.0) for each parameter Pa_i (*A–Z*) based on Table 1. The aim of the next step is to determine the *average weighted summation risk parameter* $AWSRP_j$ for each variant of the activity on the basis of all the allocated scores that reflect environmental impacts of the proposed activity calculated as follows:

$$AWSRP_j = \frac{\sum_{i=1}^{n} Pa_i w_i}{\sum_{i=1}^{n} w_i} \quad (1)$$

where: Pa_i is assigned score for each assessed variant (-), n is the number of all considered parameters (-), w_i is the weight assigned to each parameter (-).
By comparing these risk parameters, it is then possible to compare the variants of the proposed construction/activity. The order of suitability of assessed alternatives of the proposed activity is determined by calculating the average weighted summation risk parameter $AWSRP_j$. The ranking according Table 2 reflects what level of risk the assessed variant represents for the environment.
The lower the category of the proposed implementation of project, the more risky the activity is for the environment, and the higher is the level of risk of the proposed activity. The task of the last step is to propose measures to mitigate the adverse effects of the optimal variant of the proposed activity on the environment. Measures can have character of:

- territorial planning measures (e.g., need of harmonization with valid territorial planning documentation etc.);
- technical measures (e.g., changes in technology, raw materials, the construction timetable, revitalisation of the area, salvage survey);

- other measures (e.g., expected induced investments).

The proposal of measures to mitigate the adverse impacts of the proposed activity on the environment is an integral part of the methodology, as well as post-project analysis conducted within the EIA process.

Tab. 1: Evaluation criteria of risk parameters linked with proposed structures

	Parameter Pa_i	Score of parameter SPa_i				
		0.2	0.4	0.6	0.8	1.0
A	Specific runoff q_{max} ($m^3.s^{-1}.km^{-2}$)	≤ 10	11 – 50	51 – 90	91 – 140	≥ 141
B	100-year discharge Q_{100} ($m^3.s^{-1}$)	≤ 20	21 – 70	71 – 120	121 – 200	≥ 201
C	Design discharge Q_n ($m^3.s^{-1}$)	≥ Q_{100}	< Q_{100}	< Q_{50}	< Q_{20}	≤ Q_5
D	Annual precipitation H_z (mm)	≤ 500	501 – 600	601 – 700	701 – 800	> 801
E	Forestation *I* (%)	100 – 80	79 – 60	59 – 40	39 – 20	19 – 0
F	Coefficient of saturation *S* (mm)	≥ 21	16 – 20	11 – 15	6 – 10	≤ 5
G	Character of river (-)	stream	torrent	middle torrent	strong torrent	very strong
H	Longitudinal slope of the stream i_t (%)	< 2	2 – 5	6 – 10	11 – 15	> 15
I	Type of the basin (-)	-	elongated	transitional	feathery	-
J	Catchment area S_p (km^2)	≤ 10	11 – 30	31 – 60	61 – 90	≥ 91
K	Soil type (-)	sandy	clay-sand, sand-clay	loam	clay-loam	clay
L	Slope of the basin i_s (%)	< 2	2 – 5	6 – 10	11 – 15	> 15
M	Ecological significance of the area (-)	very low	low	high	very high	extremely high
N	Protected species of fauna, flora (n)	0 – 1	2	3	4	≥ 5
O	Change of the landscape (-)	preserved harmonic landscape, without disturbing elements	future appearance and character of landscape is not disturbing	impact of projcet on landscape creates risk of negative impact	presence of symptoms and disturbing elements in landscape	degradation of landscape
P	Cultural and historical significance of the area (-)	no	regional	national	national and sup-regional	international and national
Q	Archaeological/ paleontological and geological sites (n)	0	1	2	3	≥ 4
R	Population in the area (n)	< 100	101 – 250	251 – 500	501 – 1000	> 1000

S	Coefficient of built-up area (-)	≤ 0.02	0.021 – 0.025	0.026 – 0.03	0.031 – 0.035	> 0.035
T	Importance of transport (point)	≤ 1	2	3	4	≥ 5
U	Infrastructure of the area (point)	0 – 1	2 – 3	4 – 5	6 – 7	8
V	Production activity in the area (point)	0 – 2	4	6	8	10
W	Degree of environmental and human damages (-)	significant losses of property and human life are not expected	loss of human life and environmental damage is insignificant	loss of human life and damage to environment is unlikely	loss of human life and damage to the environment is likely	significant losses of property and human life are expected
X	Total cost of the proposed activity (EUR)	0 – 100 000	100 001 – 400 000	400 001 – 800 000	800 001 – 1 200 000	> 1 200 000
Y	Distance of activity from builtareas (km)	≥ 0.501	0.101 – 0.500	0.051 – 0.100	0.011 – 0.050	≤ 0.010
Z	State of flood protection objects (-)	construction of a polder and stabilization of the stream	regulation and stabilization of the stream in an urban zone	ensure the regulation of runoff water and flow capacity in the stream	maintenance of the river basin, the river bed and riparian vegetation	no technical flood protection measures are implemented

Tab. 2: Categorization of project based on multiparametric risk determination

$AWSRP_j$ (-)	Category of the activity	The level of the risk of the proposed activity for the environment
0.2 – 0.4	IV.	very low
0.41 – 0.6	III.	low
0.61 – 0.8	II.	medium
0.81 – 1	I.	high

Conclusion

The basic principle of the methodology is to calculate the risk index, which is an estimation of the level of risk that flood protection structures may represent for the environment. Risk analysis is based on the principle that every construction, not only by its technical character adversely affects the hydrological, morphological and geographical, ecological, archaeological, historical, and socio-economic characteristics of the area. Negative impacts can be quantified by calculating the risk index of flood-protection structures for the environment.
Determination of the values of the average weighted summation risk parameter $AWSRP_j$ for assessing the category of the proposed activity is directly related to comparing variants of the proposed action. The optimal variant is then identified on the basis of the lowest levels of $AWSRP_j$. This choice is justified in terms of expected impacts on the environment.

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Souhrn
Posuzování vlivů na životní prostředí navrhované činnosti je standardním výstupem v plné odpovědnosti navrhovatele. Náš metodický postup představuje kvantitativní přístup, který je založen na analýze rizika neboli multiparametrického vyjádření rizika. Cílem této metody je sjednotit způsob posuzování vlivů navrhovaných činností na životní prostředí a stanovení standardního postupu při výběru nejvhodnější varianty návrhu a objektivizaci procesu EIA. Navrhovaná metodika

posuzování vlivů na životní prostředí je použitelná na jakýkoliv typ stavby nebo vývojové činnosti, ačkoliv původně byla tato metodika navržena pro navrhování protipovodňových opatření. Kategorie rizika určující míru ohrožení daným plánovaným opatřením mohou být klasifikovány na základě AWSRPj (vážený průměr sumy jednotlivých parametrů rizika).

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RISK ASSESSMENT OF POTENTIAL REMOVAL OF TREE VEGETATION IN THE NORTHERN TERRACES LOCALITY, HRADEC KRÁLOVÉ

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Abstract
The aim of this study was to define risks to a city park on the slopes of the Northern Terraces locality in case of potential tree vegetation removal. The study was conducted as a field survey of local pedology and vegetation cover combined with potential evapotranspiration calculation. A hydrological model PERSiST was then used to estimate the rainfall-runoff process under the conditions of a climatic "standard" year (2013). The results indicated that the soils consist of deep anthroposols containing lots of debris and artefacts with high permeability and little shear resistance. There were two main vegetation types: park lawn and tree vegetation. On average, the total evapotranspiration was 30% higher for tree vegetation than for park lawn. The surface runoff from tree vegetation was negligible as most of the water was used by interception and evapotranspiration or transformed into subsurface runoff. In comparison, the runoff from park lawn was almost the same as from paved areas reaching approximately 30% of total precipitation. Tree vegetation proved to be a key agent in sustaining slope stability in this locality.

Key words: hydrological modelling; evapotranspiration, slope stability

Introduction

This paper presents the approach used for a study focused on the risk assessment of potential tree removal in the locality The Northern Terraces in Hradec Králové (later only STUDY). It was carried out by the authors from The Faculty of Forestry and Wood Technology of Mendel University in Brno on a request from the Magistrate of Hradec Králové Municipality. The aim of STUDY was to investigate the role of full grown trees growing in the locality in sustaining slope stability and what would be the risks associated with their potential removal.
STUDY was carried out as one-time Pedology survey and mapping of current vegetation in combination with modelled estimations of transpiration and the rainfall-runoff system in the PERSiST model. The aim of this paper is to present an original approach to risk assessment and the methods used.
Trees do control slope stability by a number of coexisting effects as summarized for example by Stone and Kalisz (1991):

- Trees have extensive root system that can reach several meters deep bellow the ground according to the soil type. Horizontally they usually reach wider, beyond the crown projection. Therefore, trees have a big potential to decrease the soil water content in deeper horizons and thus contribute to the mitigation of erosion and soil failure risk.
- The assimilation apparatus (be it leaves or needles) of trees holds precipitation water during the interception process on its surface and thus

decreases the amount of water falling on the ground and limits its erosive energy.
- Trees suck out water from the soil profile by the power by the sap flow rate during transpiration.
- Litterfall further protects the ground surface from water erosion and prevents the soil crust to be created which sustains positive infiltration capacity and the evaporation from both ground surface and the humus layer.
- Growing tree roots improve soil structure by increasing the portion of organic matter in the soil and by supporting the biological activity of pedo-fauna.

The effect of tree stands on the runoff processes has been studied for a long time across the globe. Here, we present the summary of relevant effects as of woody vegetation on discharge characteristics on the example of the Czech Republic described by Švihla (2001):

- Tree stands increase total precipitation if compared to tree-less areas by its effect on the microclimate
- Tree stands decrease the amount of discharge water during flood events and thus contribute to flood protection and mitigation. When compared to tree-less areas, the discharge during such events is decreased by up to 50 %. The main agent controlling flood mitigation is the interception by tree canopy reaching up to 45 % in somce case.
- Tree stands increase streamflow during dry periods sustaining more stable aquatic environment and water availability. During extreme droughts the discharge from stands can reach up to 150 % of that from tree-less areas.
- Tree stands enable the conversion of surface to subsurface runoff. Surface runoff in stands is usually negligible.

Materials and methods

The locality of STUDY was the Northern Terraces, a city park situated in the center of Hradec Králové (fig. 1). It is characterized by steep slopes of up to 45 % with northern exposition. The vegetation in the park consists of park lawn and islands of dense tree stands with continuous canopy. The borders of the STUDY locality were established as a catchment divide of a complete sub-catchment gravitating towards the city center. The risk assessment was carried out in three steps:

1. Pedology terrain survey
2. Vegetation assessment
3. Rainfall-runoff modelling

The vegetation assessment took place on the 24. 9. 2015. Different landuse categories were distinguished based on their expected hydrological behavior during the rainfall-runoff process. Inside of the locality the model catchment was established. The following landuse categories were distinguished during the field survey (Table 1):

- Paved areas – areas covered by solid material such as asphalt, concrete, etc. They consisted mostly of pavements, roads, house roofs gravitating towards the basin etc. The expected hydrological response was rapid surface runoff, no interception and very low evapotranspiration.
- Tree vegetation – areas with dense tree vegetation with continuous canopy. They consist mostly of park vegetation of full grown trees within the park. The expected hydrological response is high interception and evapotranspiration as well as low surface runoff and slow subsurface discharge.

- Park lawn – areas of intensively managed park lawn. The lawn is cut every two week during vegetation which greatly limits its interception potential. The expected hydrological response is low interception and medium evapotranspiration as well as some surface runoff and quick subsurface discharge due to small rooting depth.

Fig. 1: The Northern Terraces locality

Tab. 1: Landuse categories within the model catchment

Landuse	Area (m2)	Percent
Paved areas	24300	39 %
Tree vegetation	30100	49 %
Lawn	7500	12 %
Total	61900	100 %

The pedological survey was carried out in order to describe the soil profile most of all, its hydrological characteristics. Soil probes in the two different landuse types were dug and three soil samples were taking from different depths according to Zbíral (2002).
Potential evapotranspiration in the two landuse types was estimated by the Penman – Monteith method for a model growing season 2013 that was used as climatic "standard" year closest to the year of STUDY measurements. Together with climatic data (precipitation and temperature) of 2013 it was used as input for the modelling of the rainfall-runoff process in different landuse types in PERSiST. The model was calibrated against the observed measured pedological characteristics (soil profile depth, infiltration etc.) and the modelled evapotranspiration.

Results
The soil probes indicated some differences in the two landscape categories. In both cases the soil stratigraphy is quite similar characterized by A horizon consisting of allochthonous overburden material of various depths followed by a several meters deep heterogeneous mixture of debris, artefacts, cinder, ashes and soils of different

origin. This material arrived mostly likely during the development of the city throughout centuries. There was no lithic contact with the bedrock whatsoever. The soils are loose with high porosity and permeability close to the surface, with a lot of skeleton in the deeper parts. The main difference was that the soil under tree vegetation was more dense rooted and more compact probably caused by the weight of the biomass which indicated better overall stability.

Tab. 2: Comparison of total evapotranspiration, transpiration and surface runoff under the conditions in 2013 modelled in PERSiST

Landuse	Precipitation (mm)	Evapotranspiration (mm)	Surface runoff (m3)
Tree vegetation	569	406	8
Lawn	569	275	177
Paved areas	569	130	439

It is clear that the best “meliorating” effect is provided by tree vegetation (Table 2) by approximately 30 % compared to park lawn and 60 % to paved areas. The total runoff from tree vegetation during the year 2013 was negligible – basically most of the water is intercepted by the canopy or transpired to the atmosphere. Compared to this the surface runoff from par lawn is much higher reaching approximately 30 % of total precipitation or 77 % from paved areas respectively. The evapotranspiration from tree vegetation was approximately by a third higher than that of lawn and two thirds higher than that of paved areas.

Conclusion

Our results indicate that in case tree removal from the Northern Terraces locality by its conversion to park lawn, a radical disruption of local rainfall-runoff process would take place. Precipitation water otherwise used up by trees for transpiration would overflow the locality in the form of surface runoff. This could lead to overfilling of local canalization and would lead to an increased risk potential of local floods. With such dramatic increase of surface runoff the destruction of current slopes would be much more likely given their steep slope, pedological characteristics and the loss of anchorage by tree roots and increased infilatration.

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Souhrn

Předkládaná studie "Hodnocení rizik likvidace stromové vegetace v lokalitě Severní terasy v Hradci Králové" byla zpracována pracovníky Lesnické a dřevařské fakulty Mendelovy univerzity v Brně na základě zádání Odboru životního prostředí Magistrátu města Hradec Králové. Předmětem studie je vlastní hodnocení rizik likvidace stromové vegetace v lokalitě Severní terasy v Hradci Králové. Jejím smyslem je konstatovat zda a pokud ano, tak jaké hrozí riziko spojené s odstraněním vzrostlé stromové vegetace v uvedené lokalitě.

Likvidací zapojené stromové vegetace v lokalitě Severní terasy v Hradci Králové by došlo k dramatickému narušení místního srážkoodtokového procesu. Voda využívaná vegetací pro její růst by pravděpodobně procházela lokalitou formou povrchového odtoku (se zvýšením objemu podpovrchového odtoku), čímž by přeplňovala místní kanalizační systém a zřejmě by se zvýšila pravděpodobnost lokální povodně. Druhým neméně významným důsledkem odstranění stromové vegetace by byla pravděpodobná destrukce stávajících svahů, daná zejména jejich sklonem, půdními vlastnostmi, ztrátou kotvící funkce stromové vegetace a zvýšením infiltrace vody do půdního tělesa.

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RUNNING AS A FORM OF RECREATION IN THE POLISH FORESTS

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Abstract

The article presents the results of a research whose aim was to determine the social preference for the running in forests. Social preferences ware established on the base of on-line survey sent through the social media to different discussion groups, bringing together the enthusiasts of running. The survey included questions about the frequency and time running in the forests, factors determining the attractiveness of the forest as a place to run. The survey involved a total of 346 users of forests. The results pointed that the respondents occasionally run in the forests and do not often participate in organized sports events. The largest group of people running around in the forests are men, persons aged 35 - 44, running alone 2 - 3 times a week, with long experience in running (over than 4 year) and the average weekly training mileage of up to 10 km. Forests are an attractive place to run mainly because of the contact with nature, landscape, clean air and a friendly surface. Among the most frequently mentioned shortcomings of running in the forests were: lack of lit and marked trails, fear of ticks. The results may be useful in the planning of recreational infrastructure in forest.

Key words: forest tourism management, sport facilities, runners

Introduction

In recent years, in Poland, there has been an increased interest in running. According to Waśkowski (2014) various estimates currently show that 1 to 3 million Poles run. The development of running promotes greater social awareness of the impact of physical activity on the quality of life, health and mental condition of the person. Among other factors Waśkowski (2014) lists: running popularity in Western countries, increasing access of high-quality footwear, apparel and accessories for runners, as well as the growing number of mass running events. Also worth noticing is the running style, the relatively low cost of doing this sport and the lack of special requirements for the place of running. People have been running since the dawn of history. Over the centuries the course was used during hunting or escaping, and is now regarded as one of many forms of physical activity. Running, as noted by Waśkowski (2014), has seen many variants, described in the form of cross-country competition, eg. sprinting, mid-range, long-distance racing; Cross-country, mountain, orientation, relay, etc. At the same time as running sports, recreational jogging develops in Poland too. The basic difference between sport and leisure is the lack of competition. Recreational recreation is designed to regenerate strength, relax after work and maintain good health and fitness. On the other hand, rivalry, which is essential for running sports, is only an additional motivational element. The vast majority of recreational runners are also participants in cross-country tourism, which is a specialized form of sport tourism. Cross-country skiing has all the characteristics of sports tourism, raising and promoting a healthy lifestyle and shaping the will power by fighting its own weaknesses and external obstacles (Korzeva et al., 2014).

According to Ważyński (2011), the recreational needs of people, especially urban dwellers, are most beneficial in the forest environment. The recreational attractiveness of forest areas is due to the fact that they are generally available, while staying in forest areas, except for those that are part of national parks or some reserves, do not require any payment. The forest is one of the most outside part of the data that recreational space due to the characteristics bioclimatic-health, filtration and detoxification, physical and aesthetic and isolation features. The development of recreation in forest areas is supported by the fact that forests have the ability to attenuate noise and reduce wind speed. In the forests we are dealing with reduced insolation combined with greater humidity than open air. Moreover, the majority of forest is characterized by fitoncyde and aesthetic value of forest areas is also not without significance for man psychophysical regeneration. The above features of the forest make the forest an ideal place to popularize the idea of outdoor physical activity, including running. The purpose of this article is to determine the social preferences regarding the use of forests for recreational purposes, particularly those related to running.

Material and methods

Social preferences have been identified through an online survey. The study was quantitative and was carried out using a questionnaire posted on www.webankieta.pl. The data were collected in the period from 1st October to 20th November 2016. The study involved 346 people over 18 years. The survey was distributed through social networking sites (eg Facebook) among people interested in running. The wide range of social networking sites that published the survey invitations was aimed at reaching out to inform the survey of a very wide group of runners, both mass participants and those who practice running as a form of recreational activity they undertake. However, it should be noted that the test sample is not a representative sample for all Poles and is not a representative sample for Polish internet users. The survey questionnaire consisted of two parts. The first part included questions about demographic characteristics that the respondent (sex, age and place of residence) and the reasons for interest in running. The second part consisted of questions aimed at identifying key issues related to running in the woods, such as running frequency, distance traveled, etc., and questions for more detailed information, including the advantages and disadvantages of running in the forests.

Results

112 women (32%) and 234 men (68%) participated in the study. The largest group of respondents (45%) were people aged 35 - 44, the smallest (1%) - aged > 65. The share of respondents aged 25 - 34 was 33%, and aged 45 - 55 - 11%. In contrast, respondents aged 18 - 24 and 55 - 64 were 5% of the respondents in each case. The respondents were predominantly urban dwellers (76%) including over 500,000 the population indicated 56% of respondents, the city to 100 thousand the population - 31% of respondents and the city from 100 to 500 thousand the population - 13% of respondents. 24% of the respondents came from rural areas. Over 4 years of jogging or running sports 54% of respondents. Approximately 19% of respondents have been running for more than three years, 14% - for two years. 4% of respondents have been running their jogging adventure for a year. While 9% of respondents declared that they were running for less than one year.

Among the most frequently cited by respondents, the reasons for running were: improvement in health or fitness (29%), desire to relax or improve (24%). 15,5% of responses were declarations "I just like running". One of the important reasons for running are also the possibility of dropping unnecessary pounds (12% of responses) or the desire to improve their sports scores (10% of responses). Quite high, as 6% was the percentage of responses indicating jogging dependency. Among the least mentioned reasons for running were "running jogging" (0.5% of responses), interest in running among friends and family (0.5% of all responses) and high running costs (2.6%).

The vast majority of respondents (95%) believe that forests in Poland are an attractive place to run. The opposite opinion was 3% of respondents, while 2% did not comment on this.

The majority of respondents declared that they run in the woods most often in the summer (46%) or spring (25%). Winter was preferred by 11% of respondents, autumn (18%). Most respondents (63%) run in the woods several times a week, including: 2 - 3 times a week - 31%, once a week - 24%, 4 times a week - 8%. Once a month, 16% of respondents are in the woods, 2 - 3 times a month - 17%, and daily - 2% of respondents. 2% of respondents declared that they did not run in the forest at all.

Among the respondents a large group consisted of people running a weekly average of up to 10 km (38% of the respondents). Between 11 and 20 km on average - 32% of respondents each day, and 21 to 40 km - 16% of respondents. A relatively large group (10%) were respondents who claimed to be on average from 41 to 60 km per week. Over 60 km per week ran in the forests of 4% of the respondents.

The most frequently mentioned advantages of running in the forest were: contact with nature (22% response), clean air (21% response), landscape, pleasant environment (18% response) and adequate substrate (15% response) and no noise (14%). For less significant respondents, the respondents considered: lack of infrastructure slowing down typical urban streets, ie crossings with traffic lights, pedestrian crossings (6% of responses), no or no other runners (3% of the responses) or outdoor gyms, health paths, etc. (1% of responses).

Among the shortcomings of running in the forest, the respondents mentioned mainly: ticks (19%), presence of hunters (16%), lack of clearly marked or illuminated routes (14% each). Also fear of the bandits and animals living in the forest were frequently exchanged (13% and 12% respectively) of defects running in the forest. Among other factors limiting the comfort of running in the forests were: uneven pavement (8% of respondents) or telephone problems (4% of respondents).

Discussion

According to Dzięgiel (2014) data, women in the Polish women's runner environment account for about 20 - 30%. It is not surprising, therefore, that in the studies the share of women was significantly lower than that of men. Among the runners in the forests are middle-aged or younger. Similar results were obtained by Dusiński (2016). Mass specimens also show the predominance of runners aged 30 - 40 (Dzięgiel, Tomanek, 2014). As demonstrated by the research conducted, it is the city dwellers that mainly run. Similar observations were made by Dusiński (2016). Also, Dzięgiel and Tomanek (2014) found that 81% of respondents participating in mountain cross-country events came from cities, including 45% from cities over 200,000 residents. The main motive for starting a running adventure, according to the results, was physical fitness, followed by mood improvement. This observation is also confirmed by the study Dzięgiel (2014) and the results of the

Report - National list of runners 2014 (http://polskabiega.sport.pl/pdf/nsb_raport.pdf), prepared by the organization "Poland Runs".
Most of the respondents in the woods that runs several times a week, mostly 2-3 times a week. Similar results were obtained in Dusiński (2016) research. Taking into account the season's running preferences, it turns out that the preferences of people running in the woods coincide with the results of research on preferences for broadly understood forest recreation. For example, as the work of many authors (Vander Stoep, Duniavy 1992, Hammitt, Patterson 1993, Janeczko 2002), the most preferred season for recreation in the forest is summer followed by spring. A lot of people treat running as a physical activity by which you can lose weight or prepare for the next season of the competition, which takes place mainly during the summer months. From the National Cross-Country Report 2014, it also appears that there is a decrease in interest in running in winter and even in the autumn.
Regarding the results of the advantages and disadvantages of running in the woods, it was noted that, in the first place, the advantages were the characteristics of the forest environment, which determine the attractiveness of the forest as a recreation area (clean air, landscape, etc.). Similar factors were mentioned by respondents in studies conducted, for example, by Janeczko (2002). Aspects such as proper ground, or specialized cross-country infrastructure (eg cross-country trails) were not mentioned until very definite. On the other hand, one of the main disadvantages was the lack of legibly marked routes or no routes with no lights. Therefore, an important issue for the development of recreation in forests is their proper management. In particular, these activities should focus on the proper layout of the forest road network and the introduction of a road information system.

Conclusion

Lastly, running has become one of the most popular forms of physical activity. It is one of the simplest forms of recreation. The forest, especially for the city dwellers, is the place where they quickly and fully fulfill their leisure needs. Forest areas are considered attractive by the vast majority of runners. The analysis of preferences and expectations of respondents leads to the conclusion that for the development of running in the forests, promotion of the forest as a place of friendly running is crucial for the recreational development of the forest, including, above all, the care for the proper layout of the forest road network and their marking.

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Souhrn
Lesy a jiné zelené plochy a to jak ve městech tak i mimo ně jsou nejvhodnějším místem pro běh. Předkládaný příspěvek představuje výsledky internetového průzkumu mezi 346 respondenty běhajícími právě v lese. Daný průzkum řešil otázky týkající se frekvenci a délku trvání běhu v lese, míru atraktivnosti lesa pro běh. Výsledky ukázaly, že mezi respondenty je velký podíl rekreačních běžců, kteří běhají v lese. Největší skupinu běžců běhajících v lese tvoří muži ve věku 35 – 44 let, kteří běhají 2 – 3 krát týdně již více než 4 roky a průměrným týdenním výkonem 10 km. Lesy jsou atraktivním místem pro běh hlavně díky kontaktu s přírodou, čistý vzduch a vhodný povrch pro běh. Mezi nejčastěji zmiňované nedostatky běžců v lesním prostředí byly: nedostatek osvětlených a značených tras a strach z klíšťat. Výsledky mohou být použity při plánování rekreační infrastruktury v rámci lesních pozemků.

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SCIENTIFIC VS. VISITOR BASED CRITERIA FOR ASSESSMENT OF GEOTOURISM POTENTIAL AS A SUPPORTIVE TOOL FOR DESTINATION'S PERFORMANCE ENHANCEMENT

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Abstract
As geotourism and use of geological heritage for tourism purposes has become more and more popular worldwide, many authors have introduced their method how to set a specific value of geosite. Knowledge of such value may be helpful in the development and management of various, predominantly nature-based, forms of tourism. Most of the geosite visitors or possible geotourists, mainly in the areas of geoparks, are people from the general public with no special geo-education. Therefore, when considering effective geotourism development based on tourists' demand, use of scientific geosite assessment methods introduced by specialists in the field of geotourism and similar fields has very limited or zero potential. Moreover, very little research attention is paid to criteria and/or factors affecting visits of specific geosite by general public. This paper compares scientific and visitor based geosite assessment criteria. Results indicate that there are significant differences in these criteria. In addition, the paper discusses the possibility of use such assessment criteria, both scientific and visitor based, within specific destination to enhance the efficiency of its management and performance.

Key words: geotourism, geosite assessment, the general public, professional, destination

Introduction

Last decades have become a real challenge in the sector of tourism as many tourists or visitors have started to require more specific, special and/or alternative products from both tourism operators and local stakeholders. As the demand has gradually grown, various new forms of tourism have been defined all around the world from which many of them are well established in the market today. Moreover, rapid urbanization, recognition the importance of nature and nature-friendly behavior of one part of tourists in combination with various other factors of today's "fast lifestyle" resulted in the definition of nature-based tourism forms, including e.g. ecotourism or geotourism.

Geotourism as one of the recent global phenomena becomes more and more popular in different countries. Since it has been firstly defined only in 1995 (Hose 1995), it has a relatively clear concept, primarily based on abiotic part of the environment – geological heritage (geoheritage) represented by individual geosites. Recognizing geosites as an essential part of geotourism development, many authors have introduced various methods how to set the value of individual geosite. Nevertheless, tens of geosite assessment methods have been introduced including quantitative and qualitative approaches or their combination, comparing these methods, there is only limited number of specific criteria used within almost each method as mentioned by Kubalíková (2013) and Štrba et al. (2015). Additionally, application of various geosite assessment methods on specific geosites may result into different ranking within assessment final scores (Štrba et al. 2015).

This article compares the most frequent geosite assessment criteria used within

various geosite assessment methods (criteria set by professionals in the field of geotourism or geosciences) and criteria that are important from the visitor's (general public and often laic) perspective in order to specify specific geosite related factors that, when considering, may help to enhance the destination performance.

Material and methods

To achieve the aim of the study, quantitative geosite assessment methods introduced by various authors were considered in order to summarize criteria used within individual methods and to specify the most important criteria (assessment categories implemented within all or almost all method). In this study, assessment methods of following authors were used: Bruschi et al. (2011), Doktor et al. (2015), Pereira and Pereira (2010), Pralong (2005), Reynard et al. (2007), Štrba and Rybár (2015), Vujičić et al. (2011), and Zouros (2007).

For comparison, results of a pilot survey on criteria preferred by general public geosites visitors were included in this study also. Here, answers from 531 questionnaires filled by Slovak respondents were used.

Comparison of both approaches (professional geosite assessment criteria defined by various authors vs. general public criteria affecting geosite visits) results into a final list of potential categories that should be considered in the process of geosite evaluation.

Resulting geosite assessment categories represent a significant source of information and data which is possible to incorporate into existing destination analysis. Moreover, such valuable data can positively affect destination's performance.

Results and discussion

As mentioned above, relatively large amount of various assessment methods has been introduced in last two decades. Experts in the field of geosciences have defined more or less similar methodologies to set a specific value of an individual geosite. Table 1 summarizes criteria used within the individual method.

It can be assumed that the most frequent criteria affecting the final value of assessed geosite are: representatives, rarity or uniqueness, integrity or degree of preservation, geosite knowledge, protection, study conditions or viewpoints, accessibility, additional values, and economic value. These findings correspond to previous research results of Kubalíková (2013) and Štrba et al. (2015). These categories reflect experts' perspective of geosite assessment. On the other hand, these categories do not reflect or reflect at the very limited level the tourism demand and overall requirements of the general public (potential geotourists). On one hand, geotourism principles (Dowling 2011, National Geographic 2006) indicate that this form of tourism is primarily focused on general public (not educated in the field of geosciences) but on the other hand, there is only very a limited number of studies devoted to motivation or factors of tourists undertaking geotourism experience (e. g. Allan et al. 2015, Csorvási 2016).

A pilot study of factors affecting geosite visits by general public visitors in Slovakia indicates that laic (geo)tourists prefer different criteria when visiting geosite. These are: visual attractiveness of locality, access, tour/visit safety, uniqueness/rarity, information availability, tour/visit difficulty, time-limited visit, tour/visit length, possibility to gain knowledge, the number of tourists.

Tab. 1: Comparison of criteria used within selected geosite assessment methods

Criterion	Pralong (2005)	Reynard et al. (2007)	Zouros (2007)	Pereira & Pereira (2010)	Bruschi et al. (2011)	Vujičić et al. (2011)	Doktor et al. (2015)	Štrba & Rybár (2015)
recognizability / level of importance	x		x		x			x
rarity/uniqueness	x	x	x	x	x	x	x	x
representativeness	x	x	x	x		x		
geosite knowledge / information availability		x		x	x	x	x	x
level of interpretation						x		
viewpoints / study conditions	x	x		x	x	x		x
surface / geodiversity	x	x	x		x	x	x	
surrounding landscape and nature						x		
environmental fitting of sites						x		
ecological value	x		x	x				
current condition / integrity	x	x	x	x	x	x		x
protection level	x	x	x	x	x	x		
vulnerability / fragility			x	x	x	x		
suitable number of visitors						x		
accessibility	x		x	x		x	x	x
additional natural values					x	x		
additional anthropogenic / cultural values	x	x	x	x	x	x	x	
road infrastructure						x	x	
additional functional values			x		x	x	x	
Promotion						x		x
organized visits						x		
vicinity of visitors center						x	x	x
interpretative panels						x	x	
numbers of visitors						x	x	
economic potential	x	x	x		x	x	x	x

There is a notable difference between academic (scientific) and laic (the majority of potential visitors) understating of value or importance of individual geosite. Considering overall (geo)tourism development, it is crucial to take into account both approaches or combination of them. The fact is, that most of the visitors have no special knowledge and/or education and (at least for the first time) they do not understand and recognize e. g. the scientific value of specific geosite. Therefore, criteria presented by various authors, as shown in this paper (Tab. 1), have a very limited practical use for overall demand driven geotourism development Moreover, recently, in the time of information, data about geosite value may be effectively used to support responsible decision-making in destination management. But, local

stakeholders and regional/national authorities often use incomplete data (in some special cases no data) to create destination products and to attract potential visitors.
To monitor, manage and improve sustainability in tourism destinations controlled and managed at local level, European Tourism Indicator System (ETIS) has been developed in 2013. In general, it consists of two main indicator categories – core and supplementary indicators. Here, only one core indicator reflects abiotic natural heritage – D.7 Landscape and biodiversity protection. At this point, it can be assumed that ETIS does not reflect natural heritage that may attract visitors of various kinds of destinations (e.g. coastal area with cliffs, mountain areas – Alps, Carpathians, karst areas, etc.). The absence of such category (or categories) results into incorrect and/or incomplete picture of individual destination. Besides that, destination profile form given by ETIS does not include any information on geodiversity. There are only questions concerning dominant habitats and level of biodiversity. On the other hand, authors of ETIS support extensions regarding an individual destination's needs.
Knowledge of why a specific group of tourist wants to visit geological heritage as well as the knowledge of its value (whether academic – set by professionals of tourism-like – set according to preferences of the general public) may positively affect the performance of destination via effective destination planning and management. Therefore, more complex approach is required when creating a profile of the destination with an individual section devoted to natural resources and heritage, both living and non-living.
Besides update of the ETIS, such solution offers currently developed Destination Business Intelligence System (DBIS) that incorporates diverse types of information about the destination and its specific points of interest including geosites and is aimed at improving destination stakeholder's decision making within the managing and planning processes within the destination management via building own knowledge structures (Kršák et al. 2016). In addition, such innovative approach can generate positive economic effects (Duľová Spišáková & Stričík 2016).

Conclusion

Geotourism development requires specific approach respecting its principles (Dowling 2011, National Geographic 2006). Knowledge of the value of geosite in any part of the world helps us to recognize and understand its importance and position within the environment. To enhance the performance of destination via geotourism development it is necessary: (1) to set criteria affecting the performance, (2) follow the results and recommendations of assessment based on such criteria, (3) include information about geosites into destination's profile within destination based systems (e.g. ETIS) to create more complex picture of destination that may help to more precisely select future activities related to destination development in order to attract more visitors/tourists.

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Souhrn
Postupné narůstání popularity geoturismu v celosvětovém měřítku mělo kromě jiného za následek definování různých způsobů hodnocení geologického dědictví. Jednotlivé metodiky hodnocení vycházejí z hodnotících kritérií, které se od jednoho způsobu hodnocení k jinému víc nebo méně liší. Mezi nejpodstatnější hodnotící kritéria (obsaženy v každé nebo většině hodnocení) patří: jedinečnost, reprezentativnost, stupeň zachování, přístup na lokalitu, poznatky o lokalitě, možnosti pozorování, přidaná hodnota a ekonomická hodnota. Tyto kriteria odzrcadlují vědecký přístup k hodnocení geolokalit ale nereflektují priority turistů

(návštěvníků), kteří tvoři podstatní faktor při rozvoji geoturismu v jakékoli turistické destinaci. A právě efektivní využití kritérií preferovaných návštěvníky (vizuální atraktivita, přistup na lokalitu, bezpečnost, obtížnost túry/návštěvy, délka túry/návštěvy, možnost získat poznatky, počet turistů) ve vhodné kombinaci s vědeckým přístupem hodnocení geolokalit za využití současných forem určených pro destinační managementu jako je ETIS nebo DBIS můžou napomoci ke zvýšení výkonnosti destinace.

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SEASONAL GROWTH DYNAMIC OF NORWAY SPRUCE AT THE STUDY SITE OF RÁJEC (DRAHANSKÁ VRCHOVINA HIGHLAND)

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Abstract
The circumference increment assessment of Norway spruce focused on the effect of inter-tree competition in the mature spruce stand was made at the study site of Rájec (Drahanská vrchovina Highland) over a 5-year period. Data were collected from 49 trees, which were monitored continuously with mechanical band dendrometers from 2010 to 2014. The dependency of the circumference increment on competition index, diameter at breast height, Lang's rain factor, mean temperature of various periods and sum of precipitation of various periods was evaluated. Climatic conditions of the study site are characterised with warm and wet summers and cold-dry winters. In 5 years average around 61 % of the annual precipitation falls during growing season. There was highly significant correlation between relative increment and temperature ($p=2.324^{e-13}$) and significant correlation between relative increment and precipitation ($p=0.0439$). These results confirmed that inter-tree competition and diameter at breast height are sufficient variables for circumference increment estimation of unmeasured trees in the particular year. Coefficient of determination reached 0.25 – 0.63 for competition and 0.40 – 0.84 for tree diameter at breast height. The present investigation brings important results about tree growth and seasonal growth dynamics and its relation with competition and microclimatic conditions in mature spruce stand.

Key words: dendrometers, seasonality, Picea abies, stem girth increment, competition

Introduction

Norway spruce (*Picea abies* (L.) Karst.) is one of the most important European tree species and also a tree species with the highest number of various health and growth problems which have appeared in the last decades (Rybníček *et al.,* 2010). It is amongst the trees most strongly affected by forest dieback in Central Europe, which is generally attributed to industrial and automobile pollution (Eckenwalder, 2009). The presence of distinct seasonal changes is the main prerequisite for trees forming growth rings. However, our knowledge concerning the timing of the various phases and the rate of wood formation is still far complete (Savidge *et al.,* 2000; Chaffey, 2002). The seasonality of an organism's growth should be tuned to the annual cycle of resource availability (Muir *et al.,* 1997). For many regions, the period of wood cells formation remains unknown, or the variation of growth rate during that period. The main reason for the gaps in our knowledge is the difficulty in measuring xylem formation at short intervals (Chaffey, 2002).

Material and methods

The samples for the study were obtained at the study site of Rájec (Figure 1), about 30 km to the north of Brno (geographic coordinates N49°26'37"; E16°41'48"). The study site is located in the natural forest area 30 Drahanská vrchovina Highland,

forest vegetation zone 5 (fir-beech), representing about 2.7 % of the Czech Republic area. This study site was established for long-term detailed experiments for various scientific issues. The bedrock consists of intrusive rock acid granodiorite of Brno Massive (Hruška, 1980). The soil type was determined as unsaturated acidic brown forest soil (Klimo, 1992), and it is modal oligotrophic Cambisol (Němeček *et al.,* 2001). The site is situated at an altitude ranging between 620-630 m a.s.l. (Klimo, 1992) and in a moderate climatic region (Quitt, 1971). Mean annual air temperature at the study site is 7.1 °C and mean annual sum of precipitation 673 mm (Marková *et al.,* 2015).

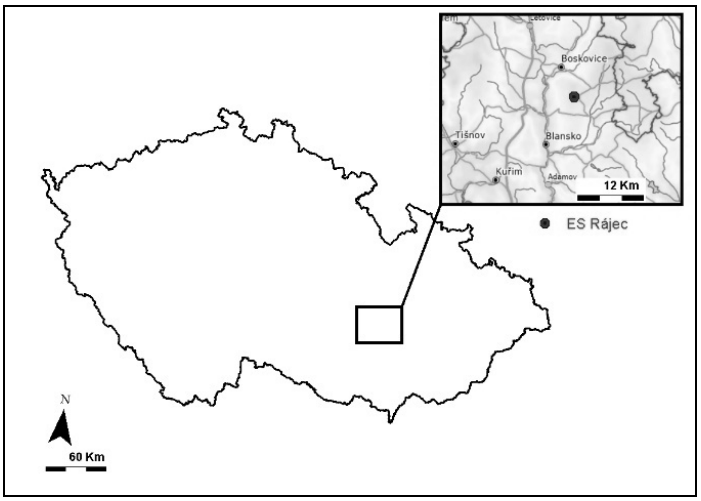

Fig. 1: Location of the study site of Rájec (the Drahanská vrchovina Highland)

Results

In this research a dendroclimatic investigation on Norway spruce from 2010 to 2014 (2009 was additionally included) was conducted. The number of trees (Figure 2) at the studied stand has decreased between 2010 and 2011 due to an intense cutting, as most trees have felt down because of the silvicultural management and/or severe climatic conditions.

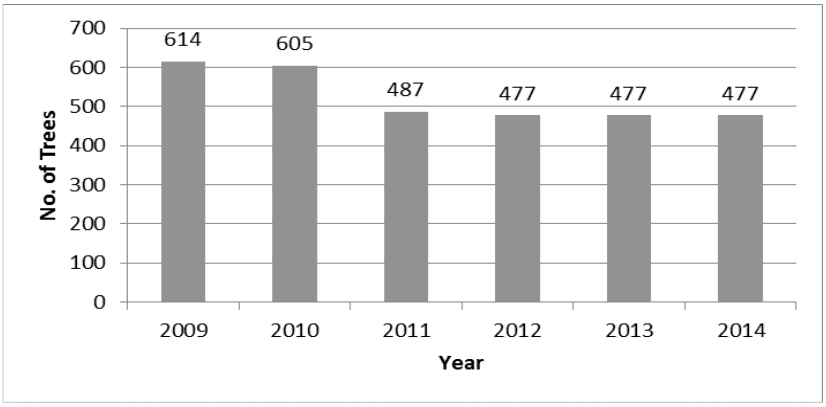

Fig. 2: Number of trees per year at the study site of Rájec (Drahanská vrchovina Highland) in 2009 - 2014

The relative increment of the girth of the portion of stem in individual years (5-year increment is 100 %) is shown on Figure 4. To see the effect of climatic conditions on stem girth increment there are shown only trees with recorded stem increment in whole 5 years' period. Figure 5 describes the relative increment of the stem girth in the studied years 2010 – 2014; the confidence interval was very wide (for comparison year of 2011 with the highest value of confidence interval and year of 2013 with the lowest confidence interval). The year 2012 showed the second highest confidence interval. Trees increment in 2013 had significantly lower than in 2012 and 2014.
At each of the development stages, climatic factors manifest different degrees of impact.

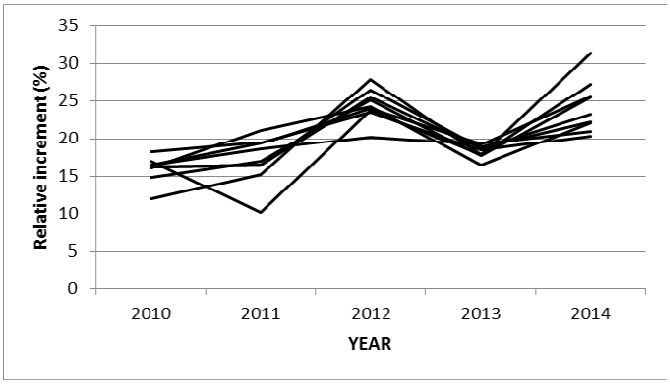

Fig. 3: The relative stem increment in spruce stand at the study site of Rájec (Drahanská vrchovina Highland) in 2010 – 2014

Discussion

The relative increment for any given year often integrates the effects of the previous and current's year's climate. There were tested 300 periods and combined all possible complex periods of the mean monthly air temperatures, and their correlations with stem increments, with the duration from one month up to January of the previous year to September of the current year, among which 25 best correlations of the girth or circumference increment with mean monthly air temperatures had positive highly statistical significant values. For all years, the green part on the Tables 3 and 4 represents the 25 best periods to estimate tree increments in current year; it is the indication of the best period to estimate tree growth. The period with the highest correlation of increment and mean monthly air temperature was from September of the previous year till September of the current year, i.e. the period of 13 months.
The growth of Norway spruce was statistically significantly affected only by precipitation in May of the previous year. In our case, the correlation was not good enough with precipitation to estimate the stem increment, as we had one result between significant and non-significant (***p=0.0439***). The second best correlation of the girth or circumference increment with precipitation is from July to September, either of the previous year was not statistically significant. The growth of Norway spruce was less statistically significantly affected by precipitation in September of the previous year and the precipitation in September of the current year.

Conclusion

The effect of climate, tree size (characterized with diameter at the breast height) and competition on variations in annual circumference increment of Norway spruce (*Picea abies* (L.) Karst.) trees were investigated in a mature spruce stand located at the study site of Rájec (Drahanská vrchovina Highland, the Czech Republic).

There were tested 300 periods of the mean monthly air temperatures, and their correlations with stem increments, with the duration from one month up to January of the previous year to September of the current year. All possible complex periods were combined. 25 best correlations of the girth or circumference increment with mean monthly air temperatures had positive highly statistical significant values.

The microclimate at the study site is characterized by warm-wet summers and cold-dry winters. This study revealed that competition index and stem diameter at the breast height were good parameters for tree growth prediction; correlation was very good with air temperature [$p<0.01$ (highly significant)], and it is possible to say that it is a good estimator in this case. The growth of Norway spruce was less statistically significantly affected only by sum of precipitation. Overall, there was highly significant correlation between air temperature and relative stem increment, and significant correlation between sum of precipitation and relative stem increment was confirmed.

It is obvious that unsuitable climatic conditions for spruce can lead to stem shrinkage during growing season. Here we assume that these responses are caused mostly by water storage deficit in stem and this leads to decreasing of the tree vitality.

This study provides new data revealing the basic growth processes of Norway spruce trees, and provides significant information to quantify the responses of tree growth to expected global warming. This approach provided a great opportunity to deepen our understanding and knowledge about the interactions of different environmental factors with the short-, medium- and long-term growth dynamics of one of the most important forest tree species.

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Souhrn
Předkládaný příspěvek se zabýval vlivem klimatu, velikostí stromu (charakterizováno průměrem kmene ve výčetní výšce) a konkurence na rozdílech v ročním přírůstu v obvodu smrku ztepilého *(Picea abies L. Karst.)*; zkoumané stromy se nacházely ve zralém smrkovém porostu v Rájci (Drahanská vrchovina, Česká republika).
Na dané lokalitě byly zjišťovány průměrné měsíční teploty vzduchu a jejich korelace s přírůsty na kmeni. Měření probíhalo od ledna předchozího roku do září roku následujícího. Jednotlivá měření byla spojena. Celkem 25 vzájemných korelací nabylo vysokých pozitivních statisticky významných hodnot.
Variabilita v přírůstu na kmeni se lišila dle velikosti stromů, dle konkurenceschopnosti a dle počtu dnů v daném měřeném měsíci. Je zřejmé, že nevhodné klimatické podmínky pro smrk mohou vést k zastavení či zmenšení během vegetačního období. Předpokládáme, že tyto změny jsou způsobeny především deficitem vody na kmeni, což vede ke snížení vitality stromu.

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SELECTED ISSUES OF ENVIRONMENTAL PERSONALITY DISPOSITIONS IN THE CONTEXT OF ENVIRONMENTAL EDUCATION

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Abstract
Environmental personality dispositions indicate typical individual interactions between humans and the surrounding environment. The elaboration of this idea in psychological literature we have encountered since the 70s of the 20th century, when scientists (e.g. Little, 1976, McKechnie, 1974, Gibson 1979) noticed differences in individual preferences in the perception of the environment and the resulting behaviour. Knowledge of these personality dispositions and especially self-awareness of one's own environmental preferences should be a part of environmental education and relevant concepts and options for practical application in education are discussed in this paper.

Key words: environmental preferences, self-reflection, environmental dimensions, practical exercises

Introduction

Environmental education and awareness is a globally recognized discipline that has been developing for decades in the Czech Republic. The goal of environmental education in the Czech Republic is the development of competencies (knowledge, skills and attitudes) required for the environmentally responsible action - it means the action - that is under a specific situation and its opportunities are the most beneficial for the current as well as for the future state of the environment. The environmentally responsible action is seen as responsible individual, civil and professional behaviour concerning the treatment of nature and natural resources, consumer behaviour and active influence of the environment using democratic processes and legal means. Environmental education and awareness prepares and motivates people for this kind of actions, although the real behaviour is a matter of free choice of each individual.[5]

According to the U.S. Environmental Protection Agency the components of environmental education are[6]:

- Awareness and sensitivity to the environment and environmental challenges;
- Knowledge and understanding of the environment and environmental challenges;
- Attitudes of concern for the environment and motivation to improve or maintain environmental quality;
- Skills to identify and help resolve environmental challenges;
- Participation in activities that lead to the resolution of environmental

[5] Environmentální vzdělávání, výchova a osvěta [Online] [cit. 2017-03-10]. Available from: <http://www.mzp.cz/cz/evvo>

[6] What is Environmental Education? [Online] [cit. 2017-03-15]. Available from: <https://www.epa.gov/education/what-environmental-education>

challenges.
Environmental education does not advocate a particular viewpoint or course of action. Rather, environmental education teaches individuals how to weigh various sides of an issue through critical thinking and it enhances their own problem-solving and decision-making skills. Environmental education[7]:

- Increases public awareness and knowledge of environmental issues;
- Teach individuals critical-thinking;
- Enhance individuals' problem-solving and decision-making skills;
- Does not advocate a particular viewpoint.

The components of environmental education show that its important part is self-reflection, which is a prerequisite for responsibility and a platform for the evaluation of own actions. Self-reflection is a part of the personality structure and one of the prerequisites of the personal development; this paper is focused on the methods for awareness of own environmental preferences and also brings examples for practical application on personality development in this area.

Material and methods

This paper is based on the overview of relevant written sources which form the platform for suggesting practical exercises for self-reflection and understanding of own environmental preferences and behaviour.

Theoretical background

The topic of nature and environment became a hot issue for psychologists in the early twenties of the last century. First, psychologists were focused more on the influence of environment on man (J.B. Watson, K. Lewin, E. Brunswik). Environmentally minded researchers recognized the need to examine the relationship between environmental stimuli and human reactions, and to use this knowledge for solving current problems. So the new discipline has been created gradually; that time environmental psychology was defined as the study of environmental influences on the human psyche. In the relation person - environment play an important role personal variables - e.g. differences in perception, evaluation and attitudes, which are reflected in the resulting behaviour and which also gradually became the subject of the studies of psychologists and sociologists.
Since the 1970s studies of perception-appraisal processes in the real world context (Ittelson, 1978; Gibson, 1979; Zube, 1980, 1982) have prepared the ground for the proliferation of studies assessing the aesthetic quality of landscapes. The three central concepts characterising these studies (aesthetics, landscape and quality) and the investigation of the relationships between them has determined the character and significance of the developing research in this field.
Within the framework has gradually developed landscape evaluation studies and preference studies (see for example, Gold, 1980, or Penning-Rowsell, 1981, 1982).
For determination of ways of behaviour in the relationship human-environment play an important role personality variables. One of the first concepts hypothesized that some individuals are more oriented toward things and environment, others on the contrary are rather more oriented toward the people. This idea was elaborated by

[7] What is Environmental Education? [Online] [cit. 2017-03-15]. Available from: <https://www.epa.gov/education/what-environmental-education>

Brian R. Little (1976), who distinguishes four types of "specialists", according to their cognitive, affective and behavioural reactions to people and things:
1. The non-specialist - express little interest in the world of things and people. He perceives things more personally (such as people) and persons more physically (as things). He is generally less active in exploring and he avoids situations that require his assistance.
2. Person specialist - is focused on the emotional aspects of other people and on encountering them. He is prosocial, empathetic and has educational tendencies.
3. Things specialist - is interested mainly in material objects, for example in machines, and in other human artefacts. He strongly prefers order, practicality, comprehensibility. He focuses on activities that require mechanical, handling and analytical skills.
4. Generalist - is widely oriented. He is interested in things as well as in people; the problem may be an information glut.
George E. McKechnie (1977) is the author of ERI - Environmental Response Inventory, 184 items test, which is the best known multidimensional methodology for measuring the environmental dispositions that are relevant in everyday interactions of a man with the environment. The method consists of eight scales of environmental dispositions (and of one independent, validation scale):
• Pastoralism - the tendency to defend the landscape against changes, to protect nature and natural resources, to prefer satisfaction in the natural environment and sensitivity to environmental experiences.
• Urbanism - the tendency to enjoy the stay in the areas with high population density, i.e. in cities; preference of interpersonal and cultural stimulation.
• Environmental adaptation - modification of the environment for human needs; the use of technology for solving environmental problems.
• Stimulus Seeking - interest in traveling and discovering new places, finding pleasures and intense physical sensations.
• Environmental Trust - general environmental openness and responsibility, competence in finding own way in the environment, experiencing home safety and minimal fear of unfamiliar places or loneliness.
• Antiquarism - the joy of historic sites and old things, preferring traditional design, aesthetic sensitivity for the country, the tendency to collect things for their emotional significance.
• Need for privacy - the need for physical isolation from incentives, searching for loneliness, avoiding neighbours, entertainment and any distraction.
• Mechanistic orientation - focus on mechanics and technological processes, enjoyment of work with "own hands", monitoring the functional characteristics of objects.
• Communality - validation scale, which measures the openness and honesty of tested attitudes.

Similarly, Kaplan and Kaplan (1989) distinguish seven environmental preferences (Nature, Suburbs, Romantic Escape, Modern Development, Social, City, Passive Reaction to Stress) and they developed EPQ - Environmental Preference Questionnaire.

Chawla (1999) conducted standardized interviews with open questions with several dozen of environmentalists in the U.S. and Norway. The respondents were selected to represent a relatively large breadth of environmental activities (not only members

of environmental organizations and teachers of environmental education as it was in previous surveys).
On the first place the respondents mentioned (as the source of their environmental motivation) experiences with the contact with nature, on the second place were answers related to examples of family members; in these cases their experience of their contact with nature dates back to childhood (e.g. garden near lake and forest, where they as children played, grandparents´ cottage or farm visited during childhood or favourite hiking trails during the university years.) Always it was a place that was somehow connected with a regular rhythm of life.
On the third rank were placed environmental organizations and recreational organizations, whose program is associated with the stay in the countryside. Respondents were remembering Scouting (Boy Scouts / Girl Scouts), organizations dealing with social issues (Third World solidarity groups) and civil organizations dealing with local issues.
On the fourth place of the motives which prompted the respondents´ interest in environmental activities were their negative experiences. Essentially two groups can be distinguished with the negative experience: the experience associated with the destruction of a personally significant place; and fear due to threats to health harmful substances (pollution, radiation).
The following influences were associated with formal education (e.g. an inspirational teacher or lessons, field trips, internships); and also other factors were mentioned (influence of friends, experiences form the employment, sense of social justice, the book or the author transmitting environmental messages, religious principles, interest in the future of children or grandchildren).
According to Krajhanzl (2009) not all people who are sensitive in their contact with nature behave also environmentally friendly. The author distinguishes "a man with a higher environmental awareness" who is motivated to protect the nature and the environment and "a man with a low environmental awareness" who is environmentally lax and indifferent. In the worst case, this type can fight against conservation activities and does not hesitate with activities that damage and destroy the environment.
Adding other dimensions - describing the relationship between the individual and nature - "the alienated" or "not alienated ", "with a close relationship to nature" and "remoted to nature" Krajhanzl (2009) distinguishes these following types :
1. Cottager - a man who wants to be in nature, this type represents the need for the contact with nature.
2. Soldier - a man trained to survive in extreme environmental conditions; it means a man, who can live in the nature and with the nature; a man capable of contact with nature.
3. Nature writer or poet - an individual who strongly perceives the surrounding nature; an example of environmental sensitivity.
4. Conservationist - a man who protects nature, who has ecological awareness.

Results - Practical application
Self-recognition is the process of understanding of own personality in a variety of situations, and which results in the recognition of motives and causes own behaviour. Methods of self-recognition can be used effectively also for environmental education because knowledge of own environmental preferences can significantly affect the decision-making processes and the actual environmental

activities. This chapter provides examples of the three exercises that are designed or modified by the author of the paper for group work with adolescents and adult[8]s:

The Perfect Holiday Week

This exercise is inspired by the method of McKechnie (1977) and aims to reflect and clarify own preferences and to compare own preferences and the preferences of other members in the group. Respondents are asked to imagine that they can take a week off and they have a choice of the following options:

• The stay in the nature with environmental activities: You will stay in the picturesque countryside, you will take trips and spend a part of the stay with conservation activities such as collecting garbage in the forest, planting trees, monitoring wild animals etc.

• The cities tour: You will visit several metropolises, you will see the local sights, meet with locals in traditional festivities; in the evenings you will have time to visit theatres, cinemas or evening clubs.

• The sightseeing tour on the theme "people change the environment": You will see extensive works that are fundamentally changing the environment (dams, parks, artificial canals, lakes, islands, changes in the types of fauna and flora).

• The week for adventurers: A week with very intensive traveling, hiking and diving; you will reach the mountain tops and bottoms of the seas; you will discover untouched places and experience a lot of adrenaline.

• The survival course: You will learn how to navigate in the wild nature and how to use available natural resources for the survival; you will also spend a night in the wild and take a lot of activities focused on living in harmony with nature.

• The historical week: You will visit a number of historical sites, monuments, museums and open-air museums, learn passively and actively about old habits, crafts and ways of life.

• The week of peace: You have an opportunity to choose any place where you can be alone and enjoy the peace of solitude.

• The creative week: If you like to create something, you can choose your favourite activity and you can improve your skills under the supervision of experts.

Participants sort abovementioned activities according to their preferences from one to eight. Then the participants form groups according to their:

a) Similarity of preferred activities (similarity on top places of the order); Participants discuss what they have in common that and what is different; they compare themselves inside the group and then compare their group preferences with the other groups.

b) Similarity of rejected activities (similarity of the last places of the order). Participants discuss again what they have in common and in what they differ; they compare themselves inside the group and then compare their group preferences with the other groups.

Exercise will be completed by reflection as their own preferences (and non-preferences) manifest in their life, in their environmental activities.

The Physiognomic test applied in the environment

[8] These methods can be used for self-knowledge as well as for the research. /author´s note/

Physiognomic test is often used in marketing (Slaměník, Výrost, 1998); it is one of the matching techniques that are based on the assumption that people associate together these qualities from offered possibilities according to their subjectively considered optimal match.
If we apply the physiognomic test on environmental education, respondents will match various portraits of people with photos of various environments (i.e. who fits best in which environment). Then we can continue with questions:

- What are the characteristics of each type of person?
- What is their profession?
- How do they behave towards the environment in the picture?
- How do they behave generally to the environment?
- Which environment is the most sympathetic to me and why?
- Which environment is the least sympathetic to me and why?
- With which person on the pictures am I identified?
- Which person is the least likeable and why?

Participants first work independently; then it is followed by a group discussion.
Another task using visual artworks of various environments (now without portraits) is the mutual matching of the participants with the environment and comparison (i.e. which environment they would choose as the representation of their personality and which environment would chose for them the other participants). This exercise is followed by evaluation in which are compared all options. This activity is finished by a releasing discussion in which the participants can express their feelings of the results of this exercise.

Unconscious preferences of the environment
This exercise is based on the scale technique of colour matching, which measures the individual emotions and attitudes that the respondent expresses - in this case - to photos of various environments.
The respondent matches three coloured cards from the offer of 12 to 18 coloured cards with each picture of a specific environment. The colours are matched according to the individual opinion how they express or represent the environment in the picture. It is followed by a pause filled by another activity and then the respondents return and continue in this technique; now the participants are asked to sort colours according to their sympathies. This technique is based on the assumption that people match sympathetic colours with sympathetic subjects and vice versa. This exercise is completed by a discussion focused on the individual and group comparison; for example whether sympathetic colours correspond to the preference of the environment; if not the possible causes of this result should be considered. Also the group preference of environment and causes of the positive and negative feelings to each environment can be discussed.[9]

This brief example of three exercises is an example showing how we can work with the participants so that they realize their perception and their evaluation of various environments as well as their environmental activities. It also can help them to be

[9] We should be aware that these exercises can also open individual positive or negative experiences or even trauma that are associated with the pictures. In this context this methods can be used for psychotherapy but within environmental training the lecturer should try to avoid deeper analyses or opening of any problems where the solving is out of his/her competencies. /author´s note/

better aware of own environmental preferences - which environmental aspects they favour and which they neglect or ignore, and how this facts manifest in their behaviour in relation to the environment.

Conclusion

Environmental education and awareness should not be limited to the school age, but it should be included in the working environment, the company culture, in the training of managers and staff; and it should not be implemented in a "violent" form, which can elicit even more resistance, but ideally it should be perceived as a natural process increasing the total credit of companies.

We can talk about the successful environmental education and training when environmentally positive values and standards are internalized and when the individual has a plenty of moral volitional qualities for promotion of these pro-environmental attitudes and when he/she is able to "fight" against a group, company or societal pressure, which is often focused only on the economic profit without consideration environmental, societal and global consequences. E.g. Shrivastava (in Stead and Stead, 1998) proposes to include in business organizations so called "ecocentric management paradigm" that set nature in the centre of the interest of management and organization. The problem is that managers tend to be trained only on one subsystem of the Earth - the economic subsystem which cannot exist in the isolation from other subsystems. But long-term economic development can exist only within the ecosystem that has enough energy and resources to maintain it. Another problem can be seen just in the term "to educate" because the mere information without enjoying own experience is much less effective than providing information in form of experience that is often connected with emotions and where is a greater chance for internalization of the knowledge.

In this paper were presented in the theoretical and practical level examples of possibilities of using self-reflection of own environmental preferences that should increase competences in this area. Within the social corporate responsibility companies should integrate environmental education into their corporate culture and structures, and they should be able to include a relevant environmental training in motivational, development or outdoor programs.

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Souhrn
Důležitou složkou environmentálního vzdělání je sebereflexe, která je předpokladem odpovědnosti a je platformou pro hodnocení vlastního jednání. Sebereflexe je součástí osobnostní struktury a jedním z předpokladů osobnostního rozvoje; a právě možnostmi uvědomění si vlastních environmentálních preferencí a příklady praktické aplikace na osobnostní rozvoj v této oblasti se zabývá tento příspěvek.
Ve vztahu osoba – prostředí sehrávají důležitou roli osobnostní proměnné – rozdíly v např. percepci, v hodnocení a v postojích, což se projeví ve výsledném chování a což se taky postupně stávalo předmětem studia psychologů a sociologů.
V teoretické části jsou zmíněny studie a koncepty, které řešily vztah člověk prostředí z hlediska hodnocení krajiny (např. Ittelson, 1978; Gibson, 1979; Zube, 1980, 1982, Gold, 1980, Penning-Rowsell, 1981, 1982); z hlediska výchovy a motivace (Chawla, 1999, Krajhanzl, 2009), z hlediska osobnostních preferencí, tendencí či dispozic (Little, 1976, McKechnie,1977). Metody sebepoznání lze účinně využívat i pro environmentální výchovu neboť znalost vlastních environmentálních preferencí může podstatně ovlivnit rozhodovací procesy i samotné environmentální chování. V empirické části jsou uvedeny tři příklady praktických cvičení pro uvědomění si vlastních environmentálních hodnot, která mohou být využita jak na úrovni studentů středních či vysokých škol, tak také pro environmentálního vzdělávání manažerů a dalších zaměstnanců v rámci sociální odpovědnosti firem např. během outdoorových či dalších motivačních a rozvojových aktivit.

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SNOW AVALANCHE THREAT IN RECREATION AREA MAGURKA, NÍZKE TATRY MTS.

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Abstract
Nowadays, there is growing trend to build new recreational objects in mountain areas. Many mountain villages have been extended into areas never built-up formerly. In these cases, natural hazards such as floods, avalanches and similar are often neglected or wrongly considered as receding. The recent climate change, however, is characterised with an increasing frequency of natural extremes, which may result in dangerous natural events. Our work exemplifies this issue with a mountain settlement Magurka situated the Low Tatras Mts. Slovakia. Over the last decade, this settlement has expanded considerably, with certain houses located at potential avalanche paths. We used a model ELBA + to simulate snow avalanche with its possible impacts. The results validation was carried out based on reconstruction of the historical avalanches from year 1970, belonging to the most disastrous in Slovakia. The results confirm that there is a potential avalanche threat to the village and that the model is applicable in spatial planning.

Key words: snow avalanche, spatial planning, ELBA+, Vavrinka valley,

Introduction

Avalanches are common events occurring in Slovak mountains during winter. Mountain settlements dwellers as well as sport and tourism oriented visitors need to consider avalanches as a tangible phenomenon with already many human victims on account. Since long, people have been seeking for ways how to protect themselves against avalanches. To prevent avalanche formation or to abate disastrous avalanche effects, there have been applied various measures working with prevention, technology, biology and management (Bukovčan 1960). Biological measures primarily mean foresting of the territories related. Midriak (1977) declares that a vigorous forest with permanent appropriate age structure can serve as effective protection against avalanche formation over the forested area. Forests also affect snow cover accumulation and ablation (Holko et al. 2009; Hríbik et al. 2012). Recently, there is an evident large-area spruce forest decline and shift spruce zones due to climate change (Minďáš, Škvarenina 1995; Ďurský et al. 2006; Grodzki et al. 2006; Plieštiková, Škvarenina 2009; Mezei et al. 2014; Fazekašová et al. 2016; Rončák et al. 2016; Sitko et al. 2016). Today, the decision-making on avalanche-protecting measures, preventive as well as technical, can noticeably be supported from software applications, primarily the ones that represent simulating programs, such as RAMMS, ELBA+, AVAL 1D.

Materials and methods

Study area

The mountain settlement Magurka is a former mining settlement, located at 1 036 m a.s.l. in the upmost part of the Ľupčianska mountain valley, under the principal

mountain ridge of the Low Tatras Mts, the segment Chabenec-Latiborská hora. Belonging to the village Partizánska Lupča, the settlement is almost 20 km apart. Recently, the built-up area of Magurka has been extended considerably (Fig.1), with recreational buildings. This paper tries to find out whether these houses are situated in a potential avalanche hazard zone. The locality Magurka with its surroundings mostly consists of crystalline Tatric rocks (SGIDŠ 2008), on surface transformed into cambisolic podzolic soils, in higher situated sites modal and humus-iron soils (Šály, Šurina 2002). These soils are low productive with low environmental potential (Vilček,Bujnovský 2014). Magurka belongs to the cold oceanic climate zone (Vilček et al. 2016). The dominant forest cover is spruce with admixed fir and beech, in higher situated sites rowan and alder. The uppermost zone is dwarf pine. (Škvarenina et al. 2004; NFC 2012).

Model ELBA+

Model has been developed by NiT in Pressbaum, Austria (VOLK 2005). The input data processing requires creating a specific owner´s database. This is possible directly from the ArcGIS environment. Our input data represent: area of interest, avalanche release site, and digital elevation model (DEM). There are also provided snow cover parameters (snow depth, density). The data for simulation were acquired from archive-preserved materials supplied by the Slovak Avalanche Prevention Center (APC), Mountain rescue service (MRS). The APC also provided orthophotos, DEM, vector-expressed release sites and data on forest condition in the past. The actual forest area was assessed through vectors, based orthophotos taken in 2010, with a grid cell size of 0.5 m in the coordinate system S-JTSK Krovak East North. DEM with a grid cell size of 5 m was derived from DEM third generations with a grid cell size of 10 m.

Results and discussion

The first step was the reconstruction of the historical avalanche fallen in the Ďurková valley on March 14, 1970. We had at disposal the avalanche deposition map and the data concerning the avalanche volume, release depth, and similar. These data were provided by the APC archive (Milan, Kresák 1970). As the most suitable, we elected the combined friction model working with the following parameters: mean release depth 1.7 m, friction coefficient 1 for forest and 0.2 outside forest, minimum flowing thickness 1 m and snow tear-off depth 0.5 m along the avalanche path. The reconstruction results manifest a good accordance, primarily with the avalanche impact (Bartík et al. 2014). Then the same parameters were used for the neighbour valley Viedenka, a with steeper slope gradient, where the new houses built at the valley mouth may be supposed to hit (Fig.2). The simulation for Viedenka was carried out with considering all the potential avalanche release zones recorded in the avalanche cadastre, with a release height of 1.7 m.

According to our simulation, the potential avalanche has been assessed having: length 2 230 m, volume 610 000 m^3 ant total area 58 ha. This avalanche could hit a part of the Magurka settlement situated just in the mouth of the Viedenka valley (Fig. 2). The supposed hazard area includes the village residential area, with the avalanche track progressing down to the meadow under the settlement. The supposed avalanche deposition is illustrated in Fig. 3. Such impact area of the avalanche is enabled by the direct longitudinal profile of the Viedenka valley as well as a relatively short distance between Magurka and the main mountain ridge of the Low Tatras Mts. We cannot, however, omit the fact that there are no records on avalanches with similar impact pressure in the Viedenka valley nor on hitting

Magurka in the past. On the other hand, some senior settlers remember a similar avalanche from the world-war II (1944 – 45). From 1984, there has been reported one human victim, nevertheless, the avalanche track was short, and the sediment was not too thick (Milan 2006). However, there can be identified remains of another, more extensive avalanche. The remains are well-visible also in Fig. 3. The figure shows a totally destroyed forest in the upper part of the valley below mouths of several steeper creases where an avalanche, probably from the left border crease (in the valley direction), totally destroyed the forest on the opposite-facing slope. The progressive avalanche track with the corresponding parameters is in Figs 3 to 6 graphically illustrating the results obtained with the ELBA+ programme for the valley Viedenka: maximum avalanche pressure (Fig. 4), maximum flowing slab thickness (Fig. 5) and velocity (Fig. 6). The intervention into the settlement residential area could result in a slab thickness from 5 to 7 m, a pressure up to 70 kPa and a velocity of ca 15 $m.s^{-1}$. These results may be under-estimated considerably. The avalanche consisted of snow only, so its impact pressure and disastrous potential were notably lower thanks to absence of alien materials such as broken tree stems, torn-out roots, branch segments hit and swept out from higher situated forest stands by the avalanche rushing through the valley.

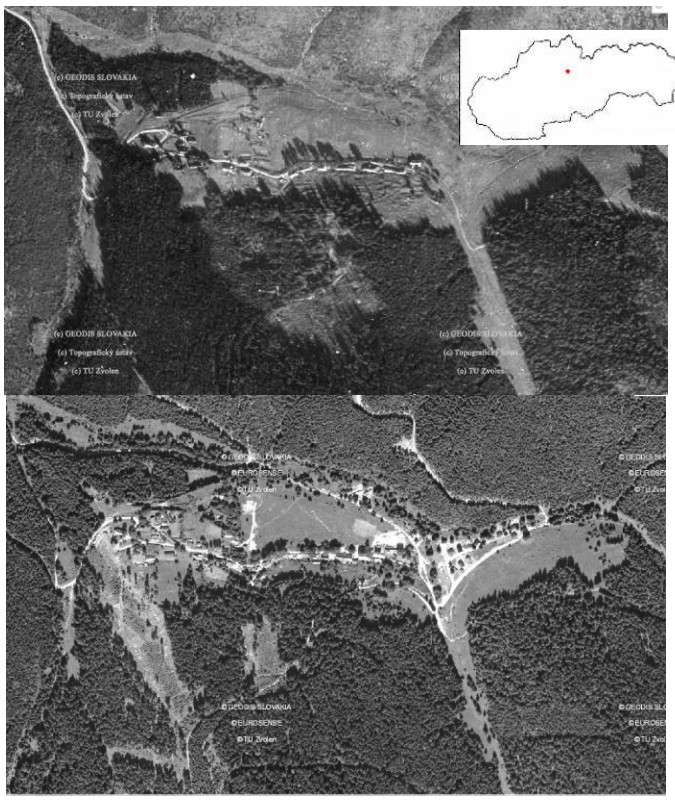

Fig. 1: Settlement Magurka in 1950 (up) and 2010 (down)

Fig. 2: The view from the mouth of the Viedenka valley on the part of the settlement Magurka

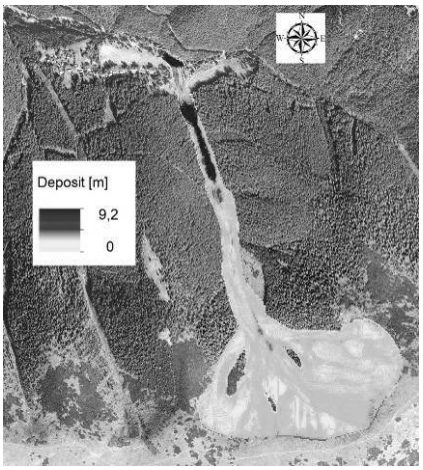

Fig. 3: Deposit of simulated avalanche in the Viedenka valley

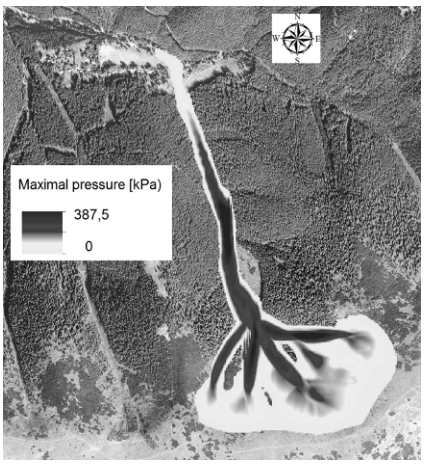

Fig. 4: Maximal pressure of simulated avalanche in the Viedenka valley

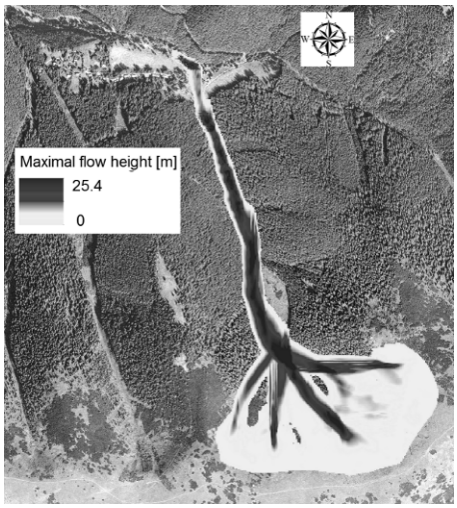

Fig. 5: Maximal flow height of simulated avalanche in the Viedenka valley

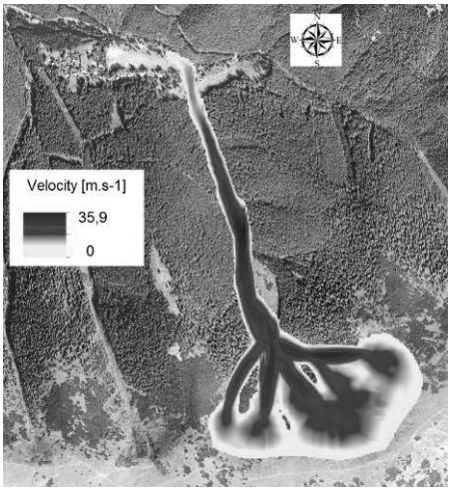

Fig. 6: Velocity of simulated avalanche in the Viedenka valley

Conclusion

Avalanches in mountain areas represent serious dangers, with many victims encompassing local settlers, tourists, skiers and ski-alpinists known from history. Moreover, there are hazards of extensive material damage to forest stands and to buildings situated in the avalanche hazard zones. This explains why the people try preventing the avalanche formation and lowering their impacts to minimum. Measures applicable in avalanche prevention involve also simulation models with data providing information on the potential avalanches, their extent and disastrous impacts.

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Souhrn
V našem příspěvku jsme použili simulační model ELBA+ při zhodnocení ohroženosti horského prostředí v okolí staré bánské osady Magurky (1036 m n. m.), nacházející se v Ľupčianskej doline pod hlavním hřebenem Nízkých Tater. Tato osada se stala svědkem několika lavinových neštěstí. Výsledky potvrdily, že potenciální lavina v dolině Viedenka s průměrnou výškou sněhu v odtrhovém pásmě se skluzným podkladem 1,7 m by při zohlednění všech potenciálních míst odtrhu pravděpodobně zasáhla část osady Magurka. Tato lavina by svým objemem a rozsahem až 58 ha pravděpodobně překonala rekordní lavinu v Durkové z roku 1970. Výška toku laviny by mohla při vniknutí do části osady dosahovat 5 až 7 metrů a zastavila by se při náraze do protisvahu na louce pod osadou.

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SPECIAL PROTECTION AREA OF NATURA 2000 THREATENED BY DROUGHT

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Abstract
The accession of the Czech Republic into the European Union brought an obligation to define the territory of protected areas within our state under project Natura 2000. This system consists of Special Protection Area (SPA) and Sites of Community Importance. Within the SPA are protected the most important sites which are inhabited by nesting species of birds and territory where occur migratory species (e.g. wintering, migration stop, gathering etc.). Currently on the territory of The Czech Republic is defined 41 SPA. Many of them provide living conditions for the species of bird whose existence is directly tied to the aquatic environment. Total number of this sites in the Czech republic is 15. Change of moisture conditions on these sites may endanger species which are depend on it. In the context of this paper are demarcated localities which are affected by this problem. Indicator of drought was chosen climatic drought expressed by potential humidity balance of grass cover. The results are presented as maps which demarcate the jurisdiction of individual SPA to the degree of moisture balance.

Key words: Special Protection Area, drought, potential humidity balance, Natura 2000

Introduction

Valuable ecosystems in the Czech Republic are protected by Act no. 114/1992 Coll., On nature and landscape protection. The accession of the Czech Republic into the European Union brought an obligation to define the territory of protected areas within our state under project Natura 2000. This network consists of Special protection areas (SPA, which protect birds) and Sites od Community Importance (SCI, which protect natural habitats and wild fauna and flora). The Czech Republic was obliged to create this system by two regulations of EU legislation - the Birds Directive and the Habitats Directive. The directives contain a list of species of plants, animals and habitats which should be defined by network Natura 2000. Bird areas come into being under Directive 2009/147/ ES on protection of wild birds and the content of the directive is implemented into Czech law by the said Act no. 114/1992 Coll., On nature and landscape protection.

SPA in general cover approximately 8.9% of the Czech Republic and are announced at 41 locations. Within the protected SPA, the most significant are the ones populated by brood species and the territories of occurrence of migratory species, i.e. their wintering spots, migration stops and gathering spots. Large amount of these sites overlap with other specially protected areas, similarly to Special Areas of Conservation.

All EU Member States create their own Natura 2000 network on their territory and the main goal of these systems is to ensure protection of European most valuable,

most endangered and rarest species of plants, animals and habitats (AOPK CR, 2006).

Materials and methods

In order to define bird regions potentially endangered by drought, synthesis of selected map layers of drought with a layer of bird areas was made in ArcGIS program. The map layer of bird areas was provided by the Agency for Nature Conservation and Landscape of the Czech Republic. For the purposes of the drought layer, the study uses a layer of potential moisture balance in the vegetation period which suitably characterizes climatic drought. Data to create this map layer was provided by the Czech Hydrometeorological Institute out of technical data series which represent fully homogenized database of daily values of climatic elements from 1961 for 787 locations throughout the Czech Republic in grid network of 10 km. Input data are from years 1961–2010. Technical data series based on the CHMI station network were created in grid points out of outcomes of regional climate model ALADIN-Climate / CZ. Before the calculation of the technical data series, the input data was subjected to quality control using software ProClimDB (Štěpánek, 2012).

Map layer of potential moisture balance is based on input data from years 1961–2010. The data records relative difference of rainfall and potential evapotranspiration from the reference surface–grass cover. Potential evapotranspiration represents the total amount of water in mm which can evaporate from the substrate (grass cover) at optimal saturation of the soil profile by soil water in specific climatic conditions. The values of potential evapotranspiration were formed according to the modified Penman-Monteith method which enables calculation of evaporation of water from various surfaces. The modified algorithm based on the Penman-Monteith methodology forms the basis of agro-meteorological model AVISO (Agrometeorological computing and information system) which was modified and adapted to the conditions of the Czech Republic and is operated by the Czech Hydrometeorological Institute. The modified Penman-Monteith equation applied in the AVISO model has the following form (Kohut, 2007):

$$ET = \frac{\Delta * (RN_{day} - G_{day}) + Ea}{Rs_{day}} + \frac{rE_{night} * 3600 * (24 - N)}{\lambda}$$

ET = evapotranspiration intensity, i.e. the evaporation rate of water loss [kg/m^2/s].

Δ = trend of the voltage curve of saturated water vapour at a given air temperature, i.e. derivation relationship between specific humidity of air saturated with water vapours and air temperature [hPa/ °C mb/ °C].

RNday = average daily density of shortwave and longwave radiation during daytime [W/m^2].

Gday = heat flow in the soil during daytime [W/m^2], the difference (RNday–Gday) represents the available energy for processes of evapotranspiration during daytime.

Ea = dryness of atmosphere which is primarily dependent on saturation complement and aerodynamic resistance.

Rsday = Equivalent of the denominator of the main fraction of the total combined Penman-Monteith equation to determine evapotranspiration.

rEnight = intensity of evapotranspiration of grassland during night [kg/m^2/s].

N = maximum astronomically possible sunshine duration [h/day].

λ = latent heat of vaporization [J/kg], λ = 2465000 J / kg (Kohut, 2007).

On the basis of the Water Framework Directive policy (2000/60 / EEC) several bird sanctuaries are distinguished. These are directly linked to water (VUV TGM, v.v.i., 2012).
Depending on the degree of moisture balance these areas belong to, it is possible to determine the sites and species that are potentially affected by this factor.

Results
The Czech Republic has a total of 41 bird areas. Fig. 1 shows the SPA on the basis of map layers of potential moisture balance.
Pursuant to the Water Framework Directive policy (2000/60 / EHS), these areas in the Czech Republic are directly linked to the occurrence of water: (VUV TGM, v.v.i., 2012):

1. Water reservoir Nechranice (region Ústí nad Labem)
2. Sandstones and wetlands of Česká Lípa and Doksy (Liberec region and Cenral Bohemia)
3. Rožďalovice ponds (Cenral Bohemia and Hradec Králové region)
4. Žehuň pond – Kněžičky preserve (Cenral Bohemia and Hradec Králové region)
5. Bohdaneč pond (Pardubice region)
6. Řežabinec (South Bohemian region)
7. Třeboň region (South Bohemian region)
8. Jaroslavice ponds (South Moravian region)
9. Pálava (South Moravian region)
10. Central part of Nové Mlýny reservoir (South Moravian region)
11. Lednice ponds (South Moravian region)
12. Confluence – Tvrdonice region (South Moravian region)
13. Oak wood forest area of Bzenec region – Strážnické Pomoraví (South Moravian region)
14. Poodří region (Moravian-Silesian region)
15. Litovelské Pomoraví (Olomouc region) (VUV TGM, v.v.i., 2012)

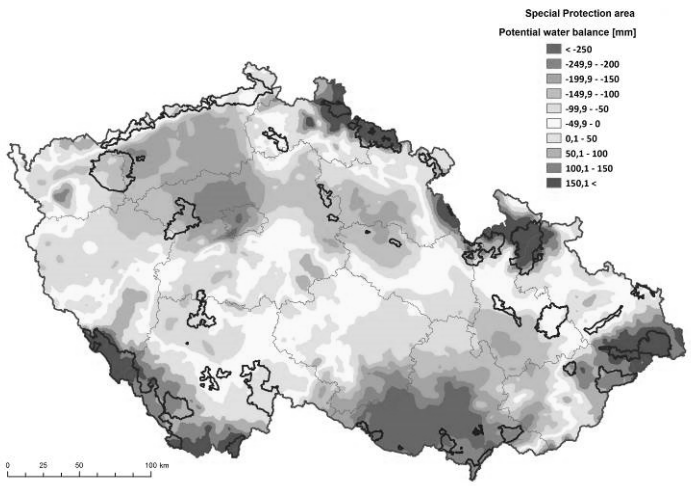

Fig. 1: Special Protection areas in the Czech Republic potentially threatened by drought

Out of the above listed bird areas, the ones in South Moravian region are currently endangered the most. At this areas the values of potential moisture balance can decrease less than 250 mm.

Pálava – subjects of protection: white stork (Ciconiaciconia), sea eagle (Haliaeetusalbicilla), honey buzzard (Pernisapivorus), middle spotted woodpecker (Dendrocoposmedius), Syrian woodpecker (Dendrocopossyriacus), barred warbler (Sylvia nisoria), collared flycatcher (Ficedulaalbicollis), shrike (Lanius collurio) (Chvátal, 2009).

Jaroslavice ponds – subject of protection: night heron (Nycticoraxnycticorax) (Chvátal, 2009).

Central part of Nové Mlýny reservoir – subjects of protection: common tern (Sterna hirundo), sea eagle (Haliaeetusalbicilla), greylag goose (Anseranser), bean goose (Anserfabalis), greater white-fronted goose (Anseralbifrons) on the wintering grounds, other waterfowl (Chvátal, 2009).

Lednice ponds – subjects of protection: night heron (Nycticoraxnycticorax), crested pochard (Nettarufina), greylag goose (Anseranser), northern shoveler (Anasclypeata) while migrating and wintering (Chvátal, 2009).

Confluence – Tvrdonice region – subjects of protection: white stork (Ciconiaciconia), honey buzzard (Pernisapivorus), black kite (Milvusmigrans), red kite (Milvusmilvus), saker falcon (Falcocherrug), common kingfisher (Alcedoatthis), gray woodpecker (Picuscanus), spotted woodpecker (Dendrocoposmedius), collared flycatcher (Ficedulaalbicollis) (Chvátal, 2009).

Oak wood forest area of Bzenec region-Strážnické Pomoraví – subjects of protection: white stork (Ciconiaciconia), marsh harrier (Circusaeruginosus), European nightjar (Camprimulgus europaeus), middle spotted woodpecker (Dendrocoposmedius), Syrian woodpecker (Dendrocopossyriacus), woodlark (Lullulaarborea) (Chvátal, 2009).

Other bird areas linked to water that currently face negative water balance include locations: Rožďalovice ponds, Žehuň pond – Kněžičky preserve, Bohdaneč pond and water reservoir Nechranice. These locations will most probably see increased dryness and thus decrease in population density and diversity.

Discussion

Drought in the Czech Republic (Central Europe) may be considered a presumable demonstration of a climate change. The results of Středová and Středa (2015) and Rožnovský et al. (2010) suggest an increase of potential evapotranspiration and thus higher susceptibility of areas of southern and Central Moravia and Central Bohemia to dryness in 1961–2010 compared to the mean of 1901–1950. Moisture certainty analyses in the Czech Republic proved an increase of the driest areas and drought event probability increased in the 1961–2010 period. They were recorded signifficant impacts of climate development on flora (Chuchma et al., 2016) and it can be expected impact on fauna. A similar tendency for neighboring Slovak Republic with similar climatic conditions reports, i.e. Škvarenina et al. (2009) who focuse on how drought, defined as a precipitation shortage, occurs in higher altitudes of the Tatra National Park, which is a significant biological reserve of the Central European fauna and flora. Regardless of the kind of drought, it will affect biodiversity, ecosystem resilience, and ecosystem services (Svejkovská and Procházková, 2016).

Conclusion

Locations of occurrence of protected species of birds directly linked to aquatic environment were identified within special protection areas. Most endangered are currently the sites located in the South Moravian region, a total of 6 sites - Pálava, Jaroslavice ponds, Central part of Nové Mlýny reservoir, Lednice ponds, Confluence – Tvrdonice region and Oak wood forest area of Bzenec region – Strážnické Pomoraví. A list of species protected in these sites was also determined. Based on the results of other authors we can conclude that the area of Czech Republic sees an increase in potential evapotranspiration and thus the occurrence of drought. At the same time, the study has also shows the influence on flora and assumes influence on fauna as well.

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Souhrn
Článek se zabývá tématem ohrožení ptačích oblastí (Natura 2000) České republiky suchem. Sucho zde bylo řešeno z pohledu klimatického sucha vyjádřeného potenciální vláhovou bilancí travního porostu. Vzájemnou syntézou mapové vrstvy ptačích oblastí s mapovou vrstvou potenciální vláhové bilance vznikla výsledná mapa vyjadřující ohrožení těchto lokalit suchem. V rámci ohrožení tímto faktorem byly identifikovány lokality s přímou vazbou na vodu. V současnosti je tímto rizikem nejvíce ohroženo 6 lokalit, které náleží do Jihomoravského kraje. Výsledky jiných autorů ukazují, že na území České republiky došlo za posledních sto let ke zvýšení evapotranspirace, čímž se zvýšil také výskyt sucha. Současně již byly zaznamenány dopady na flóru a lze tedy očekávat ovlivnění také fauny.

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SPELEOLOGY AS ADRENALIN PHENOMENON AND CURRENT SECURITY RISKS

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Abstract
Interest in the survey, or any visit to the cave environment are rapidly rising in recent years. Activity in the caves is objectively dangerous and in the interplay of several adverse circumstances, even a trivial problem can easily turn into a tragedy. Adverse conditions in the caves are mainly caused by darkness, cold, moisture, but also by the aquatic environment, vertical steps and occurrence of unbreathable gases. Every action in the underground needs to be well prepared and all risks must be listed. Underground environment may be contaminated by various originators of infectious diseases transmitted through water, aquatic and terrestrial animals and ultimately by man. While staying in this environment, all persons must therefore behave responsibly and avoid not only physical injuries. The Czech Speleological Society and its units – the Speleological Rescue Service and the Commission for Education provide education needed for successful actions in the underground.

Key words: Accident in the cave, Czech Speleological Society, Speleological Rescue Service, Health risks

Introduction

The mystery of underground world has attracted people since times immemorial. Perhaps every culture from the earliest to the most recent ones mentions underground worlds. Our society is probably best familiar with the Greek mythology where the appalling Acherón River, the Styx in Latin, encircles the whole empire of the dead in the underground and forms the non-crossable boundary of the underworld. Underground world, mostly represented by caves, has inspired human exploration since the earliest history of the mankind. For long millennia caves served as occasional shelters, dwellings or cult places (Absolon, 1970a, b; Hromas, 2009; Musil, 2010, Golec, 2013).
Hence the first injuries and accidents in caves may certainly be dated back to prehistoric times. The first cave incidents may nearly for sure also be expected to have been thought to be connected with supernatural forces. At present the questions of safety are mainly connected with our knowledge, ability to perfectly prepare for the exploration and possession of sufficient and high-standard technological equipment (fig. 1).

Legal assumptions

Caves and their access from the legal point of view: Caves and other karstic phenomena in the Czech Republic are protected by Act no 114/1992 Coll., on Nature and Landscape Protection. Section 10 of the act defines a cave as an "underground space resulting from activities of natural forces, including their fills and natural phenomena found in them. " The same section also defines cave protection formulated as follows: "Destruction, damage and modifications of a cave or its

present condition are prohibited. Exception from this prohibition may be granted by a nature protection authority only where it is in the interest of protection of the cave or when another public interest protected by this or another act substantially overweighs the cave protection interest." By further wording this protection is extended to karstic phenomena on the surface. The act permits further extension of cave protection by definition of strictly protected natural areas, such as nature parks (NP), protected landscape areas (CHKO), national nature reserves (NPR), national nature monuments (NPP), nature reserves (PR) and nature monuments (PP).
Many caves are localised within the territory of Sites of Community Importance (SCIs) in the network Natura 2000. Natura 2000 is a network of protected areas jointly formed by EU Member States. The purpose of Natura 2000 is protection of biodiversity and the individual territories are proposed on the basis of strictly defined criteria. As concerns caves the network of Natura 2000 is supported by protection pursuant to Directive 92/43/EEC on HS on the conservation of natural habitats and of wild fauna and flora which aims to create strictly protected territories for selected natural habitats and animal and plant species. In the Czech Republic these directives are integrated in Act no 114/1992 Coll., on Nature and Landscape Protection.

Work objectives
The purpose of this survey article is to introduce the readers to the risks connected with cave entry which may be effectively prevented with good knowledge of them.

Specifics of Cave Environment
In addition to cavers caves are more and more often visited by tourists and other visitors looking there for romantic adventure. These people often enter caves without the necessary equipment and experience. In case of emergency they are then unable to resolve the crisis safely.
Seriousness of accidents in caves is given by the specific nature of the underground environment. Cave fills are often unstable, the sediments are water saturated and the walls are covered with fragile sinter. Specifics of some caves include presence of non-breathable gases, most often carbon dioxide. The accident may often happen in a place where just a properly technologically equipped group of cavers can get. Therefore even a common injury, well manageable on the surface, may be a serious, life threatening issue in a complex underground cave system where standard rescue and first aid methods cannot be applied (for example Šimečková B., Geršl M., 2013).

Cave Accidents
Accidents occurring in the cave environment can be classified by cause to:
(A) Accidents caused by objective reasons, including the nature and features of the environment. This risk may be minimised by good preparation to the exploration and knowledge of the terrain; (B) Accidents caused by subjective reasons, including insufficient preparation, underestimation of the risks, poor tactic selection or use of inappropriate materials and technical aids. The most frequent causes of underground accidents are ranked as follows: 1. Aqueous environment (underwater research, floods and other accidents); 2. Cave-ins (unstable cave hanging wall getting loose); 3. Hypothermia (insufficient equipment for long-term stay in the cave atmosphere); 4. Burns (by handling various sources of light or heat); 5. Loss of orientation (insufficient or no knowledge of the visited cave env.); 6. Individual visit; 7. Accidents in vertical sections (unstable hanging wall over moving persons); 8.

Intoxication with toxic gas or radioactivity (carbon dioxide); 9. Biological risks (especially in exotic countries).

Accident Analysis

Rescue events in caves recently involving speleological rescue service interventions have differed in nature. Some of them only involved looking for a visitor in a cave who lost his way, others included freeing of a person from a narrow fissure. An exceptionally problematic case of this kind happened in Rákoczi barlang cave in Hungary in January 2002, where a diver losing orientation was unable to leave the cave through the water way and could not be rescued by standard methods. The affected diver was finally rescued by blasting a 11 m long pass with micro blasts. The Speleological Recue Service of the Czech Speleological Society was asked for help in this extensive and ultimately international intervention for the Hungarian rescue service lacked experience in this method.

Cave 13C, Moravian Karst, 13 October 1998 – Three speleologists did not leave cave 13C at the scheduled time. Due to the raised water level the Speleological Rescue Service was called. After arrival to the place and descent to the cave only two of the cavers were rescued from rubber boats who were waiting for the rescue team standing up to their waist in the water of the turbulent stream whose level continued to rise. Their way back was prevented by a damaged rubber boat. Due to the very strong stream they could not manage to swim upstream to the dry part of the cave. Despite the extensive investigation in the still rising and very dangerous stream the third caver could not be found. A week later another investigation in the already dropped water level followed. The drowned caver was found 2 m under water about 15 m from the place where the three of them parted.

Rudické propadání cave, Moravian Karst, 12 September 2004 – A water-filled cave of meander nature with vertical levels. The whole cave is crossed by a stream. A group of three mountaineers set off to pass through the cave in the afternoon of 11 September 2004. When ascending out of the cave a member of the group stopped a couple of metres under a vertical edge unable to continue with the climb. In the course of the transport preparation the condition of the female worsened considerably and therefore resuscitation had to be commenced. After partial renewal of her vital functions the victim was transported to the surface and handed over for medical care. After nearly an hour of resuscitation the doctor confirmed death. The group of mountaineers underestimated the demand of the unknown environment, used inappropriate equipment and did not employ a surface guard. To get an idea about the progress of the rescue here is the timeline of the action: 4.30 (cal for rescue service intervention), 5.10 (arrival on the loc.), 6.00 (victim reaches the surface) and 6.45 (end of resuscitation).

Nová Rasovna cave, Moravian Karst, 27–28 December 2004 – On 26 December 2004 a group of four speleologists set off for a three-day exploratory trip. On Monday 27 December 2004, after two days of heavy rain, the level of the Bílá Voda rose and closed the “Knee”, a lowered place in the cave entrance. After detection of this condition the colleagues on the surface decided to call the Speleological Rescue Service. The group of speleologists was not directly threatened but their return to the surface might become problematic. The “Knee” siphon might be closed for a long time (Dostál et al., 2005).

After arrival of the rescue group the stream passing through the cave was so strong that even a diver was unable to get to the siphon. That is why a fire brigade was called for help. After arrival the firemen decided to try to lower the water level of the stream entering the cave with fire pumps. The pumping was commenced at 5 am on

28 December 2004. At noon of the same day the water level in the siphon was so low that the rescue team could enter the cave and get out the trapped speleologists.
Křížův závrt cave, Moravian Karst, 8 August 2005 – A member of the Czech Speleological Society set off for a surface excursion after arrival to the base on 6 August 2005. When he reached the burrow, the work site of his organisation, he decided to descend to its bottom. The fall resulted in femoral bone fracture. As he did not mention his trip to anyone, his parents only began to look for him on Monday morning, two days later, on 8 August 2005. After arrival of the rescue service the victim was secured, transported to the surface and handed over for medical care.

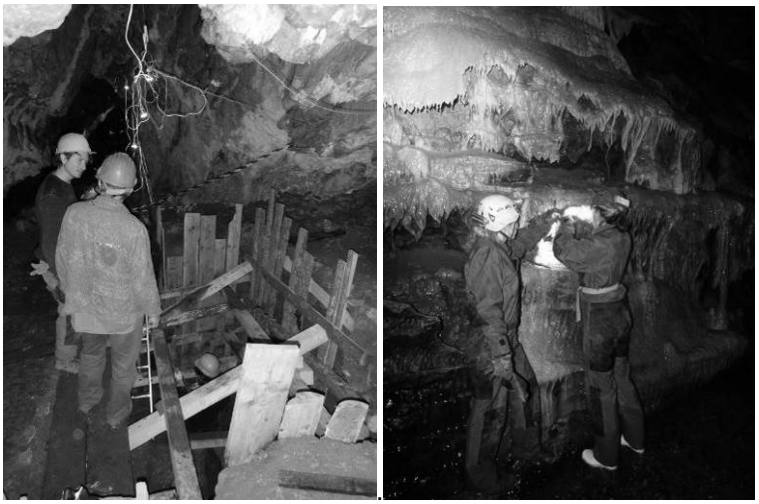

Fig. 1: Especially head protection against injury during works in cave environment is a must, as for example in the Moravian Karst where archaeological excavations were performed in the Pod hradem cave (on the left) or samples taken in Býčí skála (on the right). Source: Photo I. Pavlík

Fig. 2: When leaving the marked tourist routes in caves use gloves (on the left), for the water passing through contaminates the cave by flooding, aerosol or by other ways (on the right), see for example the Rudické propadání cave. Source: Photo I. Pavlík

Fig. 3: In some places in the caves the cups in the drip water lakes invite for tasting the water, like for example in the Rudické propadání cave (on the left) or in the Býčí skála cave in Moravian Karst (on the right). Source: Photo I. Pavlík

Speleological Rescue Service

The necessity of existence of a rescue service prepared to help in the case of an accident in a cave has been proven several times in the past, when the called fire brigade, police and mine rescue service were not successful and the case was only finally resolved by the called cavers, often volunteers. The Speleological Rescue Service of the Czech Speleological Society was established in 1982 as a voluntary specialised division of the Czech Speleological Society whose mission is to provide immediate and qualified assistance in the case of an accident under cave or other extreme conditions, for which the rescuers are equipped and professionally trained, and cooperate in rescue interventions after natural disasters and in life-threatening situations and property risks on the basis of request of the Integrated Rescue System of the Czech Republic whose part they are.

Conclusion – Practical advice for prevention of cave accidents by way of conclusion

Prepare your cave trip well. The cave environment is unusual. Study all available material before (publications, maps, internet discussions) concerning the locality. Get information from speleologists working in the locality of interest. Focus on the overall route through the cave, specifics given by its vertical levels, hydrological condition, weather changes or gas occurrence.

Check your speleological outfit. Check your speleological outfit well before you enter the cave.

Appoint a surface guard and defined the schedule. Before descent to the underground always appoint a person to guard you from the surface. This person will notify the Speleological Rescue Service if you do not return to the surface on time.

Name issues to be expected. Consider the expectable environment (traditional vertical levels, water presence, and uncommon but possible landslide risk, occurrence of non-breathable gases etc.). Define the weak points in the team, especially the team members with the weakest physical fitness.

Behave safely in the cave and do not infect yourselves, meaning do not touch dead animals, such as bats, other organic materials including earthworm droppings (fig. 2) and never drink water, not even from the clear lakes or water dripping from the stalactites (fig. 3).

Accident prevention and speleological training. The only known possibility to prevent underground accidents and control their progress and consequences is

careful preparation of all participants. There are numerous publications, training courses and practical examinations for this purpose. They have long been provided and sponsored by the Czech Speleological Society, offering educational programmes through its divisions of Speleological Rescue Service and Committee for Education.

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Souhrn

V posledních letech zřetelně stoupá zájem o průzkum, nebo i jakoukoliv návštěvu jeskynního prostředí. Činnost v jeskyních je objektivně nebezpečná a při souhře několika nepříznivých okolností se snadno může i banální problém změnit v tragédii. Nepříznivé podmínky v jeskyních jsou dány především tmou, chladem, vlhkostí, ale i vodním prostředím, vertikálními stupni a výskytem nedýchatelných plynů. Každou akci v podzemí je třeba dokonale připravit a pojmenovat všechna rizika. Prostředí v podzemí může být kontaminováno různými původci infekčních onemocnění přinesených vodou, vodními i suchozemskými živočichy a v neposlední řadě i člověkem. Při pobytu v tomto prostředí se musí proto všechny osoby chovat zodpovědně a vyvarovat se nejenom fyzickým zraněním. Vzdělávání potřebné pro úspěšné akce v podzemí poskytuje Česká speleologická společnost a její složky Speleologická záchranná služba a Komise pro vzdělávání.

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STABILIZATION OF RESERVOIR BANKS - REED VEGETATION

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Abstract
The use of vegetation elements in the reinforcement of banks of waterways has great advantages. In particular, they are low acquisition costs, an almost unlimited life and regenerative capacity, aesthetic effect etc. One possibility is to use the reed crops. Reed beds can also be used on the reservoir Hulin.

Key words: reed, reservoir, wasser, bank

Introduction

The main objective of establishing riparian and accompanying stands is the creation of a vegetation community whose species composition best corresponds to the site conditions, with the representation of individual species approximating the stands that would occur in such conditions in natural development. (Junáková, 2013, Šlezingr, 2010)
Part of riparian vegetation are reeds.

Materials and methods

The optimal species composition of stands can best be determined based on phytocoenological examination. Since riparian and, in particular, area stands have the character of forest stands, it is advisable to use forest typology knowledge in designing their species composition. The basic typological unit is the forest type. (Junáková, 2013, Zeleňáková, 2016)
Its ecological extent for species growth, optimal species composition and corresponding manners of management are defined. Since some types are very similar, they were included in the so-called forest type groups. (Pelikán, 2015, Šlezingr, 2010, Šlezingr et al, 2010)
The most important forest type groups correspond to the structure of riparian and accompanying stands according to the systematic division proposed by Mezera - Mráz –Samek

Use of Accompanying Vegetation on Waterways

The use of vegetation elements in the reinforcement of banks of waterways has great advantages. In particular, they are low acquisition costs, an almost unlimited life and regenerative capacity, aesthetic effect etc.
In the reed zone (sublitoral zone) the following species are, for instance, used:
common reed *(Phragmites communis)*
reed canary grass *(Baldingera arundinacea)*
sweet rush *(Acorus calamus)*
flowering rush *(Butomus umbellatus)* etc.

Their importance as a reinforcing element consists in the reduction of wave energy caused by vessels, ensuring slope stability under the surface, ensuring slope resistance against ice drifting and others. (Synková, 2009, Zeleňáková et al, 2011)
Vegetation elements may also be used, as in the case of unnavigable streams, in the construction of supporting footings - animation by willow cuttings, or in the use of half-vegetative blocks interlaced with grass etc.
Riparian area section:

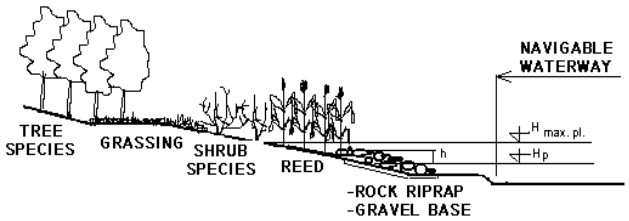

Fig. 1: Example of the possible use of plants for the protection of navigable stream banks.

h……...wave height,
Hmax.pl...maximum navigable level,
Hp…….level upon average flow (drawing by K. Valouchová)

Fig. 2: Eextensive vegetation reeds on the shore (Brno dam 2014)

Conclusion

It is extremely important to mention that all works in the recovery of bankside trees and shrubs could misfire if we fail to ensure at least basic after-planting care. This also applies to growths of reeds.

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Souhrn
Biotechnická či technická stabilizace břehů vodních toků a nádrží je založena na spolupůsobení technického (tuhého) opevnění a vegetačního prvku. V případě čistě biologické stabilizace je základem pouze biologický prvek. V oblasti sublitorálního pásma pak stabilizační funkci často přebírá pásmo rákosin. Především na vodních cestách, ale i u nádrží, kde je provozována plavba, rákosiny velmi dobře tlumí negativní účinky vlnění. Husté rákosové porosty působí jako vlnolam. Tuto funkci pak výše po svahu tvořícím břeh přebírají porosty keřových vrb (pásmo klitorální)

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STATE AND QUALITY OF FOREST SOIL AND ITS IMPACT ON THE RECREATIONAL POTENTIAL IN SUBURBAN FOREST AREAS OF BRNO

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Abstract
In recreationally attractive area Hády, about 1 km north of Brno (South Moravia, Czech Republic) was conducted a research aiming to describe the impact of conventional and reintroduced traditional forest management approaches (high forest, abandoned coppice, conversion to coppice and conversion to coppice-with-standards) on top-soil layer. One of the mentioned approaches, coppice, based on systematically repetitive vegetative regeneration is criticized for its rapid removal of mineral nutrients from the soil and humus that allegedly leads to downgrading of soil state and quality. The risk of degradation of forest soil and the consequent impact on the overall forest ecosystem could ultimately lead to a reduction in the recreational potential of the area. This paper presents the results of research consisted of two main parts, pedological and mensuration. Soil samples taken from Ah horizon (intact and mixed) and humus samples were collected and laboratory processed. In mensuration part woody species were measured and natural regeneration monitored. All data were statistically evaluated using PCA and ANOVA. The results proves insignificance of influence of forest management approach on top-soil, nor shows the downgrading state and quality of soil in coppice. Therefore the recreational potential should not be diminished by coppicing in Hády area.

Key words: top-soil, forest management approaches, recreational potential, Hády, coppice

Introduction

Suburban forests as natural outdoor areas are known for providing opportunities for increasing a public well-being and health. Their role in keeping contact with the nature is significant since the industrial revolution when many people left the countryside and moved to the cities to look for work and little by little they lost their daily contact with nature. This migration to the cities is intense even nowadays. Hády area, about 1 km north of the city of Brno could be considered as one of those places with a high recreational potential. But the question is if there exists a risk connected with reintroducing of the traditional forest management approaches (conversion to coppice and conversion to coppice-with-standards) that were, in a past, criticized for rapid removal of mineral nutrients from the soil and humus that allegedly leads to downgrading of soil state and quality. And therefore arising risk of degradation of forest soil and the consequent impact on the overall forest ecosystem that could ultimately lead to a reduction in the recreational potential of the area.

Materials and methods

Methods

Four temporary research plots were established in Training Forest Enterprise Masaryk Forest Křtiny, forest district Bílovice, during spring 2016 and 2017. The main conditions for their establishment were: same group of forest types 2H Loamy Beech-Oak (Viewegh et al. 2003), identical woody species composition (with dominance of *Quercus petraea* (Matt.) Liebl.) and different management approaches (high forest, abandoned coppice, conversion to coppice and conversion to coppice-with-standards).

Data collection was carried out on inventory circular plots (500 m^2). Mensuration part was consisted of recording number of trees, species, their heights and DBH (diameter breast height 1.3 m, for those with DBH greater than 5 cm). There was a mensuration modification for a plot in coppice. The thickness of the individual suckers was measured at a height of 0.5 m from the base and the height and the numbers of individuals in polycormons were recorded. Natural regeneration (specie, number) was evaluated on 1x1 m subplots in number of 3 for each plot. For individual stands were afterwards calculated the timber volumes using volume equations of Petráš and Pajtík (1991).

Within a plot were analysed two main layers of top-soil (organic and *Ah*-organomineral horizon). 5 shallow pits (25x25x25 cm) were dig out for each plot taking undisturbed and mixed samples of *Ah* and describing the horizons top-soil layers stratigraphy. In the immediate vicinity of shallow pits were collected fractions of overlying humus (L - litter, F - fermentation, H - humification), and humus forms were classified according to the French classification (Jabiol et al. 2007). From mixed and undisturbed soil samples were determined values relating to soil physics: structure using methodology of Zbíral et al. (2004), texture and soil hydro limits according to Rejšek (1999), to soil chemistry: content of soil macro elements according to Zbíral (2002), content of active humus fractions according to Kononova and Bělčikova (1961), and the C / N ratio, and to physic - chemical properties: soil reaction and soil sorption according to Zbíral (2002).

Data from laboratory analysis and data from field measurements were processed by the PCA (Principal Component Analysis) in R, with FactoMineR intended for multivariate analysis with two variables: 1 – forest management approach, 2 – humus form. Following this was processed one-way analysis of variance (ANOVA) and post-hoc multiple comparison using Tukey's HSD test.

Material

A1 - abandoned coppice

Stand is of vegetative origin, it is an open canopy false high forest derived from coppice by abandoning the management (Fig. 1). The area is left without management since 1950. Conditions of the stand are as follows: deciduous vegetation at the age of 147 years with a dominant proportion of oak (80 %), hornbeam (20 %). Both are clearly of coppice origin. Volume was 261 $m^3 \cdot ha^{-1}$.

A2 - high forest

Forest of generative origin is currently at the small pole stage with full stand density (Fig. 2). It was reforestated in 1995. Conditions of the stand are as follows: mix of deciduous and coniferous vegetation at the age of 21 years with a dominant proportion of oak (97 %), and larch (3 %). Both are clearly of generative origin. Volume was 47 $m^3 \cdot ha^{-1}$.

A3 – conversion to coppice-with-standards

Both stand floors are made up of individuals of vegetative origin (Fig. 3). The stand was managed as a coppice area until 1973, since then it has been gradually converted to high forest. From 2008 until present is the stand managed as conversion to coppice-with-standards. Conditions of the stand are as follows: deciduous vegetation at the age of 108 years for the layer of standards with oak (100 %). Volume was 170 $m^3 \cdot ha^{-1}$ within standards. For the coppice: deciduous vegetation at the age of 8 years with prevailing oak (67 %) and hornbeam (33 %) clearly of vegetative origin. Volume per hectare for coppice was not investigated.

A4 - conversion to coppice

The stand was managed as a coppice area until 1973, since then it has been gradually converted to high forest (Fig. 4). From 2008 until present is the stand managed as coppice again. Conditions of the stands are as follows: deciduous vegetation at the age of 8 years with prevailing proportion of oak (47 %), and the admixture of linden (26 %), hornbeam (6 %) and various shrubs as common hawthorn and hazel (19 %). All are clearly of vegetative origin. Stock per hectare was not investigated. Within the naturally regenerated species occurs oak (60 %) and hornbeam (40 %).

Fig. 1: Abandoned coppice without management since 1950.

Fig. 2: High forest reforestated in 1995.

Fig. 3: Conversion to coppice-with-standards with its 108 years old standards and 8 years old coppice.

Fig. 4: Conversion to coppice managed as coppice since 2008.

Results

Actual graphic results of soil analysis are shown in following factorial map (Fig. 5) that shows the proof soil specificity with respect to particular types of management. Although the plots initially selected under the same conditions, on the same set of forest types, do arguably varies in the top-soil properties. It turned out that there is soil specificity for each management approach in all groups of variables. The factorial map also shows strong bond between the humus forms and type of management approach (abandoned coppice and high forest – dysmull, conversion to coppice-with-standards – eumoder, conversion to coppice – oligomull).

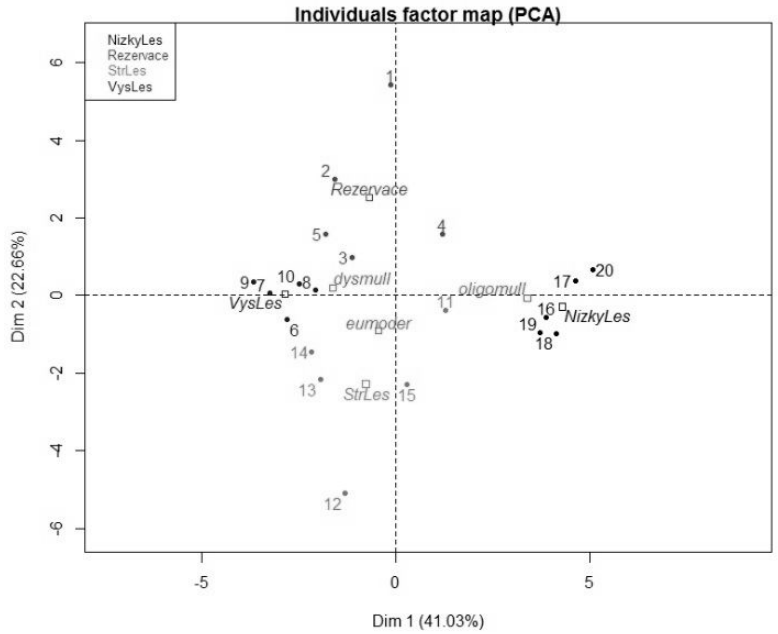

Fig. 5: Factorial map describing the bond between the management approach and by selected significant variables; A1 – abandoned coppice (Rezervace), A2 – high forest (VysLes), A3 – conversion to coppice-with-standards (StrLes), A4 - conversion to coppice (NizkyLes)

The soil in A1 to A4 was moderately heavy, with medium to high water storage, in A4 with lower degree of aeration and higher values of wilting point compared to other plots. Slightly acidic top-soil reaction showed in A4, while A1, A2 and A3 showed an acidic reaction. Cation exchange capacity (CEC) was the highest within A4 top-soil layer followed by the values of A3. Base saturation (BS) was evaluated as fully saturated in A4 and showed significant difference between A4 and other three plots. The content of carbon in top-soil layer was balanced in all research plots. The amount of nitrogen content was significantly higher in A3 and A4 when compared to other plots but similar among A3 an A4. The C/N ratio in the topsoil layer in A4 was affirmative (25:1) and it is pointing to the high quality of litter decomposition. The content of fulvic acids higher than content of humic acids in all A1 to A4 plots with no significant difference among them. Results from the field investigation shows that litter layer (L, F, H) in A4 differs significantly from A1 to A3 plots. The smaller thickness of litter is likely to reflect the speed of litter

decomposition, which corresponds with the humus form oligomull bond clearly visible in Fig. 1. Ah horizon thickness was similar within all A1 to A4. The resultsproves insignificance of influence of forest management approach on top-soil in means of degradation, nor shows the downgrading state and quality of soil in coppice.

Discussion

Even though were plots initially selected under the same conditions their top-soil properties do arguably varies and are also highly site specific to particular forest management approach. As following from the presented results there is significant proof of influence by forest management approach on top-soil, but it does not show the downgrading state and quality of soil in forest stands that are under reintroduced traditional forest management approaches. But we must consider the studies (Kneifl et al., 2016) regarding the public opinion in which are these traditional forest management approaches less positively perceived by recreants.

Conclusion

The aim of the presented research was to describe the impact of conventional and reintroduced traditional forest management approaches (high forest, abandoned coppice, conversion to coppice and conversion to coppice-with-standards) on top-soil layer. And investigate the potential risk of degradation that can traditional methods such as coppicing cause in soil. It turned out that the state and condition of soils under the stands, where the traditional management was reintroduced, is not leading to degradation by any means. From this we can conclude that there should be no decrease in recreational potential due to state of the ecosystem.

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Souhrn
Na rekreačně atraktivním území v rámci Školního lesního podniku Masarykův les Křtiny byla zpracována studie zabývající se vlivem běžných a tradičních způsobů hospodaření na svrchní vrstvu půdy. K danému účelu byly vybrány výzkumné plochy v porostech s rozdílným typem managementu (nepravá kmenovina, les vysoký, převod na les střední, les nízký). Cílem bylo zjistit, zda vlivem systematického odnímání biomasy při tradičním hospodaření, v porovnání s běžným hospodařením, dochází k vyčerpávání a následné degradaci půdy, což by mohlo zapříčinit snížení kvality daného lesního ekosystému. To by v budoucnu mohlo vést až ke snížení rekreačního potenciálu území. Výsledky však prokázaly, že ke zhoršení kondice a stavu půd na daném území nedochází a nebyla ani prokázána vazba degradace půd na určitý způsob hospodaření. Z výsledků vyplývá, že rekreační potenciál území by tradičním způsobem hospodaření neměl být ohrožen.

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THE HISTORICAL PROGRESSION OF THE APPROPRIATION OF AGRICULTURAL LAND IN THE CADASTRE OF DOLNÍ VĚSTONICE IN THE REGION OF SOUTH MORAVIA, CZ

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Abstract
The paper deals with the development of soil sealing of agricultural land in the cadastral area Dolní Věstonice (South Moravian Region, Czech Republic). We used the available data and map resources (historic and present data). Data processing was performed by using manual digitalisation. Map outputs about soil sealing in the different time periods were processed. The initial state of evaluation was the year 1824 - (data source Stable cadastre). In most cases the soil sealing is associated with the development of the municipality. For comparison of future development of soil sealing the potential future soil sealing is evaluated, which is planned in the land use plan of Dolní Věstonice. The results of this work show that in the cadastral area Dolní Věstonice has since 1824 built up to the present about 31 hectares of agricultural land (3.6 % of the total cadastral area). The biggest increase in soil sealing is between the years 2006 and 2016. In this period the area of agricultural land decreased by about 10 ha. In the future we can expect a large loss of agricultural land, coupled with the possible problems of sustainable agriculture and theoretically also problems with a lack of food sources.

Key words: soil sealing, land use, degradation, old maps, analysis of landscape

Introduction

The landscape is an open system created by the mutual influence of natural processes and human undertakings (Antrop, 1998) that change over time and space. Since the beginning of the human society development, man has influenced the appearance of the landscape and the intensity and course of natural processes. The landscape changes continuously with the varying intensity and scope of changes. The intensity depends primarily on the location, the attractiveness of the land and the degree of maturity or development of society. Alternations in land use that reflect the changes in approach to natural and socio-economic sphere in a specific area (Jeleček et al., 1999) belong to the most visible manifestations. Landscape and its disposition are characterised in their uniqueness based on remarkable variety of natural and cultural conditions (Kupka, 2010). Lokoč and Lokočová (2010) quote that landscape can be visualised as a jointly-created and controllable organism. Lipský (2000) states anthropogenic processes act very quickly and in a short space of time. These processes alter the appearance, structure and function of the landscape directly (surface mines, ploughing, planting, etc.) or indirectly (erosion, ecological succession, etc.) The most extensive and deepest changes to the landscape were offset by the industrial revolution in the mid-18th century and intensified in the second half of 20th century. Creating large soil expanses of arable land and the destruction of landscape elements with an

environmental function during agricultural collectivisation had a drastic impact on the face of our countryside.
Rectification of the brought-on damage is a long-term process, irrevocable in case of soil loss (Podhrázská, Karásek, 2014). The attention of this article focuses on the degradation of agricultural soil (loss of soil to other than agricultural utilisation) – as well as to soil sealing.
Since 1927 up until now, Czech Republic has lost 851 thousand hectares, i.e. 22.3 % of agricultural soil (Charvát, 2010). Historically worse period came between 1976 and 1981 when 37.9 ha of soil were lost every day. This development is deemed as extremely unfavourable and among the worst in Europe. The speed of agricultural soil removal has started increasing again as of late. This is some 24 ha of soil a day (Spilková, Šefrna. 2010). The fraction of agricultural land dropped in favour of built up areas by 2.6 % between 2001 and 2011 in the Czech Republic as did partially also forested plots.

Materials and methods

Statistical, spatial grid data and vector data were used as a basis for research utilising maps (historical maps and current orthophoto maps) provided by the State Administration of Land Surveying and Cadastre and also the Military Geography and Hydrometeorological Office in Dobruška (historical aerial snaps), together with the currently applicable zoning plan pertaining to this particular area. All data was processed and assessed using the methods of mathematical statistics. ArcGIS software methods and approaches were applied when processing data, creating mapping outputs and comparing information on the sealing of agricultural soil. Representative cadastral area of Dolní Věstonice was selected for the purposes of this article (South Moravia, Czech Republic). This countryside has undergone major changes in the use of land primarily because of the building of the Nové Mlýny reservoirs in the 20th century.

Characteristics of the area

Dolní Věstonice are located at the foot of the northern slopes of Pavlovské vrchy on the Dyje's right bank. Once the Nové Mlýny reservoirs were filled, the village found itself on their shores behind a preserved section of the original river bed. The settlement is positioned on the old trading route between Austria and Moravia that even today links Mikulov and Hustopeče and follows the bank between the central and lower Nové Mlýny lakes leading to Strachotín. The cadastral acreage of the village is 880.04 ha. The following Figure 1 presents a surveillance map of Dolní Věstonice cadastral area.

Creating maps of landscape cover

The source for primary analysis of changes in the countryside and assessing the sealing of agricultural soil to the benefit of the progressing residential area were primarily digitalised maps of land use dated 1824 (stable cadastre – only residential area – built-up areas - covered), 1836–1852 (2nd military mapping), 1876–1878 (3rd military mapping), 1950 (aerial snaps), 1990 (orthophoto), 2006 (orthophoto), 2016 (orthophoto). The selection of time horizons for analysing countryside structure were set with the intention of covering the most crucial alterations in landscape structure since the mid-18th century until the present day. A stable cadastre was set as the starting point. The current situation at the opposite end of the time scale is depicted by a colour orthophoto dated 2016. Another part of the analysis used the available Dolní Věstonice zoning plan that stipulates the manner of using village land in future. Just as in the case of the stable cadastre, only the residential area was covered in the case of the zoning plan.

Maps showing landscape cover were generalised by manually digitalising the source materials to the range of the area in question. The digitalisation outputs are SK, 2VM, 3VM, 1950, 1990, 2006 and 2016, LS plan (Landscape plan). Land use layers that contain categories of plots: arable land, permanent grassland, forest, vineyard, orchard, water, other areas, built-up area.

Results and Discussion

The generated land use maps mediate information on land use from ahistorical viewpoint up to the present, including the situation proposed in the municipal zoning plan.

Land use was initially analysed for the second military mapping 1836–1852 (Figure 2). Forests are the most represented category in this time period, i.e. 35.22 % of cadastral area (table 1), followed by permanent grassland (31.1 %). Arable land stands third with 21.82 %. Vineyards (8.58 %), orchards (0.54 %) follow behind as rarer categories while the built-up area covers 24.13 ha (2.74 %) in this period.

Figure 3 shows land use map from the third military mapping. We can perceive a similar land use as in the 2nd military mapping. Most represented are forests with 34.34 % (table 2), followed by permanent grassland where the acreage grew by some 6 ha (31.79 %), yet the acreage of orchards fell (0.19 %). This is also a time when we perceive a minor decrease in arable land acreage (19.83%) and an increase in vineyards (10.92 %). 25.8 ha which is 2.93 % of the cadastral area, was taken up by built up areas.

A land use map dated 1950 can be seen in figure 4. The best represented category is forests with 40 % of cadastral acreage (Table 3). Forests thus expanded against the previous years, just as arable land did by 66 ha. This fact can be explained by the starting of the collectivisation of agriculture in the then Czechoslovak Republic aimed at securing the utmost production of field crops which resulted in the decrease in permanent grasslands and vineyards. Built up area covered 32.18 ha then.

Land use analyses for the year 1990 (figure 5, table 4) brings major changes to utilisation of landscape against previously assessed periods. Whilst forests prevailed to this date, they vanished to be replaced by a body of water – the result of building the Nové Mlýny reservoirs. Their acreage covers more than half of the area in question. The second most represented category is arable land (17.08 %), followed by vineyards (6.86 %), permanent grassland (3.6 %), forest (1.63 %) and orchards (0.38 %). 33.16 ha (3.77 %) are covered with buildings.

In 2006 (Figure 6) water was the major category with 64.62 % of the cadastral area (Table 5). The analysis shows arable land acreage dropped even further (10.46 %). Yet forests, orchards and vineyards recorded an increase in the areas they cover. Forests are represented in 5.59 %, orchards 1.16 % and vineyards 10.24 %. Built up areas cover 37.98 ha (4.32 %).

At present – situation in 2016 (Figure 7) water body still prevails (64.98 %) (Table 6), followed by vineyards (8.83 %), arable land (where the acreage keeps going down continuously) with 8.3 % and forests taking up 7.76 %. Compared to the previous years the area covered by buildings increased by about a further 10 ha to the total of 47.82 ha.

The table of total values for different types of plot (Table 7) and the graph of culture development (Figure 8) give a global picture of the increases and decreases of individual areas in a complete time series. The graph shows that in history the Dolní Věstonice countryside was covered by forests – floodplain woods. Having built the Nové Mlýny reservoirs in the 1970s and 1980s forests dropped significantly in favour

of water expanses. However, over time we can perceive a slight reforestation. This applies also to arable land which attained its largest coverage before the Nové Mlýny reservoirs were built and significantly altered the character of the entire cadastral area. The arable land acreage is on a slow decrease at present. While the orchard representation in this cadastral area is very small, it has been gradually growing since 1990. The landscape analysis suggests that permanent grasslands covered a considerable part of the countryside in 1950 which also changed substantially according to data from 1990, again in connection to the water body construction). However, permanent grasslands have been further decreasing between 1990 and the present. On the other hand, the growth in the water area that covered no part of the land in 1950 is very major – in fact in 1990 sources, water covers more than 60 % of the countryside under scrutiny. The analysis carried out shows that the chosen cadastral area of Dolní Věstonice has undergone a very major land use change over less than two centuries. Vast water bodies in the form of reservoirs turned up to the detriment of arable land, permanent grassland and forests.

Assessment of agricultural land sealing in favour of built up areas was generated for eight time series (Figure 9, Table 8) including the stable cadastre from 1824 and the future situation proposed in the municipal zoning plan. The acreage of built-up areas in 1824 was 16.49 ha. The built-up areas grew by 7.64 ha in the time of the second military mapping at Dolní Věstonice while no major change occurs to the date of the third military mapping. Land use analysis in 1950 exhibits an increase in the scope of built-up areas – 32.18 ha (6.38 ha increase compared to the previous period). Comparing land use between 1990 and 2006 shows a slight increase in built-up areas. Between 1950 and 2006 5.8 ha was sealed anew. In the last ten years (2006–2016) the built-up area in the countryside under scrutiny grew by 9.83 ha. Compared to the 1950–2006 sealing of a “mere” 5.8 ha, this represents a significant building development. Sealing of built-up areas according to the zoning plan was assessed for theoretical understanding of future development. Results of the analysis are far from beneficial in terms of protecting the agricultural land fund. About a further 10 ha of soil should be sealed in future.

Fig. 1: The map of location area

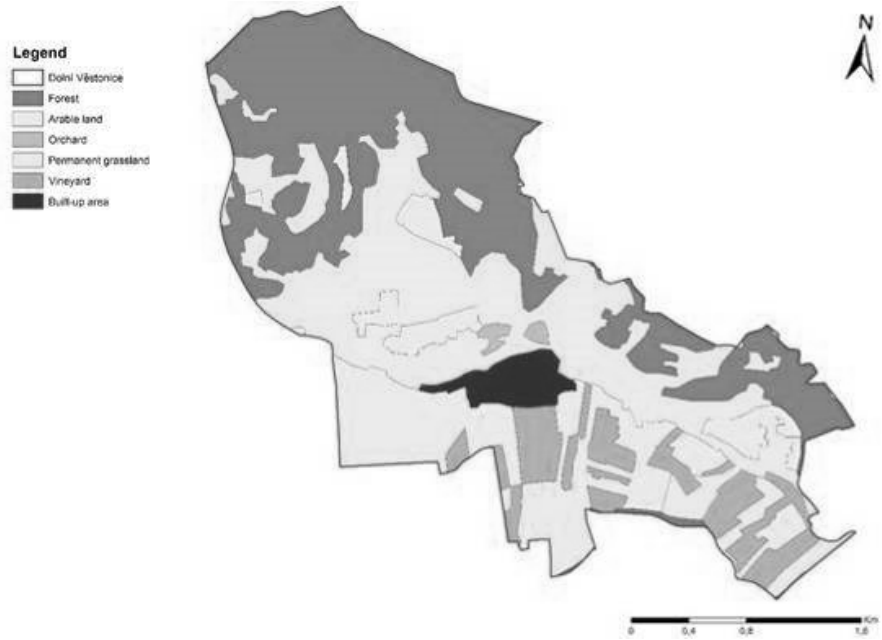

Fig. 2: The map of land use in 1836-1852 (II. Military mapping)

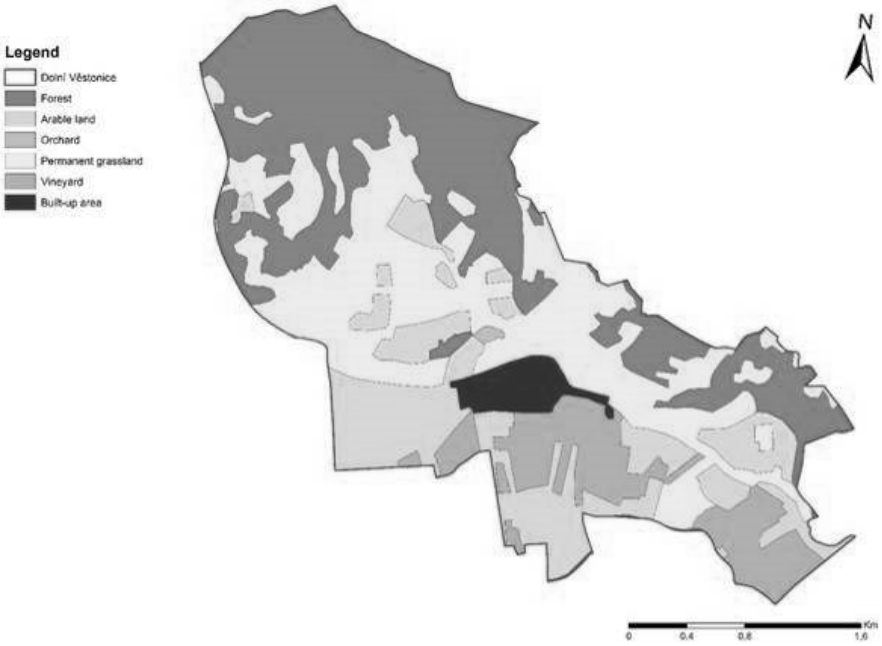

Fig. 3: The map of land use in 1876-1878 (III. Military mapping)

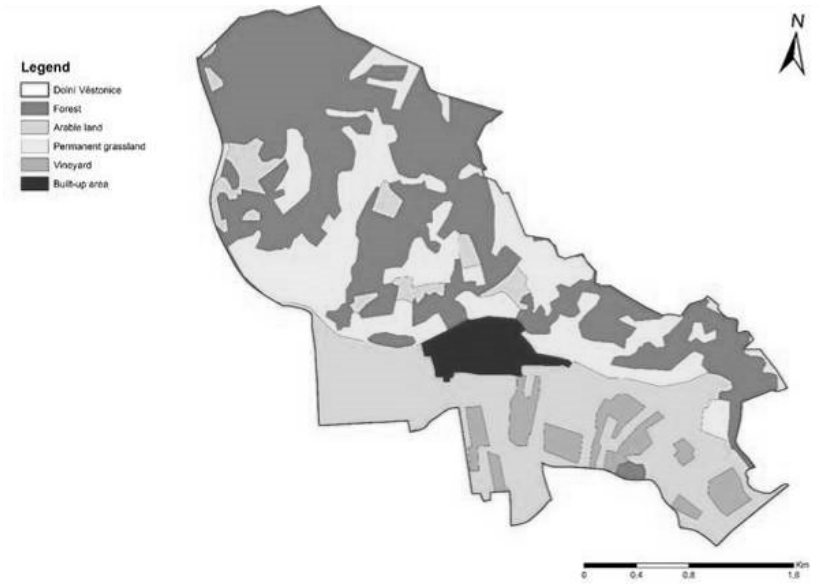

Fig. 4: The map of land use in 1950

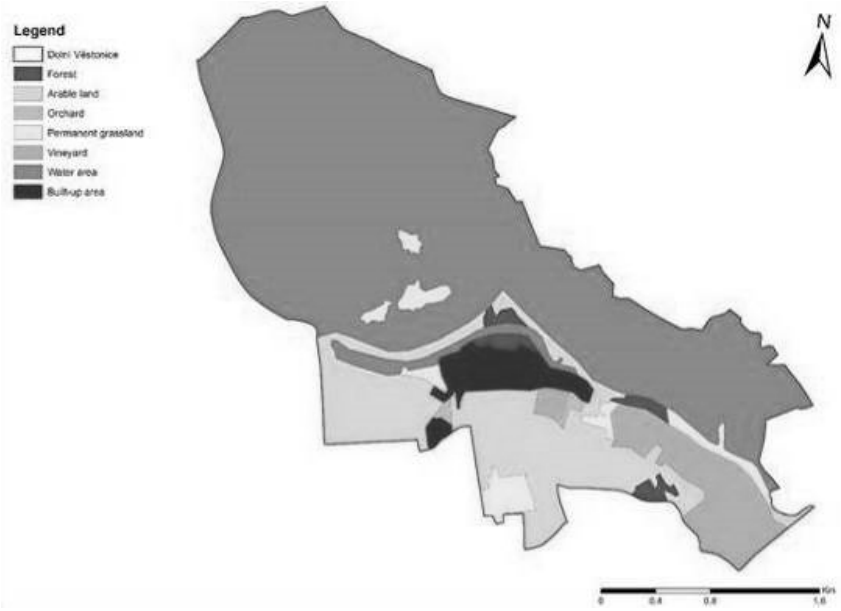

Fig. 5: The map of land use in 1990

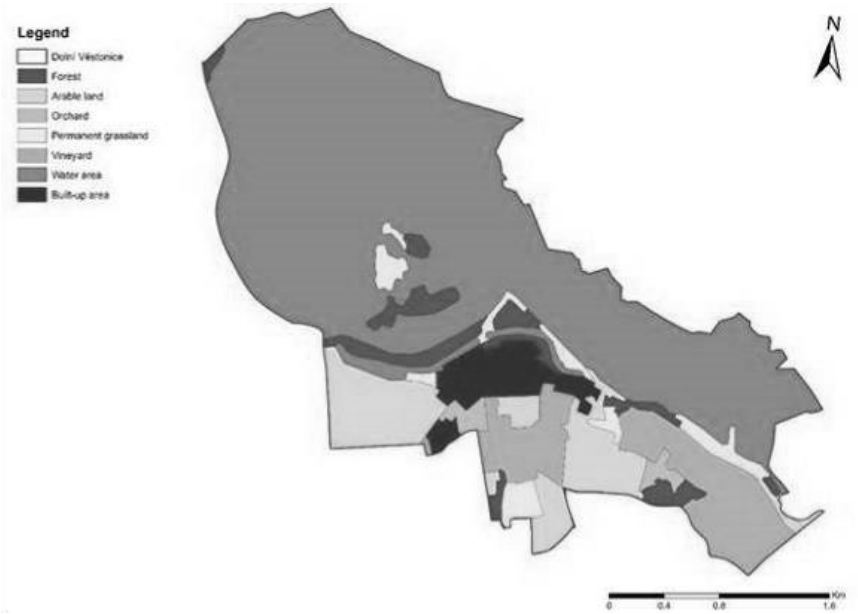

Fig. 6: The map of land use in 2006

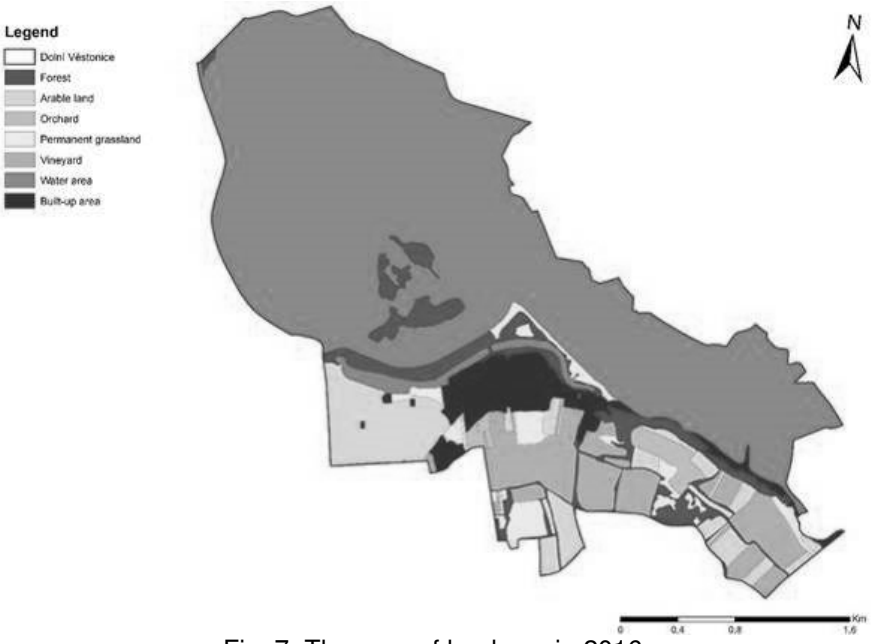

Fig. 7: The map of land use in 2016

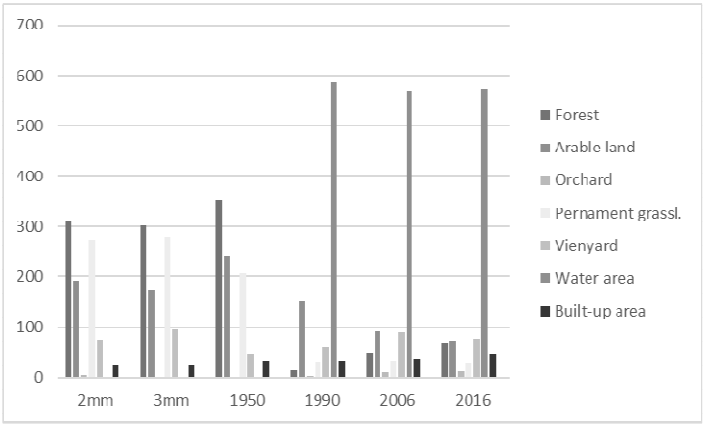

Fig. 8: Graphical representation of trends in the individual cultures

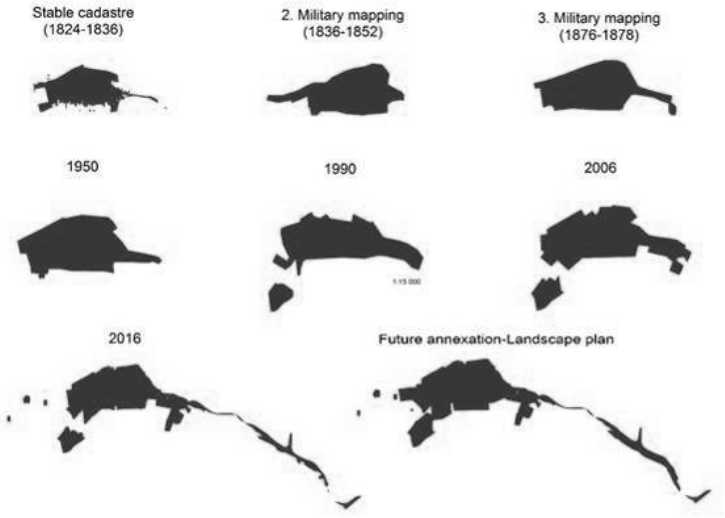

Fig. 9: The development of built-up areas

Tab. 1: The aggregate value of the kind of land in II. military mapping

CULTURE	2MM	%
Forest	309,92	35,22
Arable land	192,01	21,82
Orchard	4,77	0,54
Pernament grassl.	273,67	31,1
Vienyard	75,54	8,58
Water area	0	0
Built-up area	24,13	2,74
Total	880,04	100

Tab. 2: The aggregate value of the kind of land in III. military mapping

CULTURE	3MM	%
Forest	302,22	34,34
Arable land	174,54	19,83
Orchard	1,64	0,19
Pernament grassl.	279,73	31,79
Vienyard	96,11	10,92
Water area	0	0
Built-up area	25,8	2,93
Total	880,04	100

Tab. 3: The aggregate value of the kind of land in 1950

CULTURE	1950	%
Forest	352,06	40
Arable land	241,48	27,44
Orchard	0	0
Pernament grassl.	206,37	23,45
Vienyard	47,95	5,45
Water area	0	0
Built-up area	32,18	3,66
Total	880,04	100

Tab. 4: The aggregate value of the kind of land in 1990

CULTURE	1990	%
Forest	14,38	1,63
Arable land	150,35	17,08
Orchard	3,36	0,38
Pernament grassl.	31,64	3,6
Vienyard	60,36	6,86
Water area	586,79	66,68
Built-up area	33,16	3,77
Total	880,04	100

Tab. 5: The aggregate value of the kind of land in 2006

CULTURE	2006	%
Forest	49,22	5,59
Arable land	92,05	10,46
Orchard	10,19	1,16
Pernament grassl.	31,83	3,62
Vienyard	90,12	10,24
Water area	568,65	64,62
Built-up area	37,98	4,32
Total	880,04	100

Tab. 6: The aggregate value of the kind of land in 2016

CULTURE	2016	%
Forest	68,33	7,76
Arable land	73,08	8,31
Orchard	12,54	1,42
Pernament grassl.	28,69	3,26
Vienyard	77,74	8,83
Water area	571,84	64,98
Built-up area	47,82	5,43
Total	880,04	100

Tab. 7: The aggregate value of the kind of land in every period of time

CULTURE	2mm	3mm	1950	1990	2006	2016
Forest	309,92	302,22	352,06	14,38	49,22	68,33
Arable land	192,01	174,54	241,48	150,35	92,05	73,08
Orchard	4,77	1,64	0	3,36	10,19	12,54
Pernament grassl.	273,67	279,73	206,37	31,64	31,83	28,69
Vienyard	75,54	96,11	47,95	60,36	90,12	77,74
Water area	0	0	0	586,79	568,65	571,84
Built-up area	24,13	25,8	32,18	33,16	37,98	47,82
Total	880,04	880,04	880,04	880,04	880,04	880,04

Conclusion

Comparing changes in the use of Dolní Věstonice cadastral area over time outlined several remarkable facts. This countryside was gravely affected by the construction of the Nové Mlýny lakes in the second half of the 20th century. The areas of floodplain forests, i.e. ecologically stable and wealthy biocoenoses decreased. Other types of land (arable, permanent grassland, vineyards…) have also undergone serious changes. The local landscape significantly lost its character. At present the reservoirs cover over 60% of the cadastral area. Not only water expanses but also built-up stretches have grown. The Dolní Věstonice villages expanded continuously

at a steady rate. From 1824 to the present the built-up area grew by about 31 ha, in most cases to the detriment of agricultural soil. However, this rate has been escalating steeply in the most recent times since 2006. Should this tendency continue in future at the same rate and considering potential climate change and its impact on farming production, we can anticipate problems with insufficient agricultural land cover and a potential scarcity of food resources.

Tab. 8: The development of built up area

Period	Area
SC	16,49
2mm	24,13
3mm	25,8
1950	32,18
1990	33,16
2006	37,98
2016	47,81
LS plan	57,76

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Souhrn
Článek se zabývá problematikou vývoje záboru zemědělské půdy v katastrálním území Dolní Věstonice (Jihomoravský kraj). Byly použity dostupné datové a mapové zdroje (historické a současné). Zpracování dat bylo provedeno metodou ruční digitalizace, pomocí které byly vytvořeny potřebné mapové výstupy. V rámci vybraných časových period, kdy výchozím stavem byl rok 1824 – (zdroj dat Stabilní katastr) je vyhodnocen úbytek zemědělské půdy v jednotlivých obdobích až do současnosti. Ve většině případů je zábor zemědělské půdy spojen s rozvojem intravilánu obce. Pro porovnání budoucího vývoje je zhodnocen i potenciální (budoucí) zábor zemědělské půdy, který je navržen v rámci platného územního plánu obce. Z výsledků práce vyplývá, že na katastrálním území obce Dolní Věstonice bylo od roku 1824 do současnosti zabráno cca 31 ha zemědělské půdy (3,6 % celkové výměry katastrálního území). Největší nárůst záboru půdy nastává mezi lety 2006 až 2016. V tomto období došlo k záboru půdy na cca 10 ha. V případě udržení tohoto trendu lze očekávat do budoucnosti rozsáhlý úbytek zemědělské půdy, spojený s možnými problémy udržitelného zemědělství a teoreticky i problémy s nedostatkem potravinových zdrojů.

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THE LEVEL OF INVASION BY INVASIVE NEOPHYTES ACROSS STREAM HABITATS AS AN OBSTACLE TO RECREATIONAL LAND USE

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Abstract
The hypothesis seeks to answer the question to what degree are habitats affected by invasive knotweed (*Reynoutria spp.*), impatiens (*Impatiens glandulifera*) and other neophytes after chemical eradication has been used in the area. The method is based on the habitats mapping and the phytosociological relevés along a migration sphere. It also pays regard to the level of invasion of neophytes. These three factors were used to characterize habitats. The habitats were divided according to the features of their ecotype and invasion of neophytes. The eradication was used to prevent the spread of *Reynoutria spp.* species and to preserve rare native plant communities at the National Natural Heritage Area Skalická Morávka. *Reynoutria spp.* had created huge shrub coverage before the herbicide was applied. Survey results showed spot occurrence of *Reynoutria spp.* at 62 % of the area but when compared with the mapping of previous years, there was decreasing coverage. Unfortunately *Impatiens glandulifera* filled a vacant ecological niche after the *Reynoutria spp.* was eradicated so there was no regeneration of native habitats. The increase of affected habitats strongly influenced or created by man to the detriment of the native habitats, lowered the attractiveness of the area in terms of recreational use, creating new obstacles and reducing the interest of the protected territory for ordinary visitors.

Key words: *Reynoutria spp.* as knotweed, *Impatiens glandulifera* as Himalayan balsam, habitat mapping, attractiveness of area, eradication

Introduction

A stream ecosystem represents an enormous sphere of migration for the dispersal of plants. Humans and their activities have caused the plant species to spread to new locations. Unfortunately stream habitats bound to stagnant and flowing water are very often subject to invasion from neophytes (Pyšek et al. 1998, 2002).
Labdon et al. (2008) determined 5789 alien species in Europe. Out of that Schnitzler et al. (2007) classified 43 dangerous invasive species for coastal vegetation. In Europe (Child et Wade 2000) and in North America (Shaw et Seiger 2002) these species spread invasively: hogweed (*Haracleum mantegazzianum* Sommier and Levier), Himalayan balsam (*Impatiens glandulifera* Royle) and hybrid species of knotweed (*Reynoutria spp.* Houtt.). These species are able to form dense monoculture undergrowth with 100% abundance (Beerling et al. 1993, Pyšek et Hejda 2005, Siemens et Blossey 2007). Czech authors following the occurrence of invasive species in riverine ecosystems have come to the conclusion that the most commonly occurring taxon among the neophytes is just *I. glandulifera* and *Reynoutria spp.* (Chuman et al. 2006, Matějíček 2006).
This study is a partial outcome of the work focused on the habitats mapping, depending on the level of invasion of *Reynoutria spp.*, *Impatiens glandulifera* and other neophytes after chemical eradication has been used in the area (Švec 2015). The work maps spreading invasive neophytes along migration spheres.

In many cases alien species have had a negative impact on adjacent habitats (Arévalo et al. 2010). At first their presence reduces biodiversity and then completely changes the character of the area (Chisten et Matlack 2009). Invasive species represent a barrier for our society and their presence reduces the attractiveness of the territory for recreational use.

Materials and methods

The study was done in the National Natural Heritage Area Skalická Morávka. This is part of the Morávka basin falling under a 5.470 to 10.600 kilometer river flow at an altitude of 336-380 meters above sea level. The total area is 101.98 hectares. The heritage area is located in the eastern part of the Czech Republic, south from the town of Frýdek-Mistek, under the administration of the Moravian-Silesian region. The territory falls within the Site of Community Importance (SCI), called "Niva Morávky". The subject of protection according to Šindler et al. *Care Plan* (2012) is the section of the natural flow with rare communities. Here are situated two nature trails describing a bedload function.

The massive invasion began after a flood situation at an affected part of the Odra river basin in 1997 (Brosch 2005). The first mapping and eradication of *Reynoutria spp.* had been performed in 2000. Švec (2015) made the first surface mapping of *Reynoutria spp.* occurrence in 2007. Following the LIFE-NATURE project „Záchrana lužních stanovišť v povodí Morávky“, chemical eradication was launched. Švec (2015) performed re-mapping of the covering *Reynoutria spp*. after spraying in 2009. The last spraying was done in the autumn of 2012. The latest neophytes mapping was carried out in 2013 (Blahuta 2014).

Mapping of invasive species

The ArcGIS software was used to create a map of Skalická Morávka interspersed with a square grid of distances between points of intersection 50x50 meters. The square grid has been assigned a north-south orientation with the calibration on the northern border. The total number of cardinal points is 454. One point represents 0.25 ha of area. At each nodal point was performed a simplified phytosociological relevés of the herb layer. It mapped the coverage and frequency of neophytes. These three factors were used to characterize habitats according to Chytrý et al. (2010) *Catalogue of habitats in Czech Republic* classification. The habitats were divided according to the features of their ecotype and invasion of neophytes.

For simplifying the interpretation of results a scale was assembled which describes the condition density, frequency and coverage of individual neophytes. From the viewpoint of the simplification of the output it was not species-specific for *Reynoutria spp*.

- Slight occurrence (0) – evaluated only on species of *Reynoutria spp*., where all of its presence was recorded. This means that its occurrence was recorded outside of the cardinal points. Generally, there were located only a few individual plants of knotweed on the area.
- Spot occurrence (1) – describes the spot of occurrence for the species with low abundances. The presence of neophyte is displacing other species. There are only a few scattered individuals of growing neophytes at the cardinal point.
- Dominant occurrence (2) – a high occurrence of the species where their abundance exceeds other species. The species doesn’t create dense growth but the abundance is dangerous.

- Aerial occurrence (3) – the neophytes creates a dense canopy a with high abundance and frequency. The species diversity is rapidly reduced by neophytes.

Mapping neophytes along migration spheres

Map data to monitor the occurrence of *Reynoutria spp.* from years 2007 (Švec 2010), 2009 (Švec 2015) and 2013 (Blahuta 2014) were extended to mapping neophytes in the vicinity of migration spheres. The initial state is the mapping from 2007 (Švec 2010). Newly created were two thematic maps monitoring *Reynoutria spp.* to 10 meters from the boundary of the migration routes. The first map mapped natural migration flows (watercourses, boundaries between field and forest). The second map monitors man-made migration routes (forest roads, nature trails, hiking trails, forest paths, utilities). However, it is only mapping *Reynoutria spp*. The mapping of other invading other neophytes was not done in previous years.

Results and Discussion

On the territory of the National Natural Heritage Area Skalická Morávka 13 habitats were mapped in 2013 (Blahuta, 2014). Habitats are split into three categories according to their ecotype: forest (L2.2, L2.4 and L3.2 - 265 points), (K2.2, M1.4, M4.1 and M4.2 - 98 points), and habitats strongly influenced or created by man (X7A, X7B, X12A a X12B - 78 points). Habitats V4A and T1.1 are not included in the results. Neophytes have been confirmed in 630 cases. Overall, 16 species of invasive neophytes were found in the territory of Skalická Morávka. The total coverage of the herb layer shows that every fifth herbaceous species is a neophyte.

The mapping of 2013 confirmed that the most common neophytes are *Reynoutria spp* even after chemical eradication. However, a decrease in coverage was recorded. Knotweed was on 276 points. The spot, dominant and aerial occurrence of knotweed was confirmed on 124 points. The aerial occurrence was mapped on four points and dominant in 5 cases. Alarmingly, it appears as a slight occurrence on 81 points. From these locations a new invasion can begin.

Unfortunately, the high coverage also includes *Impatiens glandulifera*. Himalayan balsam had been mapped on 120 points. A high danger is represented by aerial occurrence which was confirmed on 17 points. Dominant occurrence was recorded on 23 points. The common of occurrence *Reynoutria spp.* and *I. glandulifera* was confirmed on 20 points at forest habitats, at the wetlands and riverine vegetation on 8 points, and in the habitats strongly influenced or created by man on 21 points.

Overall, over 6200 meters of man-made migration routes and 14090 meters of natural migration routes were mapped. Tab. 1 describe the migration routes. The results are not conclusive on which migration sphere has a major impact on the spread of neophytes. *Reynoutria spp.* occur at approximately equal locations even after herbicide application. The coverage of neophytes was higher in the vicinity of the sites used by man (Blahuta 2013) and at constructions on a stream (Šlezingr et al. 2016, Šlezingr et Ehmannová 2014). Vigorous growth of neophytes are found under power lines, along hiking trails and along forest roads. The frequency of neophytes decreases with the increasing density of forest.

Presented results confirm the spreading of *Reynoutria spp.* and *Impatiens glandulifera* along migratory spheres. Although compared to the findings of Mandáka et al. (2004) and Chrumy et al. (2013), the knotweed occurs near a watercourse. They presented a higher occurrence and coverage of invasive species in the vicinity of anthropogenic migration zones (railways, roads, trails, recreational trails). The

percentage frequency of neophytes in these studies is as follows: roadsides (ca 40%), water courses together with ponds (ca 25 %), and forest (ca 10%).
Dostálek et al. (2016) compared the historical mapping of neophytes 1970, 1994 a 2010. He examined the spread of neophytes near asphalt roads, meadows and forest. The highest frequency of neophytes was reached at a human affected site, eg.: a road embankment. Of anthropogenically influenced habitats these subsequently expanded into natural habitats. While the territory of Skalická Morávka was invaded by neophytes after flood events. The highest occurrence of neophytes was recorded in direct interaction of the riparian edge with forest and within reach of water submerged land.
The suitable forest management during felling of forest and the subsequent transportation of the timber can reduce the occurrence of non-native species (Hrůza 2015). Invasive neophytes significantly reduce the attractiveness of the territory. A considerable number of the hiking trails in Skalická Morávka run along the edge of the bank, a direct interaction with the locations of the highest occurrence of neophytes. Invasive plants reduce visibility in the landscape. The landscape character and aesthetic appearance is monotonous. In terms of human perception, monocultural cover of neophytes creates a depressive and anxious feeling.

Tab. 1: The mapping coverage of *Reynoutria spp.* along migrations sphere

Year of mapping	2007		2009		2013	
Migration sphere	Natural (m)	Man Made (m)	Natural (m)	Man Made (m)	Natural (m)	Man Made (m)
Without *Reynoutria spp.*	7082	2943	8840	4595	12583	4322
1 - spot coverage	843	399	4899	1345	1185	1561
2 - dominant coverage	589	115	106	61	187	144
3 - aerial coverage	5568	2737	248	196	148	181
Total distance of 1+2+3 coverage	7000	3251	5253	1602	1520	1885
Total distance of migration route	14082	6194	14094	6197	14104	6207

Conclusion
The initial invasion of non-native species is always associated with unusual situations. In the case of the National Natural Heritage Area Skalická Morávka there were flood situations in 1997 and 2004. A new invasion started after the first vegetation season. Neophytes spread out from the flooded zone, through line elements in a landscape, direct to woodland. Despite chemical eradication the most frequently occurring neophytes are *Reynoutria spp.* and *Impatiens glandulifera* on the territory of Skalická Morávka. If we want to preserve our natural heritage, it is essential to continue the suppression of non-native species. Even this negative aspect of the landscape can be used as a representative sample. The public should be informed of the existence and dangers of invasive plants and the need for protection against them.

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Souhrn
Studie se snaží odpovědět na otázku, do jaké míry jsou přirozené a nepřirozené migrační cesty ovlivněny přítomností neofytů. Zejména pak invazní křídlatkou (*Reynoutria spp.*) a netýkavkou žláznatou (*Impatiens glandulifera*). Na základě terénního mapování a fytocenologického snímkování byla v roce 2013 zjištěna pokryvnost a četnost neofytů na celém území Národní přírodní památky (NPP) Skalická Morávky. V předchozích letech byla v nivě Morávka provedena plošná eradikace, která měla za úkol omezit invazi šíření rodu *Reynoutria spp.* Křídlatka zde totiž tvořila rozsáhlé zapojené porosty. Výsledek šetření prokázal bodový výskyt *Reynoutria spp.* na 62% území NPP, avšak oproti mapování z předešlých let klesla její pokryvnost. Na základě šetření nelze prokázat, která migrační trasa má zásadnější vliv na šíření křídlatky. Bohužel *I. glandulifera* zaplňuje volnou ekologickou niku po *Reynoutria spp.* vzniklou po eradikaci. Nedochází tak k regeneraci původních společenstev a území podléhá nové invazi. Nárůst člověkem ovlivněných biotopů na úkor původních, přináší snížení atraktivnosti území. Z hlediska rekreační využitelnosti, invazní nárůst neofytů vytváří nové překážky pro běžné návštěvníky a snižuje zájem o území.

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THE RELEVANCE OF PROMOTING HONEY ROAD ON FOREST SUSTAINABILITY IN SOUTH DOBROGEA, ROMANIA

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Abstract
South Dobrogea is an unit plateau from South-East of Romania, predominantly rural, providing natural environmental conditions favorable to beekeeping, as a traditional activity. Research methodology is represented by bibliographic documentation and field research, in order to identify forest areas and villages with beekeeping potential. By cartographic representation are proposed and highlighted tourist routes with beekeeping profile named "*honey road*", that will contribute to promote beekeeping as a traditional activity and to protect forest landscape. The study aims to define the specific api-touristic activities in South Dobrogea and theirs impact on the forest landscapes, in order to contribute to the sustainable development of rural communities in this area. This beekeeping potential can be positively exploited along with the ecotourism and leisure tourism one, the studied region including protected forest areas (perfect environment for bees, indicators of sustainability) and touristic sights, constituted in one unit that can represent an alternative source of income and culture for its inhabitants.

Key words: agri-tourism, beekeeping, environment, landscape, rural

Introduction

South Dobrogea is an unit plateau in South-Eastern Romania, predominantly rural, providing natural environmental conditions favorable to beekeeping as a traditional activity. Forest resources are mainly concentrated in the South-West of studied area and are dispersed in the remaining territory (Popescu, 2015). Beekeeping is a traditional activity that contribute to the sustainable development of the rural community (Gruia, 2013, Pocol et. al., 2015) of South Dobrogea, in the studied region identifying several villages with beekeeping profile. This activity can be integrated into a tourist route with beekeeping theme named „***Dobrogea Honey Road***", which aims the valorisation of beekeeping potential from South Dobrogea, respectively Danube Meadow and the it's forests, associated with local tourist attractions. The region proposed for promotion is a homogeneous area of 12 administrative units (ATU) located along the Danube and in South Dobrogea (fig. 1), which belong to the *1st Bio-Apiarian Area Danube Plain and Dobrogea,* after beekeeping importance (Jitariu et. al., 2011, Popovici et. al., 2015).
The common characteristics of the 12 ATU are: appurtenance at the *1st Bio-Apiarian Romanian Area*, the geographical location between Danube and Black Sea, with alternative forms of tourism including a comparable level of socio-economic development (Gruia, 2013). The study aims to define an api-touristic specific in South Dobrogea and the impact of this activity on forest landscapes, in order to contribute to the sustainable development of this rural area.

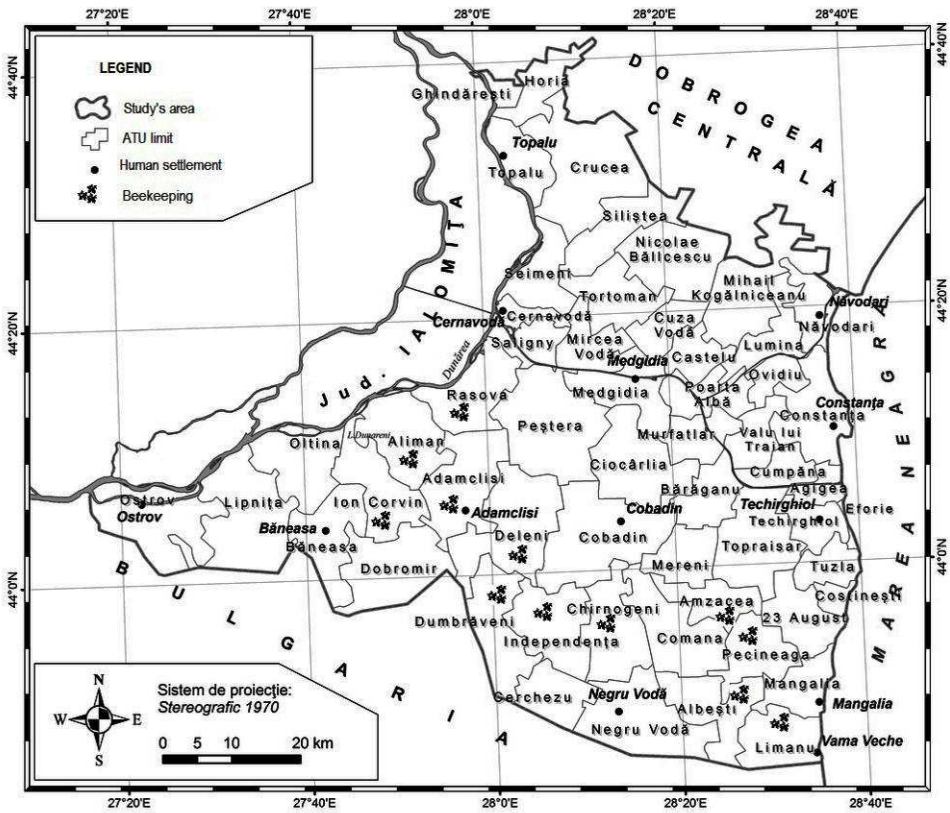

Fig. 1: South Dobrogea: main areas of beekeeping

Material and methods

The research methodology is represented by the bibliographic documentation, field research for identifying forest areas and villages with beekeeping potential. The cartographic representation highlights the resources that led to the identification of tourist routes with beekeeping specific „***Dobrogea Honey Road***", that will contribute to promote beekeeping as a traditional activity, as well as protecting forest landscape.

Results and Discussion

Beekeeping has great importance throughout Romania, with a long tradition in the territory between the Danube and the Black Sea. Honey represented not only food, but also an important medicament; beeswax was the light housing provider, until the discovery of modern lighting. In order to prove age of this occupation, archaeological discoveries are evidence, the writings of ancient authors, as well as the historical and archival documents, that attest the existence of beekeeping in Dobrogea (Jitariu et. al., 2011, Pocol et. al., 2015).

The bio-apiarian area along the Danube include steppe and Danubian forest steppe and it characterized by continental climate with annual average temperatures over 10.0°C (spring over 10.0°C, summer +22.0°C, fall +12.0°C, winter +1.0°C) and precipitation up to 500 mm annually. The typical vegetation is forest steppe, in which appear massive acacia and lime forests and blunt forests. Natural grasslands are

very few, area being typical agricultural, cereals, technical and fodder crops occupying the largest area (Jitariu et. al., 2011).
As regards beekeeping, studied area is characterized by production harvesting at acacia (*Robinia pseudocacia*) - the most important, of high intensity and short duration, and sunflower (*Helianthus annuus*), providing the main spring harvesting. For its valorization, honeybee colonies are prepared by early support harvest provided by willow (*Salix sp.*) in the wetland, then by deciduous forests vegetation (fig. 2): hazel (*Corylus avellana*), horn (*Cornus mas*), elm (*Ulmus spp.*), maple (*Acer pseudoplatanus, A. Campestre*) and of fruit trees and wild flora. Late summer, the riverbanks in the flooded rivers region and in the Danube Meadow is provided by important harvest from meliferous swamp flora, the basic species being mint (*Mentha aquatica, Mentha pulegium*). The honey production, although obtained in considerable quantities as commodity production, it becomes secondary in addition to the bees contribution to natural sustenability and to the increase of agricultural production, through pollination. Attracted by the rich nectar sources (flora and wetland forests), local beekeepers practice the most intense and frequent pastoral beekeeping since spring to autumn, so this occupation gets every year a special amplitude, unequaled in South-East Europe (Wos, 2014, Popovici et. al., 2015).

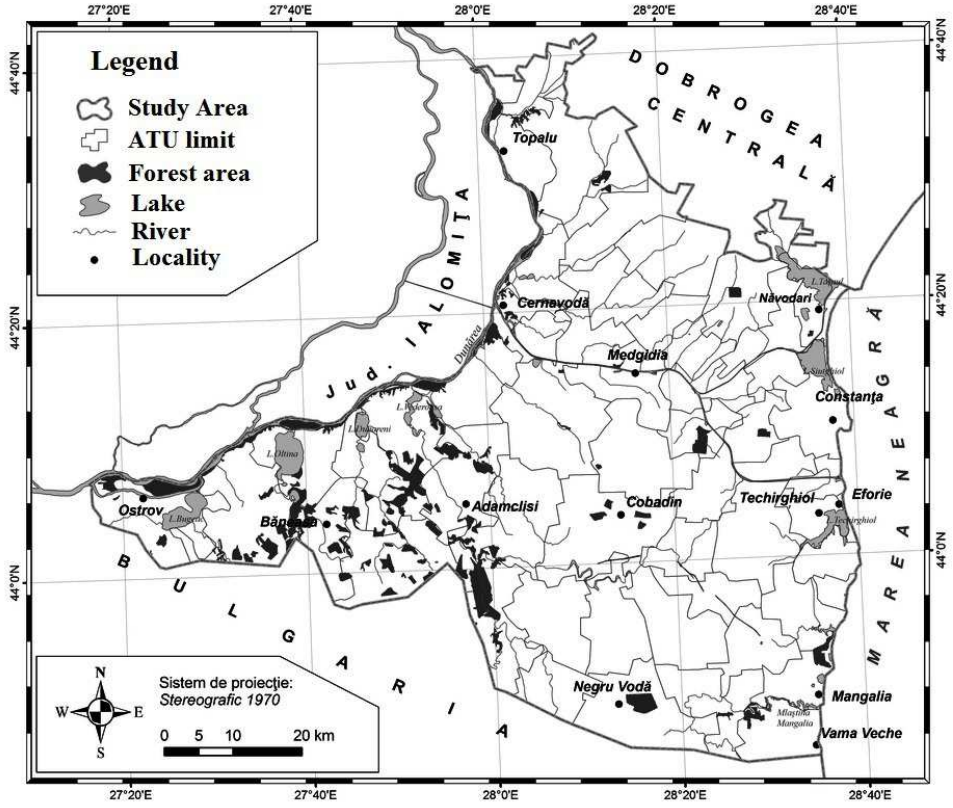

Fig. 2: South Dobrogea: Forest areas

The **thematic routes** proposed that make "***Dobrogea Honey Road***" crosses the South Dobrogea part of *1st Bio-Apiarian Area - Danube Plain and Dobrogea*, emphasizing traditional events that highlight local culture and the bee culture, natural resources (protected areas that have potential melliferous) and cultural

heritage (historical, religious customs and traditions), based on the existing infrastructure (the road that connects Danube and Black Sea). Honey routes follows pastoral beekeeping and stands out by the establishment of the melliferous plants units, depending on the type of harvesting and the Beekeeping value of the meliferous plant unit: *Baneasa Melliferous Unit* - spring harvest, *Murfatlar Melliferous Unit* - summer harvest, *Cernavoda Melliferous Unit* - early spring harvest, end of harvest in summer-autumn.

The ***routes*** will be accessible from the main extreme urban areas, as follows:

1. Danube Honey Road: *Ostrov - Lipnița - Baneasa - Ion Corvin - Aliman - Rasova* (along Danube, between Calarasi and Cernavoda);

2. Roman Honey Road: *Valu lui Traian - Murfatlar - Ciocarlia - Cobadin - Viisoara - Deleni - Adamclisi - Crangu - Ion Corvin* (coming from Constanta);

3. Seaside Honey Road: *Limanu - Pecineaga - Amzacea - General Scarisoreanu - Plopeni - Movila Verde - Independenta - Dumbraveni* (coming from Mangalia and the South of the seaside, on county and local roads) (fig. 3).

The *main tourist sites and attractions* of ***Dobrogea Honey Roads*** are:

- ***the Pastoral beekeeping zones*** belonging to the 1st Bio-Apiarian Romanian area, named apiary settlement that are in the temporary - pastoral, or stationary apiary settlement, along the route ***Rasova - Ion Corvin - Adamclisi - Dumbraveni - Plopeni - Pecineaga - Limanu,*** with visiting the points of tourist attraction located on the main road or on the farming roads;

- *Meliferous units*: Cernavoda (with honey routes Rasova, Aliman), Baneasa (with honey route Ion Corvin), Murfatlar (with honey routes Adamclisi, Deleni, Dumbraveni);

- *Natural touristic resources*: natural lakes (*Bugeac, Oltina, Dunareni, Vederoasa, Plopeni, Mangalia*), protected natural areas (*Valu lui Traian, Fantanita-Murfatlar, Canaraua Fetii, Esechioi, Hagieni, Dumbraveni*), fossiliferous sites (*Aliman, Cernavoda, Credinta*), the lake in chalk (*Murfatlar*) the caves *Obanu Mare* and *La Movile*, the marine aquatorium *2 Mai-Vama Veche*, other spread forest areas (Popescu, 2015);

- *Cultural heritage resources*: archaeological sites (*Altinum, Axiopolis, Păcuiul lui Soare, Sacidava*), *Adamclisi Monument*, the complex carved in chalk *Basarabi*, monasteries (*St. Andrew Cave, Dervent*), rural ethnographic collections (*Limanu, Cobadin, Ostrov, Rasova*), other religious objectives (*Muslim cult or Old Orthodox Rite*) (fig. 3).

Depending on the type of harvesting during the year, the scroll direction of the *Honey Routes* is as follows:

1. *Main pollination route*: Rasova - Aliman - Dunareni - Viile - Ion Corvin - Adamclisi - Deleni - Sipotele - Dumbraveni - Independenta - Movila Verde - Plopeni - Amzacea - Pecineaga - Limanu - 2 Mai - Vama Veche;

2. *Murfatlar Melliferous Unit - summer harvest*: Adamclisi - Deleni - Sipotele - Dumbraveni – Independenta - Movila Verde - Plopeni - Amzacea - Pecineaga - 23 August - Limanu - 2 Mai - Vama Veche;

3. *Murfatlar, Baneasa, Cernavoda Melliferous Units - late summer-fall harvest*: Vama Veche - 2 Mai - Limanu - Pecineaga - Amzacea - Plopeni - Movila Verde - Independenta - Dumbraveni - Sipotele - Deleni - Adamclisi - Ion Corvin - Viile - Dunareni - Aliman - Rasova.

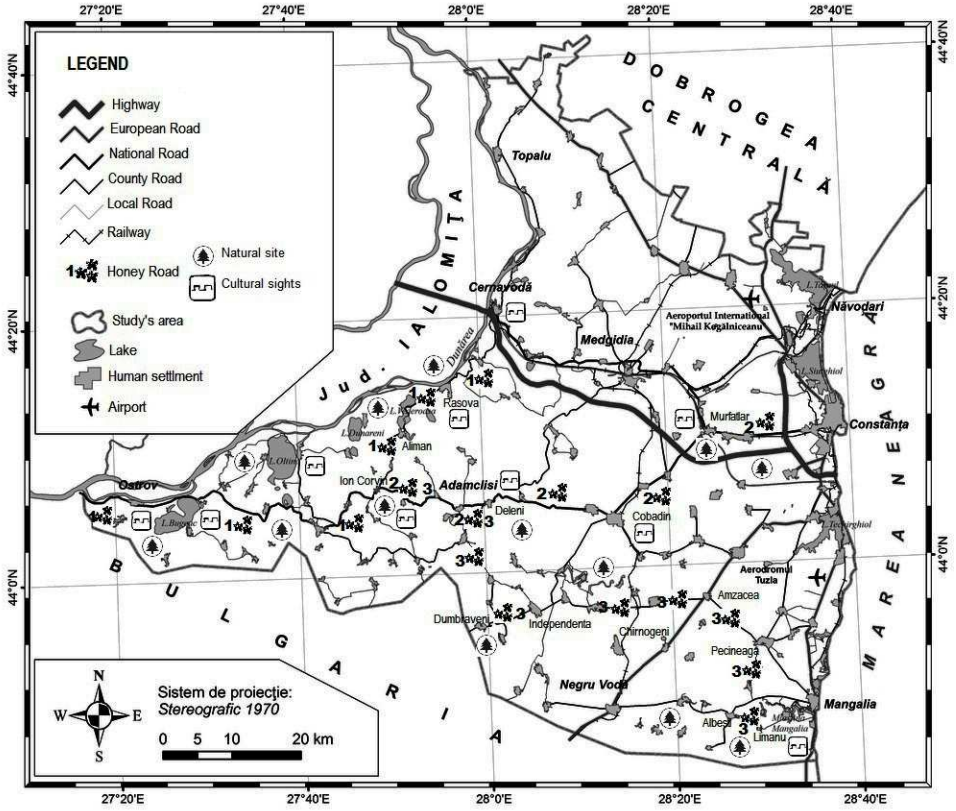

Fig. 3: Honey Roads in South Dobrogea

Conclusion

South Dobrogea has great beekeeping potential, for the efficiency of this thematic honey route being necessary the arrangement of a guesthouse near the apiary, the organize of some beekeepers activities within some events, the implementation of a local network for beekeepers that can positively contribute to promote the Dobrogea Honey Road.

By valorisation of beekeeping potential together with natural reservations and forest areas, are created optimal motivation of agri-tourism and ecotourism consumption, also having an educative role regarding the protection and conservation of local forest landscapes.

In order to promote natural and cultural heritage, traditions related to beekeeping, for tourism purposes it is mandatory to have information centers in main villages and also clearly outlines the objectives of the thematic itinerary ***Dobrogea Honey Road***.

The efficient manangement of beekeeping resources next to the natural and cultural objectives, will play an important role at the development of a sustainable tourism for local rural communities of Southern Dobrogea.

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Souhrn
Jižní Dobrogea je část jihovýchodního Rumunska převážně venkovského charakteru příznivé právě pro včelařství jakožto tradiční činnost. Tato činnost může být začleněna do turistické trasy s včelařskými motivy nesoucí název "Dobrogea medová cesta". Tematické trasy vedou přes Jižní Dobrogeu a zachycují tradiční události, vyzvedávají místní kulturu a místní zdroje spojené s medem (chráněná území s potenciálem jako medonosné), kulturní dědictví (historické, náboženské zvyky a tradice). Tyto turistické trasy využívají stávající infrastrukturu (cesty propojující Dunaj a Černé moře). Jednotlivé trasy jsou přístupné z městských aglomerací: Dunajská medová cesta (po Dunaji mezi městy Calarasi a Cernavoda); Romanská medová cesta (mezi městy Constanta a Ion Corvin, z východu na západ); Přímořská medová cesta (z Mangalie přes jižní pobřeží až do Adamclisi po okresních a místních komunikacích). Dle zohlednění včelařství s využitím potenciálu přírodních rezervací a lesních ploch, mohou být vytvořeny ideální podmínky pro agroturistiku a ekoturistiku s výchovnou funkcí zaměřenou na ochranu a zachování místní krajiny. Efektivní management včelařských zdrojů, přírodních zdrojů a kulturních cílů budou hrát důležitou roli při rozvoji udržitelného cestovního ruchu pro venkovské oblasti Jižní Dobrogei.

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THE NEW STRATEGY OF USING FOREST FOR LEISURE ACTIVITIES LEADS TO MANAGED RECREATION

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Abstract
The philosophy promoted until recently concerning the need for multifunctional use of forest roads, not only for forest management purposes but also for recreation, has led to collisions between forest visitors and forest management activities and subsequently, to collisions among visitors themselves. With the increasing wealth of the society and the amount of leisure time, hiking in forests has become part of the preferred lifestyle and active approach to life. Additionally, the number of different types of activities that the public wishes to do in the forest has risen too. The act concentrates these activities to forest roads particularly. However, forest roads, especially in the vicinity of larger cities, have started to be overloaded by the concentration of visitors of the forest ecosystems. Forest owners' and managers' effort should be to manage and disperse the various interest groups of visitors within the forest ecosystem so that each visitor can engage in their activity without a negative impact on the surrounding environment, other visitors and the forestry. An example of this strategy is the construction of a singletrail in the territory of the Training Forest Enterprise Masaryk Forest Křtiny. These cycling trails concentrate a large group of visitors to a specific territory and narrow terrain routes. It is also possible to have agreements with the operators of the trails on their maintenance and partial responsibility for their operation.

Key words: managing recreational use, forest road, leisure activities

Introduction

The use of forest stands for sports activities is a growing phenomenon due to the increasing concentration of population in cities, and the search for a contrasting type of environment to spend leisure time actively. The human population with its increasing wealth looks for various types of sports activities in forests, which are different from the classical brushwood and berry picking and nature observation. Sports activities in the forest can be divided into several main groups: in addition to hiking, it is particularly jogging or running, cycling and mountain biking, also horse riding, or cross-country skiing in winter. As reported by many authors (Jacoby 1990, Symmonds 2000, Lathrop 2003, White et al. 2006), all of these activities can have a negative impact on the environment, in particular by causing erosion and destroying the vegetation. Additionally, they have a restrictive effect on management activities in the forest, especially as collisions with the timber extraction and hauling process are possible. This places increased demands on the forest owners and managers, who in addition to management activities have to deal with the management of the forest visitors, i.e. managed recreation.

Managed recreation may include the provision of information for the visitors on which places are worth seeing, or which forest trails are marked and maintained, the construction of parking lots at the trails, or the construction of special-purpose trails for various interest groups, as well as the construction of water reservoirs and leisure zones. The elements of the managed recreation include the education of

visitors on the correct behaviour in the forest ecosystem. Benefits of performing these activities are hard to express financially for forest owners and managers. They rather consist in the expectation that in the case of a proactive approach to this issue, owners or managers will get control over the forest visitors' movement and activities that are legally permitted in the forest and can thus direct them to the sites where collisions with forest management activities will be less likely. Another expected benefit is the possible separation of the interest groups, for example, so that the collisions between pedestrians and cyclists do not occur. The authors addressing the issues of recreation in the forest ecosystems (Ruff and Mellors 1993, Symmonds 2000, Lathrop 2003, White et al. 2006, Jakubisová 2013, Jakubisová 2016) agreed that the most intensely expanding sports activity in the forest is mountain biking, which has been devoted a great deal of attention recently. Also for this reason, the paper present focuses on the options of directing the movement of mountain bikers in the forest, also because these cyclists often ride outside forest roads and use the forest stands for their activities. The movement of cyclists in the forest stand may cause erosion as well as damage to the natural regeneration of the stands or buttress roots of trees.

This is one of the reasons why the forest act of the Czech Republic directs recreational activities to forest roads in particular. Misunderstandings often arise as the general public does not realize what is actually a forest road and what is not a forest road - they sometimes use technological lines that are exclusive for timber transport within the timber extraction and hauling process and that are not roads in the sense of the act on roads and related legislative provisions. It should be noted that cycling within the forest stand, outside forest roads, is illegal. In the event of a collision with forest management technology, the cyclist is fully responsible for the accident. However, if there is a conflict between a cyclist and a vehicle on a forest road, it is assessed as any other traffic accident.

The trails for off-road cycling are often created spontaneously and uncontrollably, damage to the forest soil and stands must be removed by the forest owners at their own expense, and their removal is often challenging. This may be a reason why forest owners may agree with the construction of the so-called singletrails for off-road cycling. These are one-way, single-track trails with a natural surface, their direction and elevation designed so that they are not disruptive in the stand and at the same time provide the experience associated with their use. Forest owners' active approach brings them the advantage that they can choose the place of the construction and the technical solution so that the forest management is disrupted as little as possible. The disadvantage is their responsibility for the condition of these trails, as the law sees them as cycling trails. The forest owners are responsible, in compliance with the civil code, for any possible injury or property damage in the circumstances when they should or could presume the risk or even in the cases when they caused or allowed the unsuitable condition by their activities. In practice, this means that if they do not care about the technical condition of the cycling trails, their maintenance and repairs, or they do so but are not able to prove that in the event of litigation, any problem is considered their fault. For the owners this means not only to ensure inspection of the roads condition, their repair and maintenance, but also to keep records of the progress of such inspections. It is possible to transfer this activity to a contractor and thus partially transfer the liability for injury or property damage. At the same time, we can assume that the concentration of visitors at the sites of singletrail construction will increase as these trails will be used by cyclists from all over the Czech Republic. This will impact the organization of the timber extraction and hauling, timber transport as well as gamekeeping at the site.

Materials and methods

Here we present an example of managed recreation through the construction of singletrails in the territory of the Training Forest Enterprise Masaryk Forest Křtiny, which are contracted to the SINGLETRAIL Moravian Karst z.s. association, who was interested in the construction of these trails. In addition to the maintenance and repair agreement with the contractor, the forest owner can also partially compensate for the increased costs of agreement administration and the location of trails in their territory by a fee per linear metre of the trail length or better per m^2 of the trail area - the singletrail width is generally stated to be up to 1 m, which only relates to one track, but the total width varies depending on the trail inclination and the transverse slope of the terrain. It is necessary to take into account the cut and fill slopes and take the singletrail width as the entire width of the road formation. This greatly changes the total area take-up, as evidenced by our investigation.

The existing three singletrails are made up of trails that go through the forest stand as well as, partially, on forest roads. The total length of all singletrails is approximately 23.9 km. The starting point for these one-way trails is located near camp Olšovec in Jedovnice, where also technical facilities for the operation of the singletrails have been constructed.

The sub-sections, which go directly through the forest stand, have been selected for the purposes of evaluating the chosen parameters and they are referred to in the study as Trail 1a, 1b, 1 c, Trail 2 and Trail 3 (Fig. 1). The length of the selected sub-sections is around 12.4 km in total.

The assessed parameters of the sub-sections (i.e. downhill parts of the trails) included their total length and the width with focus on the minimum, maximum, and mean values. The total width of the trail in the cross section was considered as the sum of the track width and the length of the fill and cut slopes, including longitudinal reinforcement. The selected values can be used to determine the total area take-up of the construction.

Results

Trail 1a with its total length of 770 m represents a part that is common for all the singletrails and is used to link Forest Roads Šibrnka and Budkovanská. The section has a character of a long rise, which makes up 83% of the trail length with a variable width, including cut and fill slopes, between 1.0 and 3.0 m. The mean total width of the road formation is 1.8 m, with 77% of the trail length being wider than 1.0 m (Tab. 1).

Trail 1b has a character of a ridge trail with a balanced ascent and descent ratio. The trail starts with a turn from Forest Road Budkovanská, crosses Forest Roads Proklest and Poutnická, where it ends. The section length is 5120 m and the trail width ranges between 0.7 and 9.2 m with a mean of 1.8 m. The total width of 435 m of the trail is greater than 3.0 m (Tab. 1).

Trail 1c forms the final part of the singletrail and is defined by Forest Roads Poutnická and Šibrnka. The length of the section, going over the north-western slopes of Tipeček peak, is 2130 m. The trail width is in the range of 1.0–5.4 m with a mean of 1.8 m (Tab. 1). 30% of the length has a total width greater than 2.0 m.

Trail 2 first runs along ridge forest road Hraniční and then diverts from it after approximately 600 m. The subsequent downhill part crosses Forest Road Olšovecká and ends in Forest Road Šibrnka at the main starting point common for all singletrails. The total section length is 2010 m and the trail width ranges between 0.8 and 6.4 m (Tab. 1) with a mean of 2.1 m. The total width of 315 m of the trail is greater than 3.0 m.

Trail 3 has a total length of 2410 m and represents the main downhill part of a singletrail that is about 10 km long. The section begins at Forest Road Rakovecká, in the first third it crosses Forest Road Šibrnka, where the downhill part ends. The trail is 1.0–6.2 m wide, with a mean of 2.4 m. 66% of the trail length is wider than 2.0 m, and in a length of 535 m the trail is wider than 3.0 m.
Based on the assessment of the widths, we can conclude that the resulting width of all trails in their entire length is greater than 1.0 m. On average, 90% of the trail lengths are 1.0–3.0 m wide (Tab. 1). Almost 1.4 km of the trails are wider than 3.0 m (11% of the total length of the trails located in the forest stand).

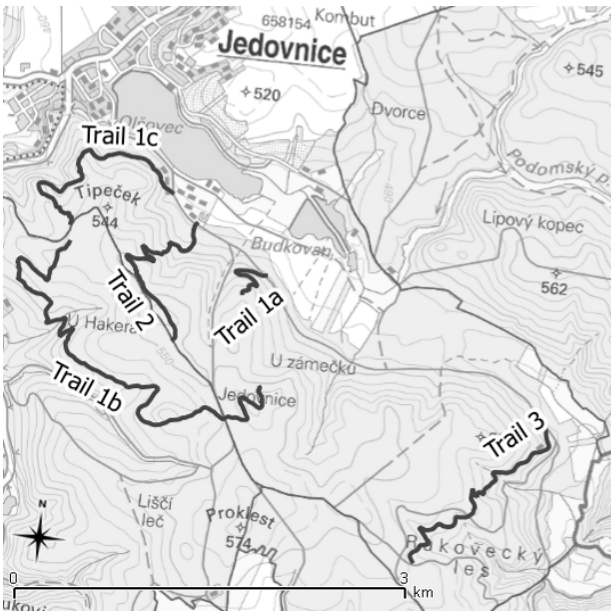

Fig. 1: Locality of interest

Tab. 1: Trail width parameters

Width [m]	Ratio of total trail length [%]				
	Trail 1a	Trail 1b	Trail 1c	Trail 2	Trail 3
<1	0.0	0.3	0.0	0.0	0.0
1–2	76.9	70.4	69.8	61.2	33.8
2–3	20.7	20.8	27.1	23.1	43.9
3–4	1.7	6.3	2.8	11.5	17.2
>4	0.7	2.2	0.3	4.1	5.1
Total length [%]	100.0	100.0	100.0	100.0	100.0

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Souhrn
Využití lesních porostů ke sportovním aktivitám je stále větším fenoménem vzhledem ke stále větší koncentraci obyvatel ve městech a hledání opačného typu prostředí k trávení volného času aktivní formou. Všechny tyto aktivity mohou mít negativní vliv na životní prostředí, zejména vznikem eroze a poškozováním vegetace. Mají ale i určitý omezující vliv na samotnou hospodářskou činnost v lese, zejména případnou kolizi s těžebně-dopravním procesem a dopravou dříví. To klade zvýšené nároky na vlastníky a správce lesů, kteří se kromě hospodářské činnosti stále více musí zabývat managementem návštěvníků lesa, tzv. řízenou rekreací. Benefity ze zajištění těchto činností jsou pro vlastníky a správce lesů těžko přímo finančně započitatelné a dají se vyjádřit spíše v úvaze, že v případě aktivního přístupu k této problematice získají vlastníci či správci lesa kontrolu nad pohybem a rekreačními aktivitami, které jsou ze zákona v lese povoleny a mohou návštěvníky lesa směřovat do lokalit, kde nebude docházet ke kolizím s lesní hospodářskou činností a případně oddělit i jednotlivé zájmové skupiny návštěvníků od sebe. Například tak, aby nedocházelo ke kolizím mezi pěšími návštěvníky lesa a cyklisty. Jako příklad řízené rekreace uvádíme realizaci singltrailů na území Školního lesního podniku Masarykův les Křtiny, které jsou smluvně provozovány spolkem SINGLETRAIL Moravský kras z.s. který měl zájem o vybudování těchto stezek. Kromě smluvního závazku údržby a oprav s provozovatelem je zde i možnost pro vlastníka lesa částečně kompenzovat jeho zvýšené náklady s administrací smluvních vztahů a umístění stezek na svém území smluvním poplatkem za běžný metr délky stezky nebo lépe za m^2 plochy stezky. Na základě vyhodnocení šířkových poměrů lze konstatovat, že výsledná šířka všech stezek je v jejich celé délce větší než 1.0 m. Průměrně na 90 % své délky mají stezky šířku v rozsahu 1.0–3.0 m (Tab. 1). V souhrnné délce téměř 1.4 km jsou stezky širší více než 3.0 m (11 % celkové délky stezek, trasovaných v lesním porostu).

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THE NON-WOOD FOREST VALUE OF BWINDI IMPENETRABLE FOREST, UGANDA

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Abstract
Bwindi impenetrable forest is the largest prehistoric forest located in the Southwestern part of Uganda, covering Districts of Kanungu and Kisoro.
The forest consists out of hardwood trees with a thick ground cover of ferns, vines, and other plant growth, which is heavily hindering direct ingress by foot.
A qualitative study explored the non-wood value of this forest. Various cases and literature were investigated to the effect. The findings indicate that the forest contains the world‘s most biological diversity with half of the world's population of the hugely endangered mountain gorillas among other species of birds, silverbacks, 220 butterfly species and 240 tree species. We recommend that the government of Uganda, and the responsible Ministries advance technological and financial investments to this forest that hosts rare biodiversity species as well as earning huge sums of foreign exchange through eco-tourism.

Key words: tourism, food hunting, habitat, and Biodiversity

Introduction

Uganda lies at both sides of the equator line, and is blessed with over ten national parks and many other reserved areas that serve the wildlife a thrilling experience for Uganda’s broader biodiversity. The country has numerous national parks and game reserves which fall in the forested areas in the country and offer various non-wood goods and services (Klemperer, 2006; Fialová, Vyskot, and Schneider, 2009; Führer, 2000; Vyskot I. et al., 2007 among others WWF, 2017);
livelihood and habitat for millions of species that live there, watershed protection and water system management, prevent soil erosion, mitigate climate change, food gathering and hunting, forest eco-tourism and forest birding, among other recreational activities, soil maintenance, Provision of clean drinking water, medicine, and game hunting and sports etc.
This forms the non-wood/non-timber product functionality of the forests in the country with eco-tourism (Fig 1 below).
The non-wood forest products/services are not limited to various forest goods such as fruits, mushrooms, handicrafts from non-wooden materials, and social services like recreation, tourism, hunting; they also cover, biosphere uses/importance such as climate mitigation, soil protection and biodiversity, as well as habitat for the various species (Vuletić, D. et al., 2009).
However, forest management plays a role on logging practices and sustainable fuelwood collection or may lead to increasing degradation that eventually leads to deforestation. Forests are often misused and put to waste by poor governance of land and unsustainable economic exploitation/utilization. The optimal value of forests‘biodiversity and ecosystem services can be recognized and safeguarded by public policies and governance systems and the reverse is true. Forests have been replaced by other forms of land uses that generate huge short-term

financial/momentary benefits, hence facing gradual depletion through unsustainable harvesting/logging, fires among others.
This qualitative study sought to understand the situation at Bwindi impenetrable forest and National Park in South Western part of Uganda among other forests in the country.

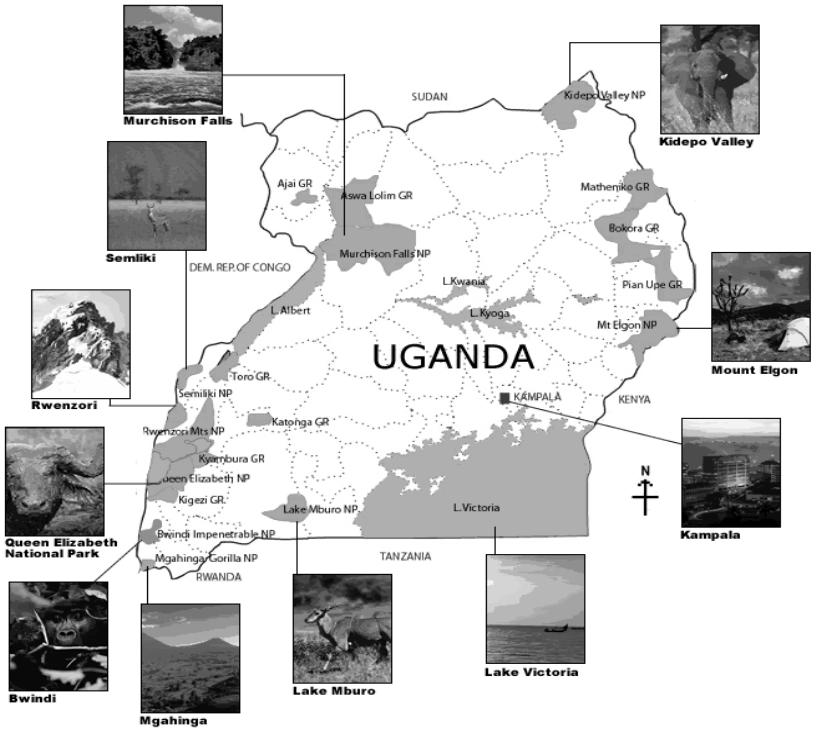

Fig. 1: A map of Uganda with major National Parks
Source: Tourism Uganda 2017.

Material and methods

The study used data from various data banks, scientific journals and necessary websites mainly the Uganda Wildlife Authority (UWA), Uganda National forestry Authority (NFA) as well as international web pages i.e. World Wide Fund for Nature (WWF).

This research study is qualitative (Maxwell, 2005, Creswell, 2009, 2011) in nature, According to Creswell, (2009, 2011) qualitative research methods have key main fundamentals of ethnography, narrative research, phenomenology, case studies among many.

Experiences, geo-maps, data and information documents were studied. Some descriptive graphs and Photos from Bwindi impenetrable forest were observed and studied carefully respectively on futures like rivers and lakes, animal species, birds, people as well as visitors in the various forests in Uganda for the years 2006 to 2013 (*Fig 1, Fig 2)*.

Results

Bwindi Impenetrable forest and National Park; Uganda's forest reserve which doubles as Bwindi Impenetrable National Park is well known for its excellent gorilla trailing, none the less, it also gives habitat to elephants, monkeys, chimpanzees, small antelopes and over 23 bird species.

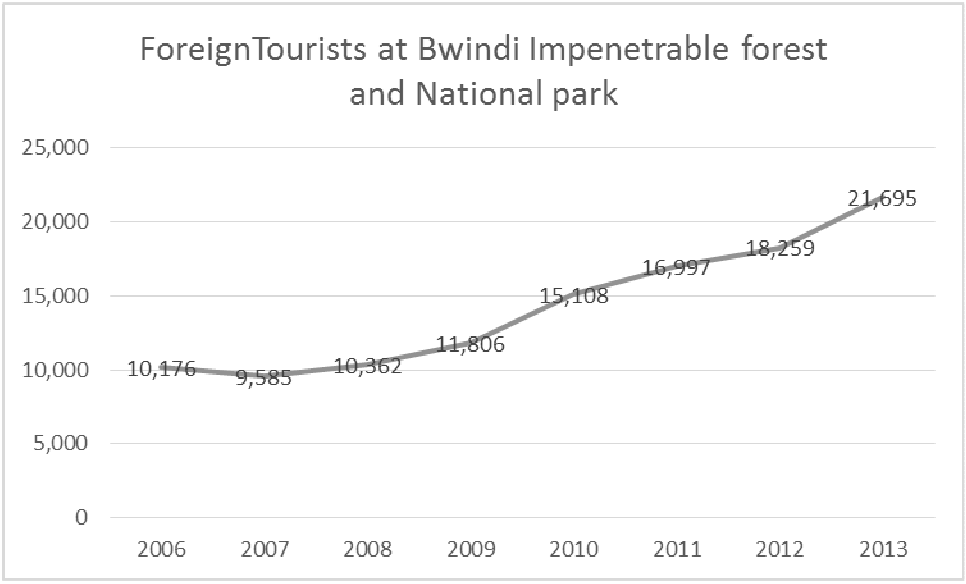

Fig. 2: Foreign Tourists at Bwindi Impenetrable forest and National park
Source: The World Bank. 2012

Mgahinga National Park; Mgahinga National Park conserves the Ugandan share of the Virungas and Mountain gorillas, which also form the main attraction together with the impressive thread of nine freestanding inexistent and active volcanoes that is shared by Rwanda and Democratic Republic of Congo (DRC).

Murchison Falls National Park: The country's largest protected area, whose palm-studded grassland provides for the dense populations of lion, buffalo, elephant and Uganda kob, giraffe and patas monkey, and birds observed all day long at the Nile below the spectacular waterfall.

Rwenzori Mountains National Park; Rwenzori Mountains National Park protects the eastern slopes and glacial peaks of the 120km-long Rwenzori Mountains. It supports a huge scale of evergreen and bamboo forest.

Queen Elizabeth National Park; It offers prime grazing to 1,000's of buffalo, elephant and various antelope plus bird species that testifies to the extraordinary ecological diversity of this park including the forest hogs, and the mythical tree-climbing lions of the Ishasha forest.

Kibale National Park; It is a home for 1,000's chimpanzees and serves as a strong community habituated to tourist visits, as well as half-a-dozen readily observed monkey species.

Lake Mburo National Park: The park is centred on a series of swamp-fringed lakes known for their rich birdlife. The green acacia woodland is surrounded by the lake harbors dense inhabitants of zebras, warthog, buffalo, impala, among other animals.

Mount Elgon National Park: It is a luxurious mosaic of Afro-montane forest, grassland and moorland habitats, which makes this park a highly rewarding destination for hikers, food for the locals, and other natural history fanatics.
Kidepo Valley National Park: The Kidepo Valley National Park provides habitat for the numerous species not found elsewhere in the country, including cheetah. The park's perpetual waters attract huge numbers of elephant and the many buffalo herds, particularly during the dry spell.

Discussion and Conclusion
Bwindi impenetrable forest doubles as a national park covering approximately 300 square kilometres and serving as a habitat for various species of birds, and other animals (Bwindi Impenetrable National Park, 2017, Uganda Wild Authority, 2017). This makes the forest being among the leading tourist destinations in Uganda (Fig 2), as well as the two sides of Rwanda and DRC (Congo). This same forest hosts the most endangered species of primates i.e. mountain gorillas.
The forest is endowed with tremendous biodiversity that offers a home to 120 mammal species i.e. primate species e.g baboons and chimpanzees etc. There are close to 350 species of birds habituated at the Bwindi impenetrable forest as well as 23 of the Albertine Rift. The area also supports agriculture, fishing to the nearby population as well as the forest dwellers (Batwa people).
Mutagamba, 2013, noted that the forestry sector, which also supports various other sub-sectors, is faced with a basket of challenges ranging from financing and corruption to poaching.
Ceteris paribus, the study concludes that non-wood forest uses are paramount. According to the charalampos et al. 2008; actually more than 60% of forests services and importance are non-wood in nature and that can be freely available on the market to the public i.e. amenity services represented by historical, cultural and spiritual services, social services i.e. recreation, tourism, sports, education etc., biosphere importance i.e. climate mitigation, and biodiversity conservation among others.
Thiw was also supplemented by studies on forestry functions (Davis S. D. et al., 2005, Klemperer, 2006, Fialová, Vyskot, and Schneider, 2009, Führer, 2000, Vyskot I. et al., 2007), who discussed functions of forestry resource such as soil and water protective functions, measures of sustainable forest management, biomass and carbon stocking, biodiversity and protection/conservation, and other socio-economic issues.
Nevertheless their study noted that numerous market failures arise and need to be addressed for financing as well as sustainability. They asserted that this can be done through valuation and scale of goods/services and is not limited to parties involved.
We recommend that non-wood forest services be taken as a matter of urgency since evidences show connection between forest and these variables and the role they play in human survival. The government of Uganda should seriously take on the implementation of its existing laws as well as strict supervision of care taker bodies such as Uganda Wild Authority (UWA), and Uganda National forestry Authority (NFA) so as to save the forest of identified dangers including the endangered mountain gorillas and others species at Bwindi impenetrable forest/national park.

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Souhrn
Studie nabízí náhled na nedřevní funkce či služby lesa v Ugandě, konkrétně v podmínkách lesa Bwindi. Kvalitativní posouzení různých zdrojů naznačují, že les jako takový v Ugandě hraje důležitou roli jak v přežití lidské bytosti, stejně tak je důležitým životním prostředím celé řady zvířat, mnoha druhů ptáků. Má vliv na půdu a klima v celém regionu.

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THE PHENOMENON OF DE-URBANISATION AND ITS MANIFESTATION IN THE RURAL LANDSCAPE AT DIFFERENT TIMES AND CONCEPTS

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Abstract
The paper analyses the importance of the de-urbanisation phenomenon as one of the shaping processing of today's rural landscape. The research focused on the identification of problems associated with the countryside. There are presented several different examples of de-urbanisation at different times and conceptions. The average indicators for individual areas of interest were compiled and evaluated with a special focus on overall changes in the countryside caused by de-urbanisation. There were included and analysed also the possibility of transport accessibility to the closest cities. A comparative method was applied to selected areas together with mapping and statistical data analysis. Results describe the individual differences of the territories in predetermined ratios. The difference between suburbanisation and de-urbanisation was evaluated. Based on the outputs it can be defined and stated the differences in pressure that is developed by de-urbanisation process at individual territories.

Key words: confiscation of soil, suburbanisation, counterurbanisation, countryside, land use

Introduction

Rural areas constitute 73–82% of the Czech Republic's land area (depending on the specific criteria) and about 26–29% of total population reside in the countryside (Novotná et al. 2013). Residential decentralisation is a major trend in the Czech Republic (Čermák et al. 2009). This trend has been especially widespread after 1990. Counterurbanisation or de-urbanisation are demographic and social processes whereby people move from urban areas to rural areas (Berry 1980). Counterurbanisation is defined as a migratory movement from larger settlements to less concentrated settings (Mitchell 2004). The selected cadastral territories this research are located in the Southmoravia Region in the district of Znojmo. These municipalities are: Hluboké Mašůvky, Velký Karlov, Lesná, Chvalovice and Božice (see. Fig. 1).

Foundation and history of municipalities

Lesná and Velký Karlov (see. Fig. 2) are examples of villages built in "greenfield" sites, yet they did not develop into so called "urban sprawl" which we consider the typical development of isolated islands with a residential or commercial function without being connected to technical, transport or social infrastructure, yet with a serious impact on the physical and social environment of metropolitan regions (Suburbanizace 2017).

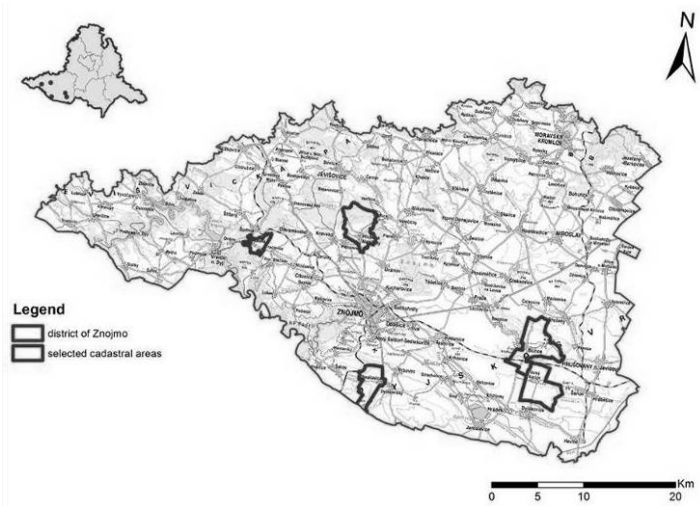


Fig. 1: Znojmo district depicting the selected cadastral areas. Source: ArcGIS Programme, Compilation: Author (ÚAKE, AF MENDELU 2017)

Fig. 2: Velký Karlov cadastral area. Source: ArcGIS Program, Produced by: Author (ÚAKE, AF MENDELU 2017)

Lesná village was founded in 1794 in the place of the original Langekammer forest that was cut down. In the case of Velký Karlov village, residential structures started to be built in 1953 for members of the agricultural collective set up in 1950. The numbers of houses in both villages grew quickly and have remained to this date with only negligible changes. Chvalovice, Božice and Hluboké Mašůvky villages are most likely of old Slavonic origin and the first written records that mention them come from the 13th century. All the selected villages besides Hluboké Mašůvky were adjoined to the Reich in 1938 and located in the so-called Deutschsüdmähren. Hluboké Mašůvky was a typically Czech village which is demonstrated by for instance local names from the facsimile of maps of the stable cadastre dated 1824.

Materials and methods

- Comparative method

Using the comparative method we compared environmental, demographic and residential aspects of individual villages. Similarly we used this method to compare changes in maps, orthophotomaps and statistical documents for individual areas. If we use the definitions above and the definition that suburbanisation is a process of moving residential, commercial and other functions from the core town to its suburbs, also moving the inhabitants and their activities from the core into extremities as the basis, while the structure of residents is also a key to understanding post-socialist urbanisation (Krisjane and Berzins 2012), it is still hard to divide the terms of suburbanisation and counterurbanisation from one another. For the purposes of our research, we anticipated that suburbanisation can be understood as a component of counterurbanisation. Therefore, we set this as a condition for distinguishing between suburbanisation and counterurbanisation. To us, suburbanisation is therefore based primarily on the age and educational structure of inhabitants along with the distance to job/school where we established 5 km as a borderline distance between the municipal centre and the centre of the closest town with more than 3 000 inhabitants (this distance pertains only to municipalities with a population of over 50 000, and later increases), a pre-condition of a neighbouring cadastre, a growing number of inhabitants and a growing number of houses completed between 2001 and 2015 by more than 20% in the case of inhabitants and by 15% in the case of completed houses. Moreover, the percentage of people over the age of 60 will not exceed 20%, there is more than 50% economically active people in the population, at least 1/3 of inhabitants over the age of 15 have complete secondary or higher education and over 1/3 of inhabitants commute to work or to school.

- Processing map outputs

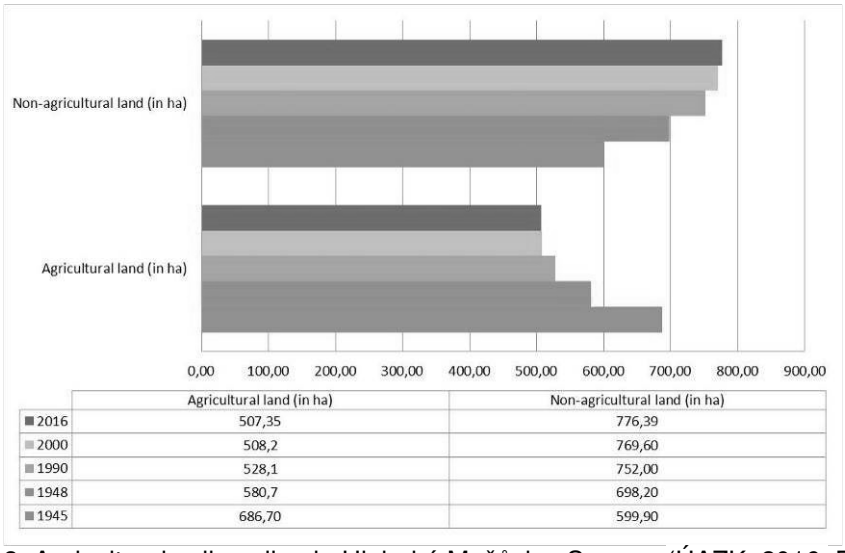
ArcGIS 10.3.1. software was used to process map outputs

Results

Environmental aspects

While the use of land has not undergone any significant changes in case of Lesná and Velký Karlov villages since their foundation, it is an entirely different case with Božice, Chvalovice and Hluboké Mašůvky. These municipalities have been gradually losing their agricultural land utilisation, best shown in figure 3 related to Hluboké Mašůvky, where the scale of the overall cadastre area changed very little over time and thus the decline of agricultural land can be best observed. While in 1945 agricultural land formed 53.4 % of the cadastre area, in 2016 it was mere 39.5%. At the same time, the built-on land segment went from 0.4% in 1945 to 1.1% in 2016.

Orthophotomaps from 2003 (see Fig. 4) and from 2016 (see Fig. 5) for comparison show another take on this situation.



	Agricultural land (in ha)	Non-agricultural land (in ha)
2016	507,35	776,39
2000	508,2	769,60
1990	528,1	752,00
1948	580,7	698,20
1945	686,70	599,90

Fig. 3: Agricultural soil sealing in Hluboké Mašůvky. Source: (ÚAZK 2016, Bičík 2008, ČSÚ 2017) Produced by: Author

Demographic and settlement aspects

The number of inhabitants in Lesná and Velký Karlov slumped between 2001 and 2015. The biggest population growth occurred in Chvalovice, by as many as 51% (630 inhabitants in 2015) in case of people and by 40.4% in case of houses (167 houses in 2015), and yet the village failed to equal the maximum number of inhabitants of 1890 which was 808 or the ultimate number of buildings which was 177 in 1930. Similarly, Božice reached its population and building top limit in 1930, specifically with 2,593 inhabitants and 596 houses. In the periods under scrutiny – 2001 - 2015, Božice attained a growth in inhabitants by 14.4% to 1,545 and 13.3% of the houses to the total of 451. Hluboké Mašůvky reached their maximum in 2015 in both instances (805 inhabitants and 339 houses) since 1869, which represents an increase by 14.5% of inhabitants and 23.3% houses between 2001 and 2015.

Fig. 4: Hluboké Mašůvky 2003 construction development Source: www.mapy.cz

Fig. 5: Hluboké Mašůvky 2016 construction development Source: www.mapy.cz

Economic aspects

Our selected economic aspects include: percentage of inhabitants over 60, percentage of economically active people, percentage of inhabitants commuting to school or a job and percentage of inhabitants over the age of 15 who have attained complete secondary or higher education. We drew on data from 2011 to obtain this information. We also ascertained the current services in the villages such as the general practitioner, shop, post office, primary and nursery school. All these facts are outlined in table 1. As usual Lesná and Velký Karlov were in the background, however they were also joined by Božice due to the care home for seniors that is located in the village.

Tab. 1: Percentage of population over the age of 60. Source: Czech Statistical Office (2017) Produced by: Author

Municipalities in 2011	Population of 0-59 years	Population over the age of 60	Population total	Percentage of population over the age of 60 in the village
Hluboké Mašůvky	616	173	789	21,90%
Lesná	205	63	268	23,50%
Chvalovice	438	91	529	17,20%
Velký Karlov	322	86	408	21,10%
Božice	1179	346	1 525	22,70%

Conclusion

It is very hard to distinguish between suburbanisation and counterurbanisation in real life. In the case of the villages chosen by us, no location can actually be deemed suburbanised. Lesná and Velký Karlov are not in fact even de-urbanised areas. Under the condition that counterurbanisation is defined as a migratory movement from larger settlements to less concentrated settings (Mitchell 2004) and provided we omit the factor that newcomers must come from cities, we consider the remaining three villages of Božice, Chvalovice and Hluboké Mašůvky to be de-urbanised. Neither of the villages met the 5km condition from the village centre to the closest town. In spite of Chvalovice meeting or very nearly meeting all of our

conditions linked to suburbanisation, which are: requirement of neighbouring cadastre with a town of over 3,000 inhabitants, an increasing number of inhabitants as well as completed houses between 2001 and 2015 by more than 20% in case of inhabitants and 15% in the case of completed houses. In the case of Chvalovice it was a surge by 51% and 40.4% houses. Likewise, the number of inhabitants over the age of 60 will not exceed 20% (Chvalovice 17.2%), economically active inhabitants represent over 50% of the population (Chvalovice 49.9%), at least 1/3 of inhabitants over the age of 15 let have completed secondary or higher education (Chvalovice 28.1%) and over 1/3 inhabitants commute to work or to school (26.1%). Those points where the village failed to attain the stipulated limit have not, most likely, been attained only because data from 2011 are given for number of inhabitants of 529 and in 2015 there were 630 inhabitants, and we believe it met all the other criteria. In spite of all this, we included it as a de-urbanised area, primarily due to the decentralised new construction within the village, incorporating newcomers into local cultural life, securing the village shop, post office, general practitioner and nursery.

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Souhrn
Příspěvek analyzuje význam fenoménu desurbanizace jako jednoho z tvůrců dnešní venkovské krajiny. Výzkum se zaměřil na identifikaci problémů spojených s fenoménem suburbanizace a desurbanizace. Pro toto hodnocení nám slouží několik různých příkladů desurbanizace v různých dobách a koncepcích. Průměrné ukazatele byly stanoveny, především z demografických, ekonomických a sídelních aspektů. Ty byly sestaveny a vyhodnoceny pro jednotlivé oblasti zájmu. Byly srovnávány celkové historické změny v nejen v krajině způsobené desurbanizace. Výsledky popisují jednotlivé rozdíly mezí vybránými k.ú. Zároveň jsme se snažili určit rozdíl mezi suburbanizace a desurbanizací. Na základě výstupů lze definovat rozdíly mezi jednotlivými obcemi a jejich zařazení do desurbanizovaného nebo suburbanizovaného území.

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THE PODYJÍ NATIONAL PARK AND ITS ROLE AS A PROVIDER OF ENVIRONMENTAL EDUCATION IN RURAL SCHOOLS

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Abstract
The paper analyses the importance of educational programmes and environmental education in rural primary schools. The research focus on the identification of problems and their solution within the framework of the educational programmes and materials provided by "Správa národního parku Podyjí" (Podyjí National Park Administration). The methodology contained a comparative method, questionnaire survey, SWOT analysis and their evaluation. Based on the results it can be stated that the importance of environmental education, supported by the Podyjí National Park, represent a strong contribution to the education of pupils in the selected schools. Other results indicated a lack of educational programmes for the second stage of elementary education and insufficient information materials for visits to the Podyjí National Park without guides. The specific forms can be designed as a next step to complete the portfolio of environmental programmes and materials for the mentioned groups of recipients.

Key words: environmental awareness, educational programme, countryside, Podyjí National Park

Introduction

The actual term "environmental education" first emerged at an International Union for Conservation of Nature (IUCN) conference in 1947 (Palmer, 2003). Environmental education has been on the rise since the 1970s in North America and Western Europe (Hublová, 2015).
The term "ecological education" began to be used in the Czech Republic in the 1980s to be later replaced by the term "environmental education", or possibly "environmental education and awareness". Agreement was reached in the Czech professional community that all these terms will be deemed mutually interchangeable (Gošová, 2011).
The accepting of the strategic State Program of Environmental Education and Public Awareness in the Czech Republic (Novák, 2015) in October 2000 represented a key milestone. Ecological education is primarily a scientific doctrine with the main stress on knowledge directed by faith that people will behave better towards the environment if they know it better (Leskovcová et. al, 2012). Primary schools' major role is to teach children compassion and understanding for the world other than themselves, for other children, animals and plants (Kohák, 2000). At the same time it is essential to show children two diverse approaches to nature according to the philosopher Erich Fromm, to have (to possess) and to be (to experience) (Šimonová a Činčera, 2013).

Current environmental education programme (further only EEP) of the Podyjí National Park:
The Podyjí NP EEP is divided into two categories which are: Podyjí NP comes to schools and schools come to Podyjí NP. The first category, NP comes to schools, is

an educational programme provided as part of a two-hour one-off block for the first grade (ages 6 to 10) of primary schools. The second EEP, schools come to Podyjí NP, is delivered in the form of guided tours along diverse routes in Podyjí NP. This program is aimed at nursery schools, both lower and upper grades of primary schools and other in-groups.

There are a total of 65 primary schools in the Znojmo district. Only 49 (see fig.1) primary schools were chosen for this project. The limiting factor was the number of inhabitants in the municipality. We set it at 2000 inhabitants and only one primary school in a given municipality. Of these 49 schools, 55 % of schools teach only the first grade while the remaining 45 % also have a second grade.

Fig. 1: Znojmo district with selected primary schools highlighted. Source: Author (2016)

Materials and methods

- Comparative method

Using the comparative method we match different data related to environmental education from Podyjí NP management statistics.

- Questionnaire survey method

The objective of the survey was to find the negatives and positives of the education. The respondents are selected rural schools. In total 32 primary schools out of the 49 addressed took part in the survey.

- SWOT analysis

Results

Comparative method

The comparative method revealed that during the last 19 years more children called at the Čížov visitor centre in groups (organised) than individually. This fact calls attention to the opportunity to boost this form of visit using freely available worksheets in the form of so-called searches, not just for primary schools but also other organised groups of children. This method also offers the option to compare how much the rate at which environmental programmes, further only the EEP, offered by Podyjí NP to schools, has changed.

Tables 1 and 2 illustrate the use of EEP in selected primary schools in terms of the overall number of programmes provided. The average percentage of schools that used at least one form of EEP in a school year is 35.7 %, i.e. each year 17-18 primary schools of the 49 selected will use one of the forms of EEP.

Questionnaire survey

Results of the questionnaire survey confirm and support the results of the comparative method that was used first. The questionnaire results are confirmed for instance by the interest in making worksheets or the number of schools participating in EEP. The questionnaire method analyses the negatives and positives of EEP. In the case of the first grade, most of the schools, 65%, use only the NP comes to schools EEP, 25 % use only EEP where schools come to Podyjí NP EEP and the remaining 13% of schools combine both programmes. Simultaneously, the interest in visiting environmental centres is very clear. Their results support the plan of Podyjí NP management to create such a centre in buildings that have no use at the moment. The questionnaire survey points out great interest in visiting the NP with a guide. Unfortunately, the capacity of guides is limited and it is therefore impossible to satisfy all those interested in guide services as part of the schools come to Podyjí NP EEP. As a result, the schools have to opt for independent visits without a guide which results in the interest in obtaining new worksheets as additional material of environmental education. The survey results also analyse the focus on this issue in Czech Republic as a whole. Values in questionnaires oscillated between 40% and 80%, and the modus of this question is 70 %. It can be expected that the percentage of the national issue drops with the increasing study year of pupils.

Tab. 1: 2003/04-2015/16 EEP summary. Source: Author (2016)

Environmental education programme					
Podyjí NP comes to schools			**Schools come to Podyjí NP**		
school year	**number of programs**	**number of children**	**school year**	**number of programs**	**number of children**
2003/04	51	890	2003/04		
2004/05	31	352	2004/05		
2005/06	58	782	2005/06		
2006/07	39	869	2006/07	31	670
2007/08	60	1268	2007/08	44	1218
2008/09	72	1078	2008/09	90	2060
2009/10	80	1595	2009/10	68	1782
2010/11	93	1974	2010/11	61	2408
2011/12	44	1139	2011/12	52	1261
2012/13	56	1169	2012/13	30	935
2013/14	76	1894	2013/14	106	2652
2014/15	52	196	2014/15	82	1967
2015/16 (IX.-XII.)	27	610	2015/16 (IX.-XII.)	11	315
Total	**739**	**13961**	**Total**	**575**	**15268**

Tab. 2: EEP summary in rural schools. Source: Author (2016)

Environmental education programme				
Podyjí NP comes to schools/Schools come to Podyjí NP			% use Program in rural primary schools	
school year	number of programs	number of programs in the rural primary schools	Podyjí NP comes to schools	Schools come to Podyjí NP
2003/04	51/0	6/0	11,7	0
2004/05	31/0	16/0	51,6	0
2005/06	58/0	28/0	48,3	0
2006/07	39/31	31/4	79,5	13
2007/08	60/44	28/0	46,7	0
2008/09	72/90	35/25	48,6	27,7
2009/10	80/68	33/17	41,2	25
2010/11	93/61	36/20	38,7	32,8
2011/12	44/52	21/15	47,7	28,8
2012/13	56/30	27/12	48,21	40
2013/14	76/106	14/7	18,4	6
2014/15	52/82	22/14	42,3	17
2015/16 (IX.-XII.)	27/11	16/1	59,2	9,1
Total	**739/575**	**313/115**	**42,35**	**20**

SWOT Analysis

The overall SWOT illustrates EEP as a stable and significant part of environmental education at selected primary schools. Several examples from the SWOT analysis are shown below.

- Strengths

EEP options directly in Podyjí NP
Expert practitioners

- Weaknesses

Missing programme for second grade of primary schools (PS)
Missing independent department for environmental education

- Opportunities

Availability of materials for environmental education
Adding the currently missing centre for environmental education

- Threats

Change of trends in environmental programs
Exceeding personnel capacities of Podyjí NP management

Forms of new programmes and materials

Educational programme for 2nd grade of PS

Basic thematic headings will be fleshed out in two-hour programmes provided during the whole school year. Each educational programme will be finished with a brief test in the form of a word puzzle. Attention in the programs will be put on active

involvement of students and on developing their cognitive processes. All lectures can be inserted in the teaching programme independently depending on the needs of individual schools. It is equally possible to keep the five programmes as a whole and introduce them into their teaching plan. In this case, the students would also have to carry out a small task between individual programmes. That would consist particularly of the need to obtain some information for next time to be used in the upcoming programme.
Basic topics of individual two-hour programs:

- Podyjí NP and nature around us
- Ecology, environmentalism, waste management, overpopulation
- Soil, agriculture, water, countryside and drought
- Sustainable development and tourism
- Rural housing, traditional countryside

Worksheets

According to results most schools would welcome augmenting the environmental materials with worksheets. Worksheets will enhance the schools come to Podyjí NP program where they will partly replace the guiding services. These worksheets will be available in printed and electronic form. Printed copies will be on hand to be collected from Podyjí NP headquarters in Znojmo, in Čížov visitor centre and seasonally at the information point in Vranov nad Dyjí. The materials will be available in electronic form in PDF format from the Podyjí NP webpages. Individual worksheets will be produced for the most popular tourist destinations in Podyjí NP with the difficulty level and length adjusted to primary school visitors. Worksheets will be produced in the form of quests where the students fill in information into the card while on tour, and solve small challenges or word puzzles. At the end of their route the students fill in gained information into the word puzzle. These worksheets will be created in two formats for individual routes. The first format for first and the other for second grade primary school pupils. Worksheets will be available for schools and other visiting groups that wish to view Podyjí NP with children in target groups.

Single-day environmental stays

To complement the services for schools one-day environmental stays will also be set up. These stays will be intended for both grades of primary schools and divided into two formats. The stays will be carried out in the visitor centre in Čížov. Environmental stays will combine recent historical knowledge, rudimentary information on nature and on Podyjí NP in two-hour programmes, one morning and one lunch. In between the students would get out and get to know more about nature. The walk would be combined with fulfilling individual tasks set ahead depending on the weather. Having returned to the centre, they will have a lunch followed by a second hour-long lecture with a practical part. This practical part will involve making a bird box in collaboration with Podyjí NP forestry administration, cast animal footprints or plant some herbs.

Transformation of permanent exhibition

Transform the permanent exhibition in liaison with local schools, add more interactive and point-of-interest components. The idea is to involve not merely sight but also touch and hearing. This is one of the most demanding forms of interpretation requiring sufficient time and preparation.

Conclusion

The research concentrated on analysing the importance of environmental education provided by Podyjí NP in rural schools. It was essential to gain information on the overall state and historical development of environmental education in the Czech Republic. There is no independent course at rural or city schools that would concentrate purely on environmental education. However schools are learning to use environmental centres run most often by non-profit organisations. Protected areas administrations also offer a certain form of environmental education which is the case of this research. The results show that environmental education provided by Podyjí NP is a significant part of environmental awareness for rural schools. At least a third of rural primary schools in the chosen area use one of the forms of EEP every school year. At present Podyjí NP offers Podyjí NP comes to schools EEP only for the first grade of primary schools. As a consequence of this mentioned deficiency both primary schools and Podyjí NP desire to set up a new educational programme for the second grade of PS. The questionnaire survey also demonstrated a clear interest in altering the current EEP of NP comes to schools for the first grade of PS. This proposed measure should further boost the impact of environmental education that Podyjí NP offers in the select area and elsewhere.

The overall results similarly show interest in worksheets. These worksheets will serve primarily to augment the schools coming to Podyjí NP EEP. Other suitable proposals might be incorporating one-day environmental stays.

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Souhrn
Práce se soustředila na identifikaci problémů a jejich nápravu v rámci výukových programů a materiálů poskytovaných Správou NP Podyjí na vybraných školách. V práci byla použita komparativní metoda, metoda dotazníkového šetření a SWOT analýza. Z dosažených výsledků lze konstatovat, že environmentální výuka poskytovaná NP Podyjí, je významným přínosem pro vzdělání žáků na vybraných základních školách. Tyto výsledky potvrzuje jak komparativní metoda, která srovnávala a sestavovala podrobná statistická data, tak metoda dotazníkového šetření. Díky celkoým výsledkům jsme se snažili sestavit další formy environmentální osvěty, mezi niž lze zařadit: výukový program pro 2. stupeň základních škol, pracovní listy pro nejoblíbenšjší turistické trasy NP Podyjí, pořádání jednodenních environmentálních pobytů a přeměnu stálé výstavy.

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THE POSSIBILITIES OF RECREATIONAL USE OF FOREST RESERVOIRS

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Abstract

In recent years in Poland we can observe an increasing interest in tourism and recreation near water reservoirs in forest areas. The article presents the results of online survey conducted among visitors of reservoirs in forests. The survey included questions concerning, among others, evaluation of preferences for the way the reservoir was formed and its impact in terms of the possibilities of recreational use. The respondents were asked about the frequency of use of the reservoir, and what were their goals for tourist visits. At the same time, the respondents identified their preferences for attractiveness of infrastructure integrally connected with water reservoirs. The survey involved a total of 550 current and potential users of water reservoirs in forests. The water in the vicinity of the forest is an attractive place for recreational use largely due to the landscape. The results may be useful for recreational management of water bodies in the vicinity of forests, as well as for the planning of recreational infrastructure in forest areas.

Key words: water reservoirs, social preferences, infrastructure, recreation

Introduction

Due to the increase in the intensity of leisure traveling, as well as the diversity of its forms, tourism has become a subject of interest of many scientific disciplines. Forests and forest areas constitute the part of our environment. Hence they are places of tourist and recreational activity which currently takes very differentiated forms (individual or group walks, jogging, horse riding, cycling, birdwatching, nature photography, canoeing, survival etc.). Contact with nature and its resources proves to be of great importance for the proper functioning of humans. The forest has long been an attractive place for recreation, mainly for people living in heavily urbanised areas. This is due to the natural need to regain mental and physical strength in the natural environment.

The legal basis for providing access to forests within the State Treasury Property is the Act on Forests of 21 September 1991, and in accordance with the provisions of Chapter 5 of the Act this access is subject to certain limitations. In the forest every individual is obliged to behave in such a way as to avoid any danger or damage to nature. In tourism and recreation, the forest is a large format land area characterised by the variability of features. These features account for the specific recreational value of the forest and comprise its stratification, spatial structure, the age and species composition of a stand, the degree of interior visibility seen from a tourist trail. Undoubtedly, the presence of surface waters is a factor enhancing the attractiveness of forest areas. The presence of water is usually taken into consideration in the assessment of the recreational suitability (Richling, Solon 2011). The Act of 18 July 2001 Water Law (Journal of Laws 2001 No. 115, item 1229, as amended) regulating water management presumes the widespread use of waters for the purpose of, among other things, leisure, tourism, or water sports. In the years

2007-2015 the State Forests National Forest Holding (PGL LP) completed the project jointly funded by the Infrastructure and Environment Operational Program (POIiŚ) "The increase of the retention capacity and dealing with floods and droughts in lowland forest ecosystems", which is important for the shaping of the desired condition of forest ecosystems as well as for the improvement of water relations and landscape. The project covered 177 forest districts with more than 3600 hydraulic structures which hold a total of 39 million m^3 of water. In accordance with Article 57 of Regulation 1083/2006, water retention reservoirs built as part of the project can be adapted for the purpose of recreation within five years after the completion of the project. Numerous studies have shown that the occurrence of surface waters in the vicinity of the forest is a basic determinant of recreational attractiveness of an area. The aim of the survey was to determine the possibilities of use of water reservoirs in tourism.

Materials and methods

The aim of the survey was to identify the features determining the attractiveness of 22 water reservoirs, and to recognise the preferences concerning recreational use of water reservoirs as well as the possibilities and scope of their management. The survey was conducted in the spring of 2016 in nine forest districts (Radom, Kielce, Łagów, Daleszyce, Staszów, Barycz, Stąporków, Zwoleń and Zagnańsk) within the area of Radom Regional Forest Directorate (RDLP Radom). The questionnaire was sent via the Internet to present and potential users of forest water reservoirs. Respondents were asked about the frequency of use of the water reservoir and the main purpose of their visits. A carefully selected photographic material obtained from the site was a complementary part of the on-line questionnaire. Photographs presented various types of water reservoirs, taking into consideration the size of a reservoir, its coastal vegetation, the inclination of slopes, the type of shoreline, vegetation cover of water table, the presence of infrastructure in the immediate vicinity (such as trails, paths, recreation facilities, hydraulic constructions etc.). The photographs were taken from the bird's eye view by unmanned aerial vehicle (UAV), which enabled the elimination of typical for the photographs taken from the ground level technical errors resulting from image cropping. Moreover, the photographs allowed for verification of respondents' views on the importance of various properties of water reservoirs in the shaping of their visual attractiveness. With the use of the Webankieta portal 550 encoded answers were generated and further analysed.

Results and Discussion

The results of the Web survey indicate a considerable interest in relaxation in forest areas in the immediate vicinity of water bodies. Over the last year 47% out of 550 respondents used water retention reservoirs in the forest for the purpose of recreation. On the other hand, as many as 41% of respondents did not spend their leisure time in the vicinity of reservoirs, 11% do not remember or are not certain whether they used a retention reservoir for recreational purposes.

Respondents most frequently noted that retention reservoirs were used for fishing (21%), nature observations (20%) and nature photography (19%). 17% of respondents saw people bathing in the reservoirs, while 10% noticed their use for birdwatching. Only 4% of respondents reported the use of forest water bodies for water sports and the same percentage of the surveyed noted that they were used as a hunting place.

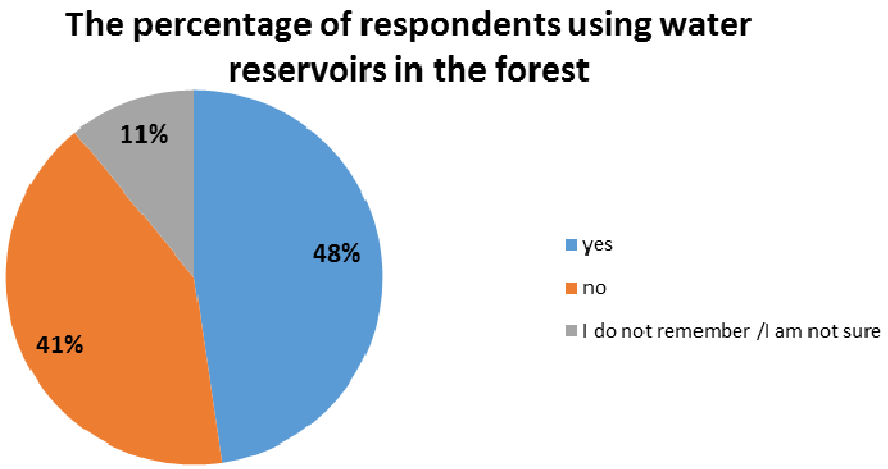

Fig. 1: The number of respondents spending leisure time in forest areas in the immediate vicinity of water retention reservoirs

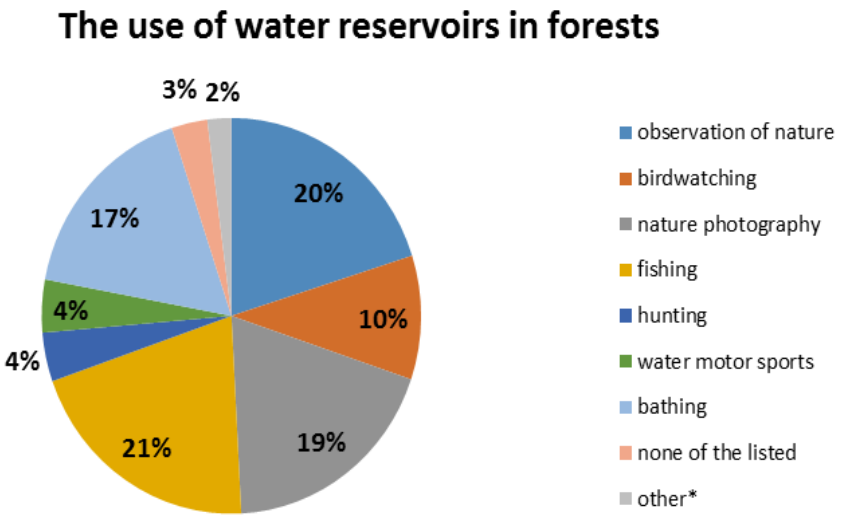

Fig. 2: The current use of reservoirs reported by respondents

It should be noted that preferences of respondents for the possible use of reservoirs for the purpose of recreation were slightly different. For a large part of the surveyed the important factor was the opportunity to observe wildlife in the vicinity of water bodies and to take photographs of nature (24% and 21% of respondents respectively), while 17% of respondents noted the need to adapt the reservoir for active recreation, including bathing. 13% of respondents saw the need to use reservoirs for fishing and the same percentage opted for birdwatching. Similar number of interviewees who noted the need to use retention reservoirs for motor sports and hunting see also the potential possibilities of such use.
In the opinion of 30% of respondents recreational trails, educational paths, cycling and walking routes should be located in the immediate vicinity of reservoirs. 21 % pointed to the need to build piers, while 17% of the interviewees saw a beach as an

important element in the management of water reservoirs for relaxation purposes. For 15% of respondents a viewing platform proved necessary.

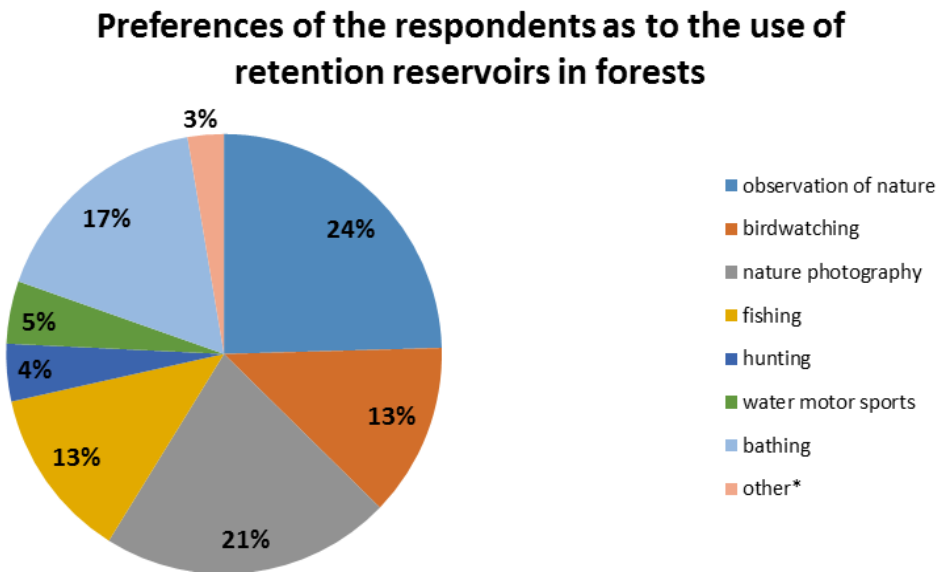

Fig. 3: Possible ways of using retention reservoirs preferred by respondents

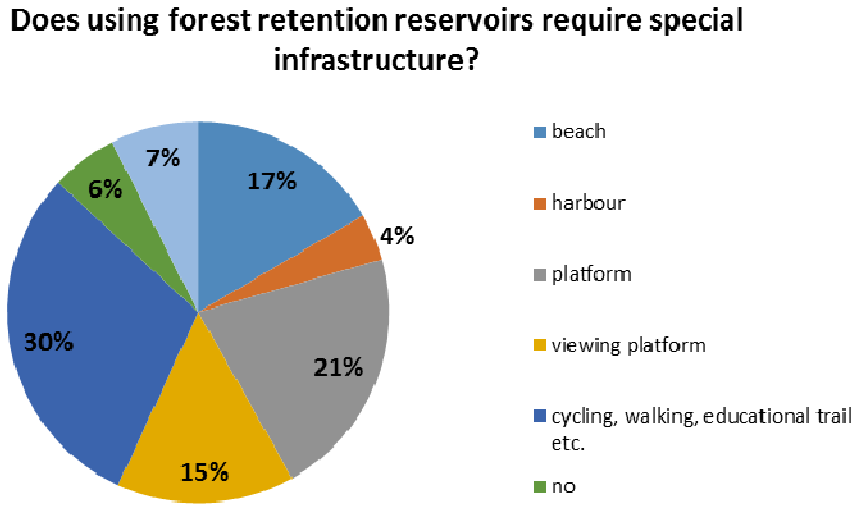

Fig. 4: Types of recreational infrastructure preferred by respondents

Conclusion

Studies on the assessment of recreational potential of the forest show that the attractiveness of forest areas is closely linked with the presence of natural and artificial water bodies. The attractiveness of water reservoirs and watercourses is conditioned by the shaping of slopes, type of shoreline vegetation, the length of a shoreline, the shape of an object etc. (Krzymowska-Kostrowicka 1997). In significant number of studies concerning landscape evaluation (Janeczko 2002, Markiewicz

and Szużmow 1992, Bajkiewicz-Grabowska and Mikulski 2006, Deja 2001) water is listed as a factor enhancing the attractiveness of landscape. The results of the survey reveal a great interest in leisure activities in the vicinity of water. Obtained results may prove useful in recreational management of forest water reservoirs, as well as in planning forest infrastructure for the purpose of recreation.

The studies based on public opinion demonstrate that making areas near water retention reservoirs available for tourism and recreation becomes increasingly important. The visual quality of the forest landscape is no longer dependent upon its vegetation solely; it is also identified with spatial characteristics of the landscape, including the presence of water. The presence of water reservoirs in forest areas is the subject of interest not only for potential tourists. It is also a specific stimuli for relevant forest divisions and local authorities. The proper management of forest areas, especially areas attractive for tourism, and their appropriate use while protecting valuable spatial elements of those areas constitute a challenge for entities managing these areas.

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Souhrn
V poslední době můžeme na území Polska sledovat rostoucí zájem v oblasti cestovního ruchu a rekreace v oblastech vodních nádrží nacházejících se v lesích. Tento článek prezentuje internetový průzkum zaměřený na rekreanty navštěvující nádrže právě v lesích. Průzkum zahrnoval otázky týkající se zjištění, o jaký typ nádrže se jedná a její způsob využití z hlediska rekreace. U respondentů byla zjišťována četnost návštěv takových lokalit a důvody návštěvy. Současně respondenti odpovídali na otázky týkající se infrastruktury a dostupnosti dané nádrže. Průzkumu se zúčastnilo celkem 550 respondentů jak skutečných tak potenciálních návštěvníků vodních nádrží. Právě voda v kombinaci s lesním prostředím je velmi atraktivním místem z hlediska rekreace. Výsledky šetření mohou být prospěšné v oblasti budování vodních nádrží v lesích, ale i v oblasti plánování rekreační infrastruktury v lesích.

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TOURISM AND WILDFIRES IN SLOVAK PARADISE NATIONAL PARK

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Abstract
The work analyses the causes of wildfires in the area of Slovak Paradise National Park. The assessment of wildfire occurrence was performed using the data obtained from the district directorates of the Fire and Rescue Service in Rožňava, Spišská Nová Ves and Poprad, across which Slovak Paradise National Park spreads. The results of the work showed that natural conditions (location of the area in a so called rainfall shadow, bedrock formed mainly by limestones, relatively frequent drought periods), vegetation conditions and forests predominantly composed of flammable pine trees contribute to the frequent occurrence of wildfires. The social structure of the population and partly also the intensive tourism play important roles in fire occurrence in the forests of Slovak Paradise National Park.

Key words: forest fires, landscape fires, meteorological fire indices

Introduction

Forest fires are a global problem and their frequency increases also in the area of Slovakia. The ongoing climate change is manifested by weather extremes that are closely connected with the increased frequency and severity of forest fires and with the protection of natural environment, mainly in the areas of national and European importance (Hrvol et al. 2009a; Skvarenina et al. 2009a; Flannigan 2015; Vido et al. 2015; Vilcek et al. 2016).

Characterisation of Slovak Paradise National Park

Slovak Paradise National Park is situated in the north-eastern part of the Slovak Ore Mts. near the Low Tatras. The region is characterised as slightly cold with the average annual temperature of 5-6°C (Čermák 1985; Fazekašová et al. 2016). The bedrock is formed by limestone and dolomite, which enable the creation of karst formations, with a specific microclimate (Stredova et al. 2014). There are rendzina soils and low productive soils with low environmental potential (Vilcek and Bujnovsky 2014, Gömöryová et al. 2013). The area of Slovak Paradise National Park is a well-known, popular tourist destination mainly because of its distinctive canyons, gorges and ravines. Forests cover approximately 75% of the total area. Most frequent tree species are spruce (50%) and beech (30%) (LESKOVJANSKA 1999). Predominantly are present forest ecosystems on limestone substrate, especially: *Pinetum dealpinum* (Calcareous pine woods) and *Fagetum dealpinum* (Calcareous beech woods) Skvarenina et al. (2004). Ground flora very often takes a "grassy" look because of the dominance of *Brachypodium pinnatum*, *Calamagrostis varia* and *Carex alba*. Rich representation of grasses in dry years increases the risk of forest fires (Durský et al. 2006; Hrvol et al. 2009b; Vida and Škvarenina 2010).

Material and methods

Census of tourists in Slovak Paradise National Park

Tourist census in Slovak Paradise National Park (NP) is performed both in winter and summer seasons. From the recorded data the average annual visitation was calculated:

Average annual visitation = 100 summer days x daily summer visitation + 265 winter days x daily winter visitation

The number of visitors is monitored at 17 sites (i.e. at 17 hiking trails, on which tourists enter Slovak Paradise NP) and in Dobšinská ice cave. Hence, the visitation is monitored only on hiking trails inside Slovak Paradise NP, and the number of visitors in catering and accommodation facilities and in ski resorts is not included. These visitors represent only a secondary load of the national park of Slovak Paradise.

Processing of wildfire data representing the analysed region

The database of natural fires comprises the information about individual fires that occurred in the area of Slovak Paradise NP in the period from 1976 to 2014, e.g. the location of their initiation, cause of fire, or damages caused by fire. All necessary data were obtained from the district directorates of the Fire and Rescue Service in Rožňava, Spišská Nová Ves and Poprad, across which Slovak Paradise National Park spreads.

Analysis of meteorological conditions

For the analyses we used the data from the meteorological station of the Slovak Hydro-meteorological Institute in Poprad, where the rainfall shadow, which has a substantial impact on the area of the national park, is well monitored (ŠKVARENINA *et al*. 2003).

Fire assessment in the national park was based on the Angström fire index, the values of which are classified into five levels of fire risk

I. Without risk
II. Low risk
III. Moderate risk
IV. High risk
V. Extremely high risk (ŠKVARENINA *et al.* 2003)

Results and discussion

The intensity of tourism in Slovak Paradise National Park is presented in Figure 1. From the data it is clear that the number of visitors is higher in summer months (during 100 summer days) than in winter months (during 265 winter days), which has an impact on the fire risk in the analysed region.

In the years from 1976 to 2014, 712 fires in the area of Slovak Paradise National Park were forest fires. Hence, 19 fires occurred per year on average. The highest number of fires (88) occurred in the year 2011 (Fig. 2). In Figure 3 we show the number of days with fires in the individual years for the comparison with the number of fires in the years. During the whole monitored period, wildfires occurred on 550 days in total. This means that fire occurred on 13 days per year on average. The highest number of days with fire was 53 days in the year 2011.

Figure 4 presents the development of the average annual temperature and the average temperature during the growing season. From the figure it is clear that the average air temperature has been increasing in the last years (since 2010).

Increasing in air temperature, coupled with the expected climate change is likely to bring growth and increasing extremes and for example in the hydrological regime (Hlavčová, et al., 2015). The long-term average during the growing season is higher by more than 4 °C, and hence, the fire risk is also greater than in other months. The largest differences of the average air temperature and the average temperature in the growing season from the long-term values were found in the years 2011 and 2014. In the year 2011, the average annual temperature was 7 °C and the average temperature in the growing season was 11.6 °C. In the year 2014, the temperatures differed from long-term averages even more. The average annual temperature and the average temperature during the growing season were 8.2 °C and 11.7 °C, respectively. However, in the year 2014 only 5 fires occurred due to the abundant precipitation (Fig. 5).

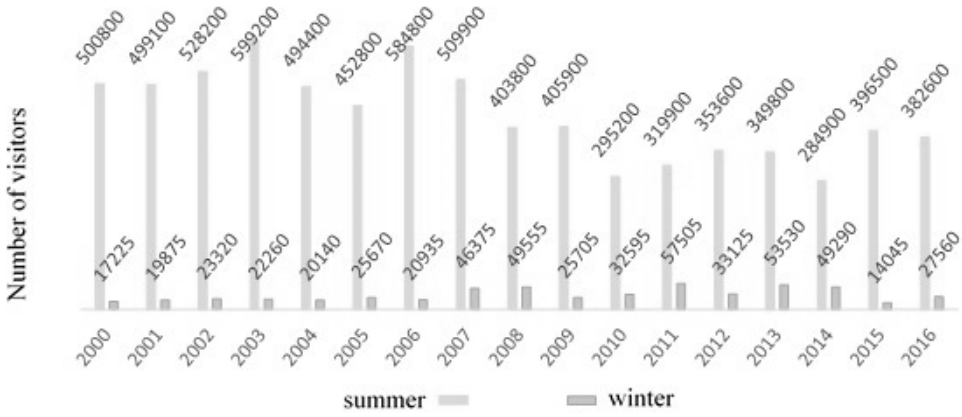

Fig. 1: Number of visitors in Slovak Paradise National Park during the years 2000-2016

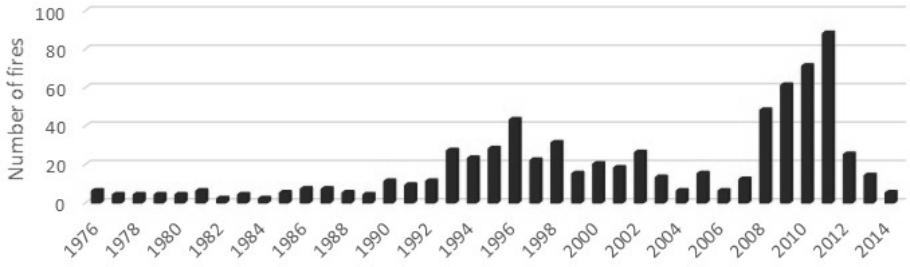

Fig. 2: Number of fires in individual years from the year 1976 to 2014

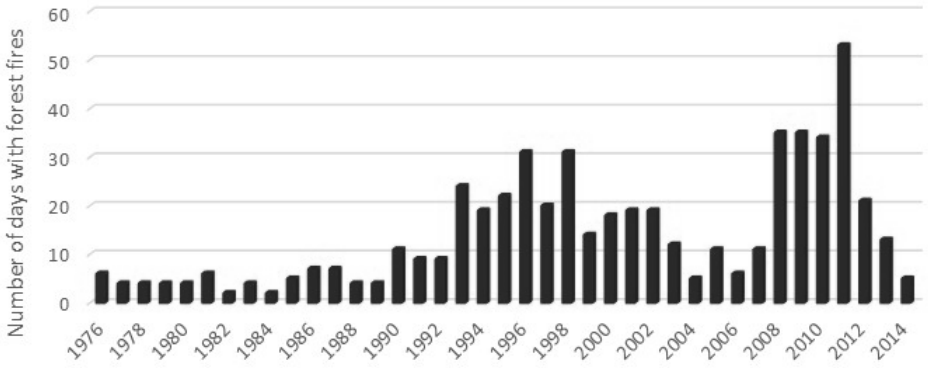

Fig. 3: Number of days with forest fires in individual years

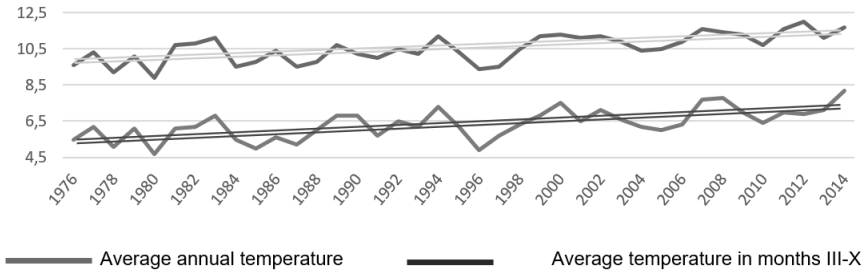

Fig. 4: Development of average annual temperature and average temperature during growing seasons

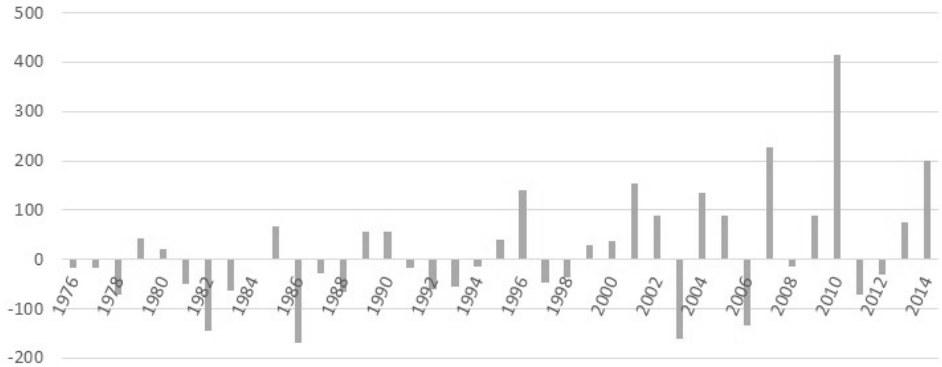

Fig. 5: Deviations of precipitation values from long-term average precipitation total

Forest fires occur during the whole year (Fig. 6), but spring months substantially differ from the mean. The highest values were obtained in the months of March and April. This results from dry grass burning in the spring time. Lower values, which did not significantly differ from each other, were observed in other months. A slightly higher number of fires was observed in August, in which 9% of all fires occurred, but this value is still incomparable with the months of March and April, in which 27.5% and 28.4% of all fires occurred.

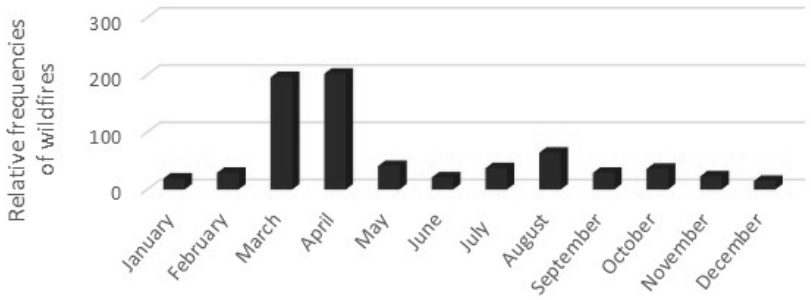

Fig. 6: Relative frequencies of wildfires in individual months during the years 1976 - 2014

Grass burning is the most common cause of fires. Out of the total number of 712 fires, 370 fires, i.e. 52%, resulted from dry grass burning. The second most frequent cause is setting fire in the wild, which was responsible for 72 fires, i.e. 10%.

Figure 7 presents the numbers of fires with regard to their cause. On forestland, setting fire in the wild was the most common cause of fire, as it caused 41 fires. This represents 24.6% of all 167 fires. However, in 30.5% of fires on forestland, the cause could not be determined.

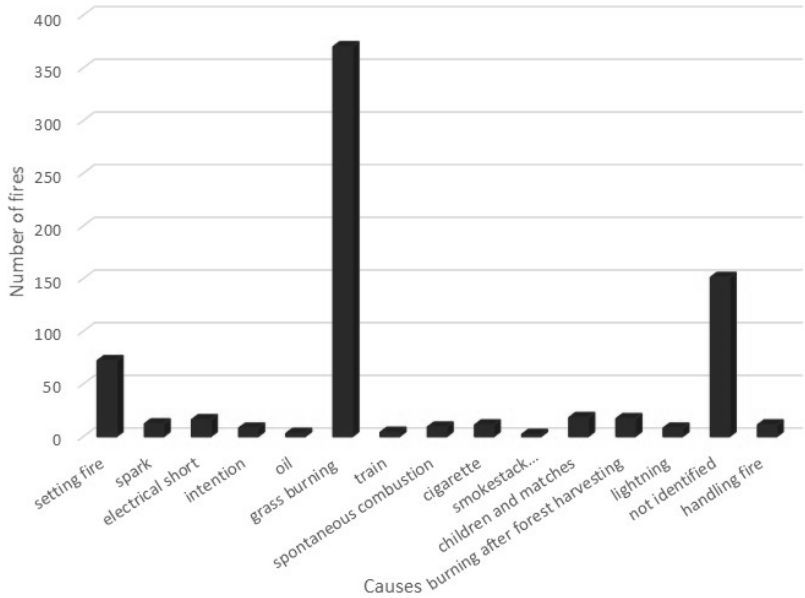

Fig. 7: Number of fires with regard to their causes on forestland

In Table 1 we present the sizes of burnt areas. A relatively large number of fires is localised early and hence, damaged areas are not large. During the analysed period, approximately 46% of all fires affected the area of less than 1 hectare. Only one fire on forestland damaged an area greater than 50 hectares in the cadastre of Hrabušice settlement, which belongs to the district of Spišská Nová Ves.

Tab. 1: Absolute and relative frequencies of wildfires in relation to the affected area

Area affected by fire in hectares	Number of fires	(%)
0-1	324	45.5
1 - 2	52	7.3
2 - 5	32	4.5
5 - 10	9	1.3
1 - 20	15	2.1
20-30	2	0.3
30-40	2	0.3
40-50	2	0.3
50 and more	1	0.1
No information	273	38.3
Σ	712	100.0

Trends of potential risk of forest and landscape fires according to Angstrőm fire index from the year 1970 to 2014.

The data obtained from the forest directorates of Fire and Rescue Services in Rožňava, Poprad, and Spišská Nová Ves revealed that 712 fires occurred in Slovak Paradise National Park between the years 1976 and 2014. 545 fires were on agricultural land, and 167 fires occurred on forestland. The majority of fires were of anthropogenic origin. Natural factors caused only 2 - 3% of all fires in the analysed area.

The natural conditions of the national park have a substantially influence on the occurrence and spread of fires. Among these factors we consider:

- Rainfall shadow
- Bedrock
- Soil cover
- Forest communities
- Tourism

In Table 2 we present the results of Student t test of significance of correlation coefficients between Angstrőm fire index and the levels of fire risk 4 + 5 and 3 + 4 + 5 Significance level $\alpha = 0.1$ * slightly significant, $\alpha = 0.05$ ** significant, $\alpha = 0.01$ *** very significant, $\alpha = 0.001$ **** highly significant. Degrees of freedom n= 44.

Tab. 2: Student t test of significance of correlation coefficients for Angstrőm fire indices

Fire index	4 + 5 levels of fire risk	3 + 4 + 5 levels of fire risk
Angstrőm (AI)	****	***

The increase of air temperature, and with it associated drying out of the country and the increase of fire risk are in general considered as indicators of climate change. In this work we evaluate the temporal trend of Angstrőm fire index. The fire index was calculated for the period 1970 - 2014, i.e. 44 years, and the highest levels of fire risk were examined. We evaluated the number of days with 4 + 5 fire risk, and with 3 + 4 + 5 fire risk. The results can be seen in Figures 8 and 9. Student t test of significance of correlation coefficients was performed following Šmelko (1995).
Angstrőm fire index is mainly sensitive to air temperature and relative air humidity. Similar results were shown by Lapin et al. (2010), who evaluated the trends of air temperature and air humidity in the northern Slovakia, similarly, Stredova and Streda (2015), Vido et al. (2016), Skvarenina et al. (2009b), in the evaluation precipitation and indexes of drought.

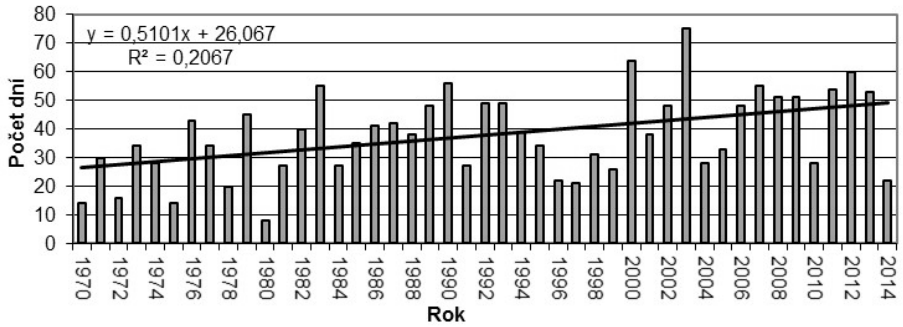

Fig. 8: Number of days with 4 + 5 fire risk during the years 1970 - 2014 and their linear trend for Angstrőm fire index

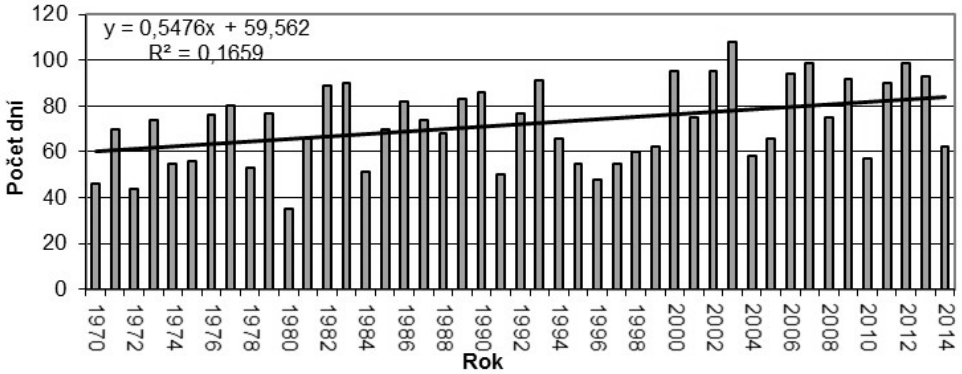

Fig. 9: Number of days with 3 + 4 + 5 fire risk evaluated by Angstrőm fire index during the years 1970 - 2014 and their linear trend

Conclusion

The work deals with the problem of forest and natural fires in the area of Slovak Paradise National Park. We analyse natural conditions, forest fires and trends of the meteorological fire index.

The dominating natural conditions in the area of the national park largely contribute to fire occurrence. An example of such conditions are e.g. location of the area in a so called rainfall shadow, bedrock formed by limestone, and relatively frequent drought periods. Conditions of vegetation and forests dominated by flammable pines are also important factors. The social structure of the population and partly also the intensive tourism play important roles in fire occurrence in the forests of Slovak Paradise National Park.

During the monitored period from 1976 to 2014, 712 forest and landscape fires occurred in the area of Slovak Paradise. Hence, 19 fires occurred per year on average. In total, 550 days with fires were recorded, i.e. 14 days per year on average. The year 2011 with 53 days with fires differed from the average value most.

In the period from 1976 to 2014 we observed a significantly increasing trend of forest fire risk, particularly in the case of fire risk category 4 + 5. We believe that this trend is to some extent related to the overall trend of climate change in Slovakia, as air temperature is increasing, air humidity is decreasing, and rainfall patterns are changing.

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Souhrn
V práci je rozebraná problematika lesních a přírodních požárů v oblasti Národního parku Slovenský ráj. Analyzují se přírodní poměry, lesní požáry a trendy meteorologického požárního indexu.
Hodnocení příčin vzniku požárů bylo realizované na základě údajů získaných z okresních ředitelství Hasičského a záchranného sboru v Rožňavě, Spišské Nové Vsi a Popradu, pod které spadá území Národního parku Slovenský ráj.
V průběhu sledovaného období od roku 1976 do r. 2014 dosáhlo množství lesních a krajinářských požárů na území Slovenského ráje počet 712 požárů. Průměrně tak připadá na každý jeden rok 19 požárů. Celkový počet dní s požárem se dostal na hodnotu 550 dní, tedy průměrně za rok 14 dní s požárem. Od průměrné hodnoty se s největší odchylkou liší rok 2011, ve kterém bylo až 53 dní s požárem.
Významným zjištěním byl i fakt, že v letech 1976 – 2014 jsme zaznamenali statisticky významný trend
růstu rizika lesních požárů, především co se týče trendu v kategorii požárního rizika 4. a 5. třídy nebezpečí vzniku požáru.
Výsledky analýz potvrdily, že k častému vzniku požárů přispívají kromě přírodních poměrů - poloha území v tzv. srážkovém stínu, geologické podloží tvořené hlavně vápencem, poměrně časté údobí sucha, také vegetační poměry a lesy tvořené ve velké míře hořlavými porosty borovic.
Důležitou úlohu při vzniku požárů v lesích NP Slovenský ráj a přilehlých oblastech sehrává i sociální
struktura obyvatelstva a částečně i cilý cestovní ruch.
Jsme toho názoru, že tento trend souvisí do jisté míry s celkovým trendem klimatických změn na Slovensku, neboť dochází k růstu teploty ovzduší, poklesu vlhkosti vzduchu a ke změnám v distribuci srážek.

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UPDATE OF THE REPORT OF ZEMPLÍN AREA'S POTENTIAL OF INCLUSION AMONG SLOVAK GEOPARKS FROM THE PERSPECTIVE OF TOURISM FLOW

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Abstract
Geoparks are an acknowledged system for preservation and protection of geological and natural heritage, but also considered as a positive stimulator for development of environmentally friendly tourism products, marketing campaigns for DMOs and growth of tourism flow in destinations covering geoparks. Currently the Ministry of Environment of the Slovak republic is working on the establishment of Slovakia's fourth geopark located in the Zemplín area. The aim of the paper is to update the 2016 ministry's report of „Zemplín area's potential of inclusion among Slovak geoparks" from the perspective of actual tourism flow via open data analysis, destination buffer zones and impact analysis of recent new products in the area by using TUKE's currently developed DBIS's modules. The results indicate that the Zemplín area's actual and future potential tourism flow are greater than currently reported and justifies benefits for every affected destination and municipality. Overall the results strengthen the importance of Zemplín geopark's establishment.

Key words: open data, destination management, buffer zones, impact analysis

Introduction

Geotourism and geoparks in their own way are providing a catalyst for sustainable rural development (Ólafsdóttir & Dowling 2014) and this innovative approach may result into positive economic effects (Duľová Spišáková & Stričík 2016). In 2012 the Ministry of Environment of the Slovak Republic acknowledged the necessity to update the national approach to geotourism in line with other European countries, as well as the necessity to implement models for funding, establishment and management of geoparks (Ministry of Environment of the Slovak Republic 2012). One of the most recent outcomes of this initiative has been last years' „*Report on the Zemplín area with the perspective of its integration among Geoparks",* hereinafter referred to as the report (Ministry of Environment of the Slovak Republic 2016). Authors of the paper as members of a research group analyzing the potential use of open data in building knowledge structures for the support of maximizing the potential of geo and mining heritage (Kršák, et al. 2015) (Kršák, Sidor, Štrba, & Mitterpák 2016) in among others also in destinations of the Lower Zemplín region welcome and acknowledge the ministry's effort. The aim of the paper is to help and update the report from the perspective of potential capacities and tourism flow.

Materials and methods

The potential of the historical Zemplín's geo heritage has been identified by many researchers, mainly by following authors: Timčák, Jablonská, Baláž, & Torma (2004), Baláž & Žec (2005), Baláž (2005), Baláž & Rybár (2006), Baláž & Štrba (2015), Lukáč & Baláž (2016). The upper mentioned report's chapter among other deal with the definition of the area with the potential of becoming a geopark, analysis of natural resources and tourism offer, quantification of tourism offer, and flow of travel and tourism. The report was reviewed and its data upload to and compared

with the dabase of the Technical university of Kosice's currently developed „Destination Business Intelignece System", (hereinafter DBIS) (Kršák, Sidor, & Štrba 2016).

Results and Discussion

The report defined the area of the geopark within the boundaries of 30 municipalities in Trebisov district. The core of the geopark was defined with boundaries of the Tokaj region destination's 10 member municipalities with a buffer zone of the other 20 municipalities stretching around the destination from north-west to south-east.

From the perspective of point of interests (hereinafter POIs) the report identified 80 POIs, more specifically: 3 archaeological sites, 22 geo sites, geo-montanistic sites, 5 historical sites, 10 cultural-historical sites, 4 recreational sites, 7 wine tourism sites. From the total, 35 POIs (43,75 %) were located in the core of the geopark in the destination Tokaj region. On the other hand, most POIs are located in the buffer zone municipality Brehov that covered 15 % of all POIs and 45,46 % of geo site POIs. DBIS's database additionally generated: 13 recreational sites, 1 archaeological site, 12 cultural-historical sites, only in the core of the geopark.

In terms of accommodation capacities of the geopark, the report uses data from destination Tokaj region's 2015 business plan and marketing strategy, identifying 10 facilities with the total of 279 bed places. DBIS's database additionally generated 5 facilities in the core of the geopark and 4 facilities in the buffer zone. According DBIS's database the actual capacity of the geopark is 429 bed places in 19 accommodation facilities, from which 75,29 % of bed places are covered by 15 facilities situated in the core of the geopark and 24,71 % of bed places covered by 4 facilities situated in the buffer zone. Interesting fact is the 53,85 % of the bed places are covered by member stakeholders of DMO Tokaj region.

From the perspective of travellers and tourists flow the report again uses data of the Tokaj region's 2015 business plan and marketing strategy for the years 2013 and 2014 extracted from the „Registry of accommodation facilities". The data was re-checked and for the given years it's valid. Since the report uses old and partially recalculated data, the latest available of the upper mentioned registry has been updated to DBIS's database and analyzed. The results show that in 2015 the core of the geopark annually recorded decreases in: total number of visitors (-5,35 %), number of domestic visitors (-6,89 %), total number of overnight stays (-6,76 %), number of overnight stays by domestic visitors (-0,58 %), number of overnight stays by foreign visitors (-71,37 %), revenue of accommodation facilities (-8,50 %), annual occupancy (-18,65 %), average length of visitors stay (-3,47 %), average length of stay of foreign visitors (-80,35 %), average expenditure per 1 overnight stay (-1,14 %) and average expenditure of 1 accommodated visitor (-2,62 %). In 2015, increases were recorded for: number of foreign visitors (+45,71%) and average length of stay of domestic visitors (+6,77 %).

Since in 2016 in the core of the geopark new attractions and products introduced in 2015 have raised awareness among the general public, bellow mentioned results compare the first two quarters of 2015 and 2016.

In the first two quarters 2016, comparison to 2015 the core of the geopark recorded increases: total number of visitors (+48,36 %), number of domestic visitors (+55,62 %), total number of overnight stays (+77,82 %), number of overnight stays by domestic visitors (+86,82 %), revenue of accommodation facilities (+24,25 %), annual occupancy (+67,16 %), average length of stay (+30,26 %), average length of stay of domestic visitors (+20,05 %), average length of stay of foreign visitors (+41,81 %). In the analyzed period of 2016 decreases were recorded: number of

foreign visitors (-36,67 %), number of foreign visitors (-10,19 %), average expenditure per 1 overnight stay (-30,12 %) and average expenditure of 1 accommodated visitor (-16,25 %). Travelers and tourists flow in the buffer zone were not available at time of data processing.

Conclusion

Demonstrated update by DBIS databases of the differences illustrated the actual state of art and real potential of the designed Zemplín geopark. After all the analyzed report is a significant a positive step towards the Tokaj region destination's supportive geotourism products development. National geoparks seeking to join the Global Geoparks Network have to meet the networks criteria, among other candidate geoparks have to demonstrate impact on local economic development (UNESCO 2016), thus it is more than appropriate to work with more exact data that describe a more realistic picture of the geopark and in all together highlight its actual economic potential. All resulted data of the analysis maybe found as exported maps from the DBIS's GIS module at http://dbis.fberg.tuke.sk/DBIS-RAOP2017/.

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Souhrn
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USE OF DISPERSED SETTLEMENT FOR AGRICULTURAL TOURISM IN THREE TOWNS IN ČADCA DISTRICT

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Abstract
In this article we are evaluating 121 dispersed settlement units in three towns (Čadca, Krásno nad Kysucou and Turzovka) in Čadca district in terms of their recreational use by cottagers and for agricultural tourism. Dispersed settlement is a settlement structure where individual settlement units are dispersed in the area. There were changes in use of dispersed settlement in last decades and a lot of these settlement units were abandoned. Nowadays some of the dispersed settlement units in marginal parts, that were abandoned, are used by cottagers and most of the dispersed settlement units in valleys are used by residents. This area is well-known for presence of dispersed settlement units that have a great potential for agricultural tourism, mainly those in marginal parts of our area. There are well preserved wooden houses surrounded by a beautiful nature, orchards, small fields and meadows that are fit for stockbreeding that is a positive factor in agricultural tourism development in our area. Besides that, almost every dispersed settlement unit is crossed by tourist routs used during whole year. It turned out that even in the towns it is possible to develop recreational activities linked to agricultural tourism thanks to presence of dispersed settlement.

Key words: agricultural tourism, recreation, dispersed settlement's function, "Javornícko-beskydská kopaničiarska oblasť"

Introduction

Dispersed settlement is one type of archetypes (Hreško et al. 2015, Špulerová et al. 2016) and is more common in villages than in towns, however there are some exceptions, for example the towns Čadca, Krásno nad Kysucou and Turzovka. These towns differ in area and number of inhabitants but in all these towns dispersed settlement is present. Dispersed settlement is a settlement type in which dispersed settlement units are composed of single houses or small groups of houses (Verešík, 1974; Horváth 1980; Huba, 1989). This settlement type was tied to agriculture, mainly to sheepfarming (Sitár, 1967; Švecová, 1984; Huba, 1997; Petrovič 2006; Petrovič, Muchová 2013) and in last decades it undergone functional and physiognomic transformation and nowadays it is used by cottagers (Huba, 1997; Omasta, 2011). Dispersed settlement units have various regional names (e.g. "kopanice, rola, rále, štále, osady") and individual dispersed settlement units are named after people who lived there or after unique natural or landscape features (Verešík, 1974). Some authors see future of dispersed settlement in its recreational use, mainly for agricultural tourism (Norling, 1960; Petrovič, 2006; Petrovič, Muchová, 2013).

Agricultural tourism or farm tourism is a form or rural tourism (Nilsson, 2002; Kurek et al., 2007). Húska (1998 in Vanková, Baláž, 2005) claims that tourist's stay at accommodation facility of agricultural cooperation, directly in farm, adapted agricultural facility of old manor houses or another objects is agricultural tourism.

Clarke (1996) says that agricultural tourism, is when farm environment and their essence is included in product offered by entrepreneurs. According Nilsson (2002) agricultural tourism is based on farmers and farm environment. There is typical to use own resources and farm products to satisfy guests. Agricultural tourism consist of providing tourism services on small farms. Tourism activities are additional income source to farmer's that are primarily specialized in agriculture. Agricultural tourism offers active resting in clear natural environment, educating in agricultural techniques and tourists can get to know local people and their way of life (Húska, 1998; Kurek et al., 2007; Matlovičová et al., 2015). Intensity of use, location, the way of management, integration with community and another factors are also important in process of defining rural tourism (Lane, 2013). Most authors coincide that agricultural tourism is part of rural tourism, therefore it is tied to the rural environment. In our study we claim that it is possible to develop agricultural tourism in marginal parts of towns thanks to presence of dispersed settlement in the area.
Because of variety of agricultural tourism definitions we decided to use the ones from Húska (1998) and Matlovičová et al. (2015).

Materials and methods

Three towns (Čadca, Krásno nad Kysucou nad Turzovka) in Čadca district was our study area, because of presence of dispersed settlement which belongs to "Javornícko-beskydská kopaničiarska oblast" area and Kysuce subarea (Huba, 1989) and it is situated in the north of Slovakia (picture 1).
We could divide our survey into several steps. At first, we had to identify individual dispersed settlement units in the area by using topological maps of our study area. The field research was the most important step in our survey because on the basis of what we saw and noted down we could decide which dispersed settlement units have potential for agricultural tourism and which one doesn't. We visited every dispersed settlement unit and note down its GPS coordinates that was used later in geographical information systems (GIS). We focused on presence of orchards, small fields and meadows near dispersed settlement that indicated agricultural use. We also focused on presence of well-preserved old wooden houses representing traditional architecture and attractions in the area (e.g. tourist routs, cycling routs, cross-country skiing routs, protected areas, interesting land structures, historical sites…).
We also assessed accessibility that depends on road surface and distance from the town centre. Roads were divided into two categories, metalled road and dirt road, and distance categories were based on Nahálka et al. (1966) work where distances were divided into four categories: 0-2 km, 2.1-5 km, 5.1-10 km and 10 and more km. Distance was measured on the road from the town centre.
After the field research processing information in QGIS 2.2.0 and ArcGIS 10.1 followed. We placed dispersed settlement units in the area thanks gained coordinates and then we made polygon shapefiles representing each dispersed settlement unit. Thanks to adding shapefile that represents agricultural use in the area, we saw what for is used land surrounding dispersed settlement units. Than we determine areas with the highest potential for agricultural tourism and to state arrangements in its development.

Results and discussion

On the ground of gained information about our area during survey we chose 41 of total 121 dispersed settlement units that have potential for agricultural tourism. Main

criterions were presence of preserved wooden houses with traditional architecture, presence of meadows, orchards and small fields, good accessibility and quiet environment. Presence of attractions (tourists, cycling and cross-country skiing routs and as well as town feasts and cultural events) were benefits.
59.09 % of all dispersed settlement units in Turzovka have potential for agricultural tourism. In Krásno nad Kysucou 52.38% of all dispersed settlement units have potential for agricultural tourism. In Čadca it is only 21.74% of all dispersed settlement units that have potential for agricultural tourism. Most of dispersed settlement units in Čadca is located in valleys and they are no more dispersed in the area but they are creating compact unit, so we think that they no longer represent traditional way of living therefore they are not quite appropriate for recreation of this kind. Krásno nad Kysucou and Turzovka are smaller towns than Čadca and majority of their citizens live in the centre not in the dispersed settlement units that are more difficult to access than those in Čadca. Thereby they are not so attractive for inhabitants but offer quiet environment with preserved architecture and land structures that are attractive for tourists.
All 41 dispersed settlement units are distant from main roads and industrial parts of these three towns. Almost all dispersed settlement units are distant more than 3 kilometres from town centre. This distance vary between 2.3 km to 9.3km. The majority of dispersed settlement units range from 2.1 to 5km (table 1). None dispersed settlement units are in interval 0-2km or 10 and more km. There are more dirt roads than metalled roads (table 2). It could cause problems, mainly during the winter. Most of metalled roads is in town Čadca and on the other hand in towns Krásno nad Kysucou and Turzovka dirt roads prevail.
There could be a problem with accommodation, because traditional houses had only two sometimes three rooms (Munková, 1983) and that will not provide enough room for hosts and tourists. Nowadays it is sufficient for cottagers but it will be necessary to carefully reconstruct some of these houses or farm buildings. But it is crucial to preserve old architecture because it is attractive for tourists.
Areas with the highest potential for agricultural tourism are in marginal parts of studied towns as we can see at picture 2. Marginal parts often preserve old ways of life and cultures (Cawley & Gillmor, 2008). This argument could be applied on 41 selected dispersed settlement units have the best conditions for agricultural tourism development just because they are in marginal parts of area and have preserved traditional way of life and culture.

Tab. 1: Percentage expresion of road type leading to selected dispersed settlement

Town/ road type	Čadca	Krásno nad Kysucou	Turzovka
Dirt road	58,82%	81,82%	76,92%
Metalled road	41,18%	18,18%	23,08%

Tab. 2: Percentage expresion of distance from town centre to selected dispersed

Town/distance categorie	Čadca	Krásno nad Kysucou	Turzovka
0-2km	0%	0%	0%
2,1-5km	35,29%	90,91%	53,85%
5,1-10km	64,71%	9,09%	46,15%
10 and more km	0%	0%	0%

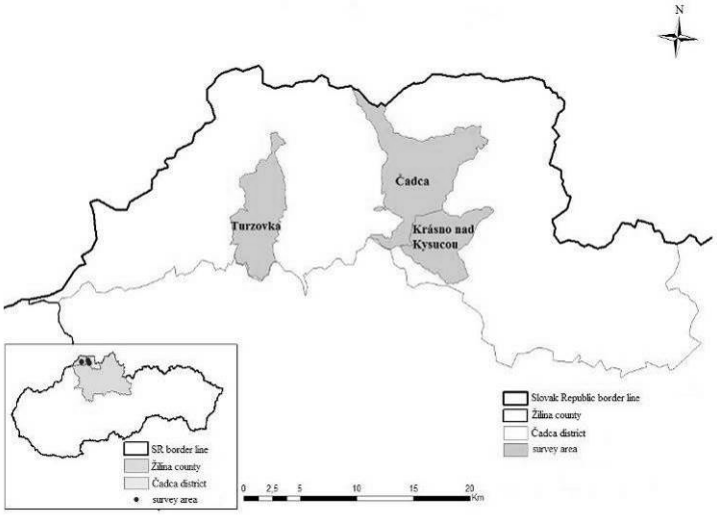

Fig. 1: Survey area within Slovak republic

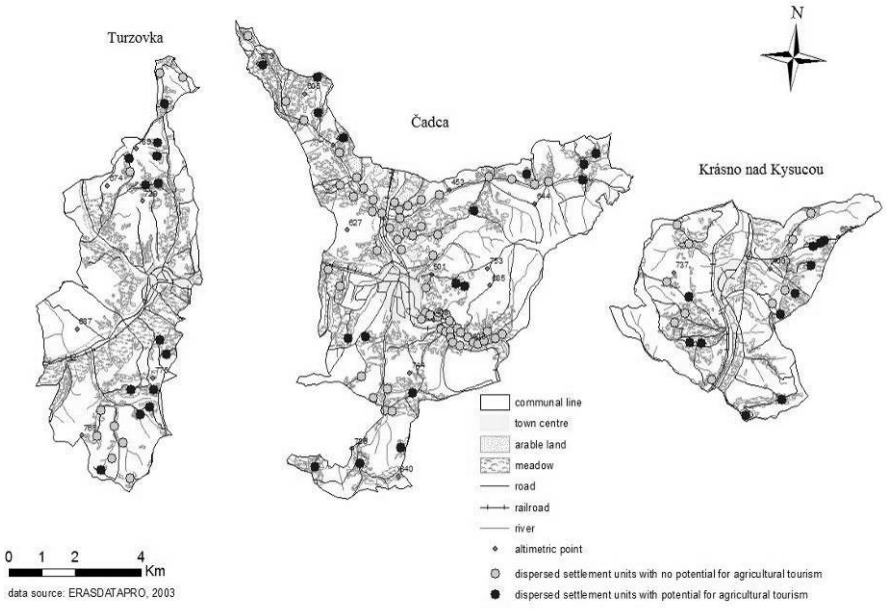

Fig. 2: Dispersed settlement units with and without potencial for agriculrural tourism

Conclusion

At first, we should realize that Čadca district lies in that part of Slovakia which is not very productive. Entrepreneurs should by orientated to animal husbandry rather than crop growing and this could be applied on almost all towns and villages with dispersed settlement in Kysuce region. Work in the orchards and crop growing can be supplement to animal husbandry which should be the main attraction for tourists besides preserved historical landscape structures.

Very important is that entrepreneurs and civic authorities should work together because it is necessary to co-operate in such matters as propagation, organization workshops and courses focused on agricultural tourism (Matlovičová et al., 2015). Agricultural tourism is dependent on wide scale of publicity and natural and cultural resources in private ownership and also developed tourism infrastructure, services and hospitability (Gunn, 1998; Wilson et al., 2001; Cawley & Gillmor, 2008).
In villages like Terchová or Zázrivá entrepreneurs run farms focused on agricultural tourism and they are very successful. It could work these way in our case study area. The natural and cultural conditions are similar to those in Terchová or Zázrivá. We manage to choose dispersed settlement units that will match the requirements which proves that even in town it is possible to develop agricultural tourism activities. Nowadays some of dispersed settlement units have a great potential for agricultural tourism. Those located in marginal parts of our study area are distant enough from town centre to have quiet and clean environment yet close enough to the town centre so tourist could use all benefits and services it offers. It seems like perfect balance for agricultural tourism development that could help rise employment rate and preserve valuable settlement type and historical landscape structures and also increase attractiveness of the region for tourists.

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Souhrn
V článku jsme se zaměřili na problematiku týkající se rozptýleného osídlení a jeho využití na agroturistické účely. Věříme, že díky přítomnosti rozptýleného osídlení je možné v tomto území rozvíjet agroturistiku. Prostřednictvím podrobného terénního výzkumu a stanovených kritérii, jako byli přítomnost zachovalých starých dřevěných domů s tradiční architekturou, přítomnost sadů, luk a malých polí, historických krajinných struktur a dobrá dostupnost se nám podařilo vymezit 41 kopanic, které mají potenciál být využívané na tyto účely. Zjistili jsme, že převážná většina těchto kopanic se nachází v okrajových částech našeho území, vzdálená od centra města víc než tři kilometry. Je to způsobeno tím, že k rekreaci je potřeba pokojného prostředí a většina zachovalých kopanic se nachází ve větší vzdálenosti od centra města. Zjistili jsme, že města Turzovka a Krásno nad Kysucou mají vetší potenciál pro agroturistiku než okresní město Čadca, kde je převážná většina kopanic využívaná na trvalé bydlení. Zajištěním spolupráce mezi vedením měst a hospodáři je možné zatraktivnit území pro návštěvníky, zabezpečit zachování rozptýleného osídlení a historických krajinných struktur jako i zvýšení zaměstnanosti v území.

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USE OF NORWAY SPRUCE AS ADMIXTURE IN SUBURBAN FORESTS AT LOWER ALTITUDES

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Abstract
In suburban forestry there is a need not only to manage a maximum financial result, but also to support recreational and aesthetic forest functions. Thus, these forests need professional treatments in the form of proper silvicultural methods to maintain stand stability. One of these methods is cultivation of mixed stands with Norway spruce. This study examines the mortality of spruce growing in stands in lower forest vegetation zones with time series of 50 years and the changes in biomass production in young variously mixed stands in three different vegetation zones. According to the results, it is beneficial to grow spruce in the range from 5 to 10% of admixture in stand establishment stage. Due to silvicultural treatments and inter-species interactions, spruce representation in a stand may increase to 30% in the mature stands. Spruce trees tended this way in young age partly will be outcompeted by other species, but the remaining individuals will adapt to the existing environmental conditions and thus the whole stand will be more stable. Biomass production of spruce trees depends on its representation in the stand. The higher the spruce admixture, the lower will be average spruce tree biomass. The study indicated that in young stands up to 30% of spruce representation, its biomass was up to 100% greater than in spruce monocultures.

Key words: recreational forests, biomass, mortality

Introduction

Currently, suburban forests around towns and villages are frequently visited and therefore it is not possible to use this natural environment to only support economic growth (Hladnik, Pirnat 2011). Suburban forests should be able to function as a stable ecosystem; fulfilling not only needs of wood production or nature conservation, but also covering social needs of urban society (Konijnendijk 2008). Thus, management of these forests is gradually changing (Kennedy et al. 1998; Otto 1998). Suburban forests require special interventions such as the application of special purpose forest stands, which includes mixed forests (Spiecker 2000). Particularly in winter when deciduous trees loose leaves, forest environment may seem rather hostile for visitors. For this reason, it would be appropriate to leave in mixed forests some coniferous tree species that, due to their green vegetation, induce positive perception of the forest environment. At lower vegetation zones and under appropriate environmental conditions, this aesthetic function may be fulfilled by cultivation of Norway spruce, which is also suitable from the point of view of financial profit. However, it is important to ensure its appropriate representation in a stand, as it may suffer from increased mortality and decreased production (Babst et al. 2013). It is expected that production and mortality of spruce in mixed stands is influenced by different vertical distribution of foliage and roots of various tree species

(Lindén 2003 Hooper et al, 2005, Kelty 2006). This paper examines the possibilities of using Norway spruce in mixed stands with different spruce representation, in suburban forests, in order to keep it from premature mortality and endangering forest visitors, while maintaining the highest possible yield.

Materials and methods

The study took place in the Training Forest Enterprise Masaryk Forest Křtiny, a special-purpose facility of Mendel University in Brno (Czech Republic). Mean annual precipitation is around 550-650 mm and mean annual temperature is around 7.5 °C (Kadavý et al 2015). Mortality data were obtained from a 50-year time series from four studied stands (Tab. 1). Selected stands were measured non-destructively. Measurements began in 1960-1961 and were continued in five-year interval up to date. Tree diameter at breast height (DBH), tree height and crown bottom height were measured. Stand DBH structure and stand density were used to calculate stand basal area and species representation ($\%_{spruce}$), in each stand. For comparison of tree mortality in stands with different $\%_{spruce}$, tree mortality was calculated for standardized stand density of 2000, 1500, 1000, 900 and 800 tree ha^{1}.

Tab. 1: Basic characteristics of Norway spruce trees in older studied stands.

Variable	Hruba jedle	Olomucany	Klepacov	Smrk
Mean height in the first measurement [m]	8.2 (± 0.2)	9.4 (± 0.9)	8.2 (± 0.3)	11.8 (± 0.2)
Mean stem diameter in the first measurement [cm]	8.4 (± 0.2)	9.6 (± 1.5)	8.7 (± 0.5)	10.8 (± 0.2)
Norway spruce representation in stand basal area in the first measurement [%]	29	6	1	52
Norway spruce representation in stand basal area in the last measurement [%]	41	27	7	11

To determine the relationship between spruce biomass and $\%_{spruce}$ in the stand, stand age and environmental conditions represented by vegetation zone, set of stands was selected to conduct measurements. Stands represented three age groups (5, 15 and 25 years old), three forest vegetation zones (FVZ, second, third and fourth FVZ) and four groups of $\%_{spruce}$ (30%; 31- 60%; 61-90% and over 91% representation of spruce in stand basal area). Younger stands were measured by the destructive method. From each stand, we selected 12 trees – four suppressed trees, four intermediate, and four dominant ones. These trees were harvested and basic dendrometric variables were measured, such as: DBH, tree height and crown bottom height. Each sample tree was divided into branches, needles and trunk and all parts were dried for 48 h at 80 ° C and 2 h at 105 ° C and weighed after drying. Dry biomass of each tree part and the whole tree was calculated. The results of destructive studies were used to generate allometric relationships for each stand separately. In studied stands, DBH, height and crown bottom height of all spruces were measured, which enabled to calculate biomass (branches, needles, trunk and total aboveground biomass) using those allometric relationships. Average biomass