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

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Faculty of Forestry and Wood Technology
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AIR TEMPERATURE DYNAMICS AND RECREATION IN THE CITY OF HRADCE KRÁLOVÉ

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Abstract
The climatological station in the city of Hradec Králové allows one to evaluate the dynamics of air temperature as an indicator of conditions for recreation in the city. A suitable indicator is the air temperature during various seasons, especially in the summer and possibly in the winter. Increase in the average air temperature in the summer during the period of 1961 to 2020 in the city of Hradec Králové is 2° C. The air temperature has risen more significantly in the last 30 years. Each consecutive decade in the period from 1961 has been the warmest on record. Change in the average temperature in winter changes the conditions for winter sports, both the duration and period of continuous snow cover and restrictions for skating.

Key words: Summer, winter, climate change, snow cover

Introduction

It is quite difficult to define the concept of the term recreation. It represents a very wide field of activities with various aims. In any case, a suitable environment is necessary for recreation, and this does not include just nature, but also cities. These provide both historical buildings, other various monuments, pleasant facilities, but also completely new attractions. In this respect, it is therefore necessary to take into account the urban environment for recreation, the most dynamic part of which is the urban climate. This has been evaluated in detail in the recent decades.

One common subject of study is the occurrence and effects of the urban heat island are studied, which can lead to extreme values, unfavorable to human health. A change in the urban surface is directly associated with a change in the radiation balance and an increase in the extremity of meteorological parameters. Atmospheric Urban Heat Island can be identified by measuring the temperature or humidity of air at standard meteorological stations, performing special purpose measurements within a dedicated network of stations or, for example, using the so-called measuring rides, which allow spatial expression of temperature and humidity field in the area of analysis.

Particularly hot spots with characteristic features (car parks, industrial facilities, flat roofs, asphalt roads, etc.) are defined as "micro urban heat islands - MUHI". An extensive study of the urban environment that used the city of Brno as an example and which was based on a network of special-purpose meteorological stations, can be found in the Klima Brna publication (Dobrovolný et al., 2012).

Material and methods

To evaluate the urban climate of the city of Hradec Králové, a climatological station located in the inner city was used (Střeštík et al 2014). This provides one with data measured in accordance with standards of the Czech Hydrometeorological Institute. The measured air temperature data were processed by basic statistical methods and their graphical representation is given.

Results

Thirty-year evaluations, the so-called normal periods, have been introduced for the climatological evaluations. Fig. 1 shows the course of average monthly air temperatures for the normal periods 1961 - 1990 (blue curve) and 1991 - 2020 (red curve). It is clear from their course that in case of all the months in the period 1991 to 2020, the average air temperatures were higher. The course of air temperature expressed by average annual temperatures is shown in Fig. 2. Annual values further prove the increase in air temperature by 2.3 °C over the 60-year period.

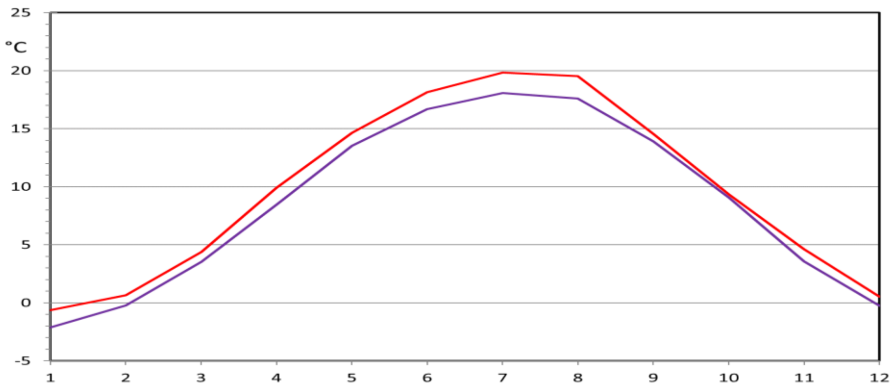

Fig. 1: Course of average monthly air temperatures (°C) for the normal periods 1961 - 1990 (blue) and 1991 – 2020 (red) in Nový Hradec

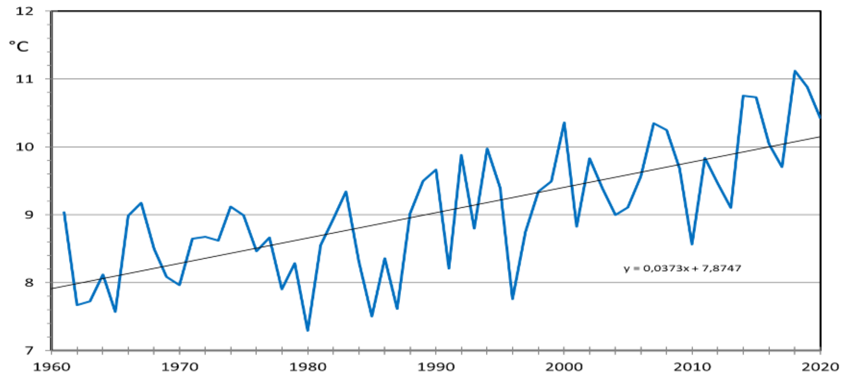

Fig. 2: Average annual air temperatures (°C) in the period 1961 - 2020 and the associated linear trend at the station in Nový Hradec.

The annual averages range from 7.2 °C to 11.1 °C, with natural fluctuations. One can see an evidence of the constant rise in air temperature during the evaluated period in Fig. 3, where one can see that temperatures have been rising steadily since the 1960s. From the perspective of recreation, however, it is more important, to evaluate the air temperature during shorter periods, it was therefore decided to further analyse the various seasons of the year.

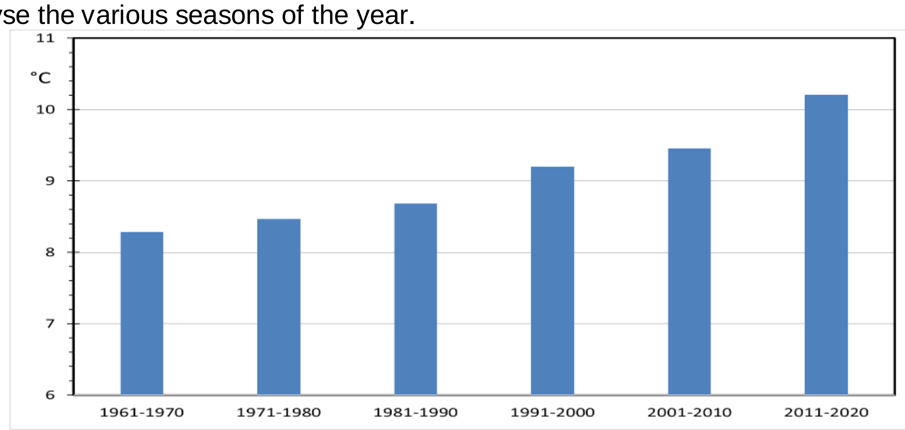

Fig. 3: Average annual air temperatures (°C) for the individual decades in the period 1961 - 2020 at the station in Nový Hradec

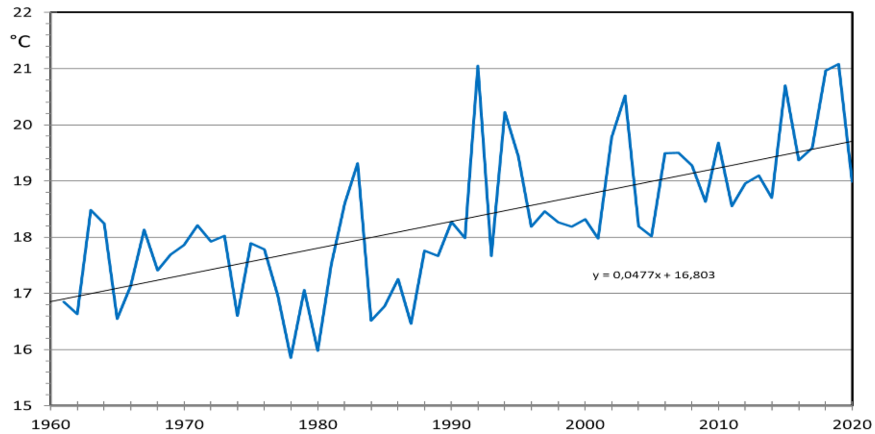

Fig. 4: Average summer air temperatures (°C) in the period 1961 - 2020 and the associated linear trend at the station in Nový Hradec

In the summer one can see the highest air temperature increase, in particular by 4.2 °C, with a relatively high amplitude from 15.9 °C in 1978 to 21.1 °C in 2019 (Fig. 4). At the same time, the average summer air temperatures have not fallen below 18 °C since 1993. However, the constantly higher air temperatures mean that the number of extremely high daily maximums is increasing. It is the air temperatures above 30 °C that are already unfavorable for the human health. Especially during longer-lasting anticyclone conditions, staying in the city at noon is unsuitable and even dangerous. From the perspective of recreation, it is important to remember this fact and, especially in the central part of cities, to always establish shade areas. This role, including cooling the environment, is well fulfilled by greenery, especially mature trees with their shade.

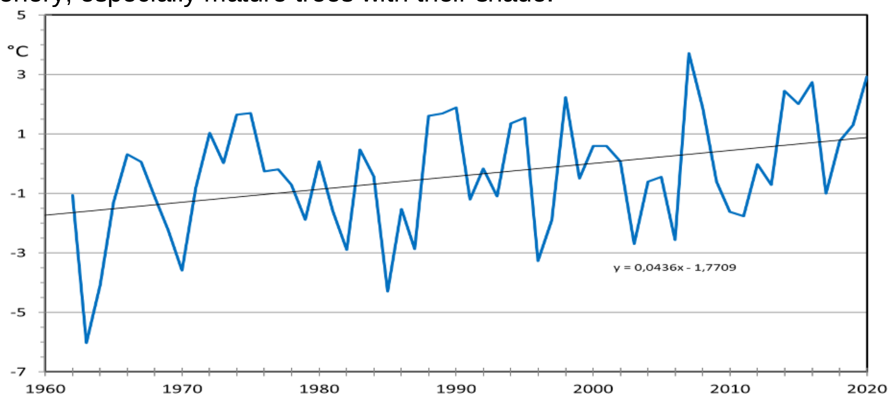

Fig. 5: Average winter air temperatures (°C) in the period 1961 - 2020 and the associated linear trend at the station in Nový Hradec

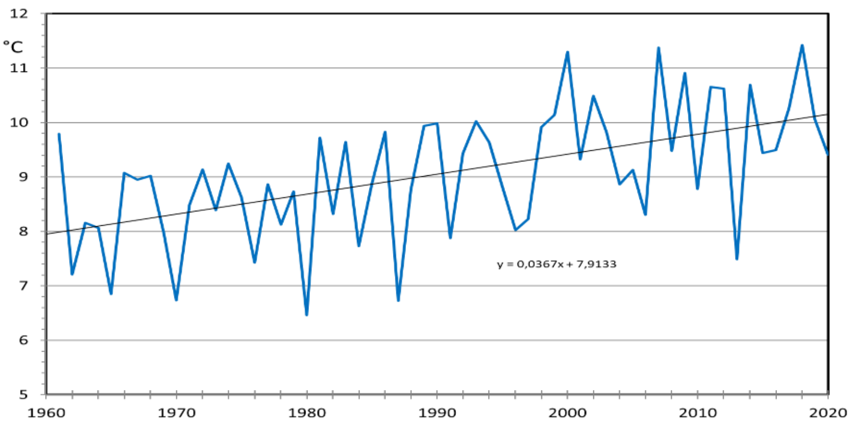

Fig. 6: Average spring air temperatures (°C) in the period 1961 - 2020 and the associated linear trend at the station in Nový Hradec

The second highest increase in air temperature of all the seasons in the year is observed in winter, on average an increase by 2.6 °C over the 60-year period (Fig. 5). With regard to winter recreation, increased air temperature has a negative impact especially on skiing and skating potential as more and more winters have an average temperature above zero, so skating in the open is almost impossible. The number of days with snow cover required for skiing is also decreasing. If one evaluates the annual season based on the extend of the air temperature increase, the third in the order is spring, with an average increase in temperature of 2.2 °C (Fig. 6). The impact of this spring increase is expressed by earlier flowering of plants, but also by an increase in the number of days suitable for an outdoor stay in the city, i.e. for walks in parks, etc.

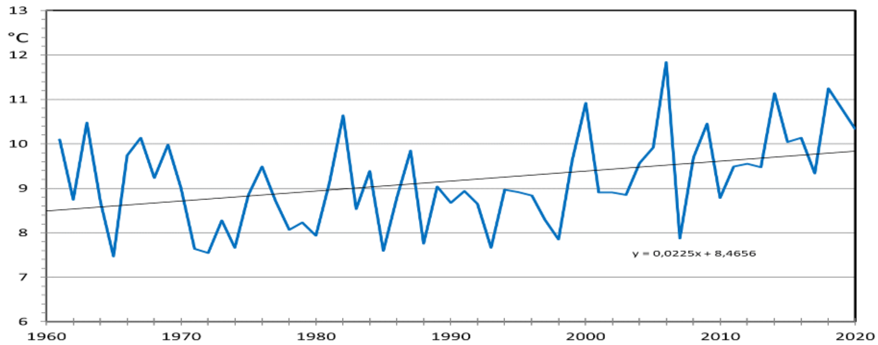

Fig. 7: Average autumn air temperatures (°C) in the period 1961 - 2020 and the associated linear trend at the station in Nový Hradec.

The smallest increase in average air temperatures is observed in the autumn, in particular an increase by 1.3 °C (Fig. 7). This increase allows extending the period for staying in the outdoor environment and the period for recreation.

It is also important to note that with the exception of the winter season, the last two decades have been the warmest. This finding is a proof that one can expect an increase in air temperature in cities in the future. It should also be noted that this increase is higher in these urban environments compared to the open countryside.

Discussion

The presented results are in accordance with findings published on the issue of urban climate in both older (Petrovič 1979, Oke 1973) and contemporary literature (Hinkel 2003, Técher 2021). Even though calculations of apparent categories, such as the temperature-humidity characteristic Humidex index (Toy et al., 2007), are not included, it can be assumed that increasing temperature leads to an increase in the number of days unsuitable for recreation in cities, especially in their central parts (Litschmann, Rožnovský). However, with regard to the possibilities of recreation development in cities, one must also take into account the outputs from climatological models, according to which the air temperature will continue to rise, albeit not

Conclusion

From the above results, it can be stated that, similarly to other cities, as documented in the literature, air temperatures in the city of Hradec Králové increase in all seasons of the year. Highest rate of increase is observed in the summer, particularly in the central built-up areas of cities, where there is no or a minimum ratio of greenery, the air temperatures exceed the values favorable for outdoor stay, i.e. cause discomfort or even extreme discomfort.

Rising air temperature negatively affects winter recreation, because shorter period of snow cover makes it more difficult to maintain ice for skating etc. Increase of air temperature in the spring and autumn, on the other hand, prolongs the suitable period for recreation. However, with regard to the outputs from climatological models, it is necessary to look for ways of preventing further rise in air temperature in general, especially in the cities. Despite the fact that Hradec Králové is known for its large parks and green areas, these should be further expanded in order to take advantage of the cooling effect of greenery as much as possible.

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Souhrn
Údaje z klimatologických měření na stanici Hradec Králové Nové dvory byla analyzována dynamika teploty vzduchu, jako ukazatel podmínek pro rekreaci na území města. Vhodným ukazatelem je teplota vzduchu v ročních obdobích, hlavně v létě a případně v zimě. Vzestup průměrné teploty vzduchu v létě za období 1961 až 2020 na území města Hradce Králové činí 2 °C. Výraznější vzestup teploty vzduchu je v posledních 30 letech. Pokud jde o desetileté průměry, potom každé desetiletí od roku 1961 bylo vždy v celé řadě nejteplejší. Změna průměrné teploty za zimu mění podmínky pro zimní sporty, a to jak dobu pro setrvání souvislé sněhové pokrývky, omezení pro bruslení.

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ANALYSING OF LAND USE IN RIVER BASIN HORNÁD FOR POSSIBILITIES OF RECREATION

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Abstract

Climate change and land use affect the hydrological cycle and water resources and recreation opportunities. The researched area is located in eastern Slovakia in the Hornád river basin. Land use for the reference years 1990, 2000 and 2012 was evaluated using CORINE Land Cover. the assessed area is suitable for recreational purposes, because it has a suitable location attractive for tourists.

Key words: Kysak, Land Cover, Recreation

Introduction

Global climate change is not an abstract of future risks, it is already happening. Climate change mitigation and adaptation measures therefore need to be seriously considered (Zeleňáková et al., 2015, Zeleňáková, et al., 2018). This applies not only to agriculture, forestry and water management, but also to other areas such as nature conservation, recreation, healthcare, urban planning, transport and tourism. These areas are under increasing pressure to adapt to climate change as well as to contribute to climate change mitigation through appropriate measures.

CORINE Land Cover (CLC) is the standard for monitoring land use and land cover at a pan-European level. CLCs are set up by national agencies and coordinated by the European Environment Agency (EEA). The data sets are created according to a common standard and represent the situation for the reference years 1990,2000, 2006, 2012 and 2018 (Feranec, 2016).

Materials and methods

Study area

The studied area is located in eastern Slovakia in the Hornád basin of the Kysak sub-basin. The Kysak sub-basin starts from the Kysak Hydrological Station (8565). In the given sub-basin there is a water reservoir Ružín and various tourist and recreational attractions e.g. Sivec with a view of the Ružín reservoir, Jánošíková bašta and many others. The area of the sub-basin is 582,3 km^2.

Methods

Land cover changes that have occurred over the last two decades have been made using the proven CORINE Land Cover (CLC) inventory. [2,3,4] CLC technical specifications state a minimum area of 25ha, with a width required for linear phenomena. at least 100 meters. The CLC categorizes land cover based on a 3-level hierarchical classification system that has 44 classes at the third and most detailed level. The second level, which has 15 classes, was used in this study.

Results

The land cover in the Kysak sub-basin consists mainly of forests and agricultural land, as we can see in Figure 1.

In Figure 2, the land cover for the reference year 2000 change compared to 1990 is that the area of forests increased at the expense of pastures and heterogeneous agricultural areas.

For the reference year 2012, it can be seen that the forest area increased again by 1% and the arable land area decreased. The area of Urban fabric increased to 4% of the area compared to 1990.

In Table 1. we see a summary of land use change in the Kysak sub-basin. Land use changes are not so significant. The biggest change was in the Forest class where the area increased by 5.7%. The increase in area was still in urban fabric, in other classes there was a decrease in the area of land used

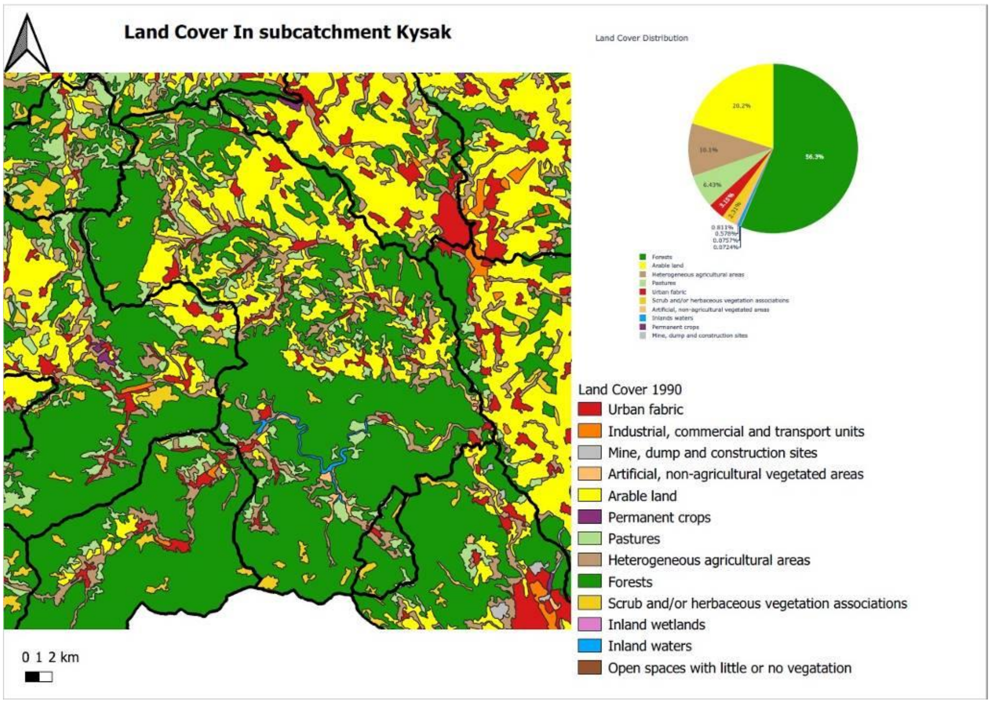

Fig. 1: Land Cover in Subcatchment Kysak 1990

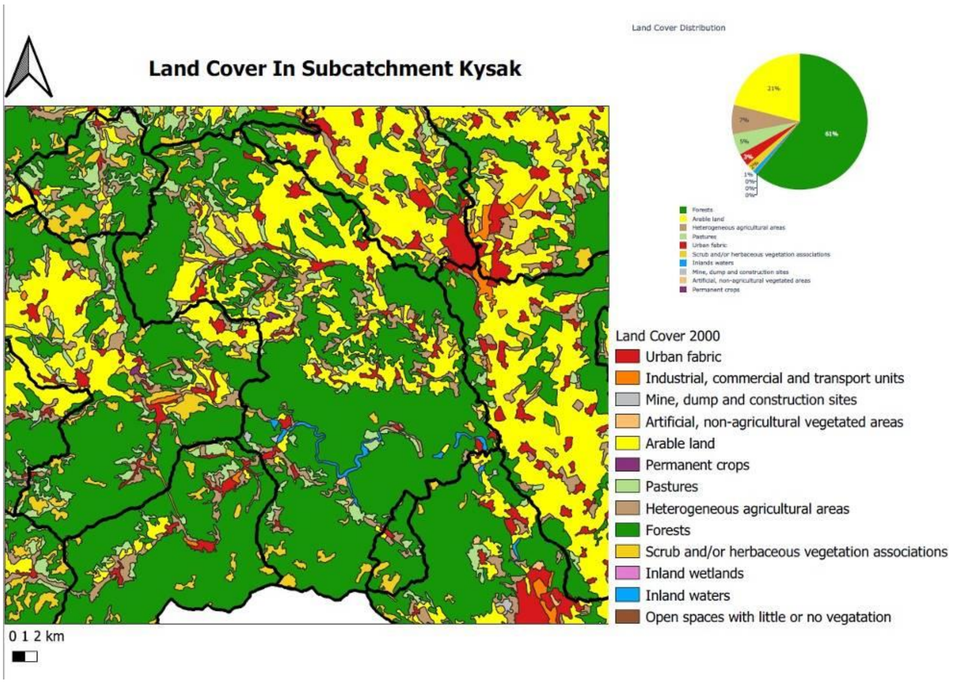

Fig. 2: Land Cover in Subcatchment Kysak 2000

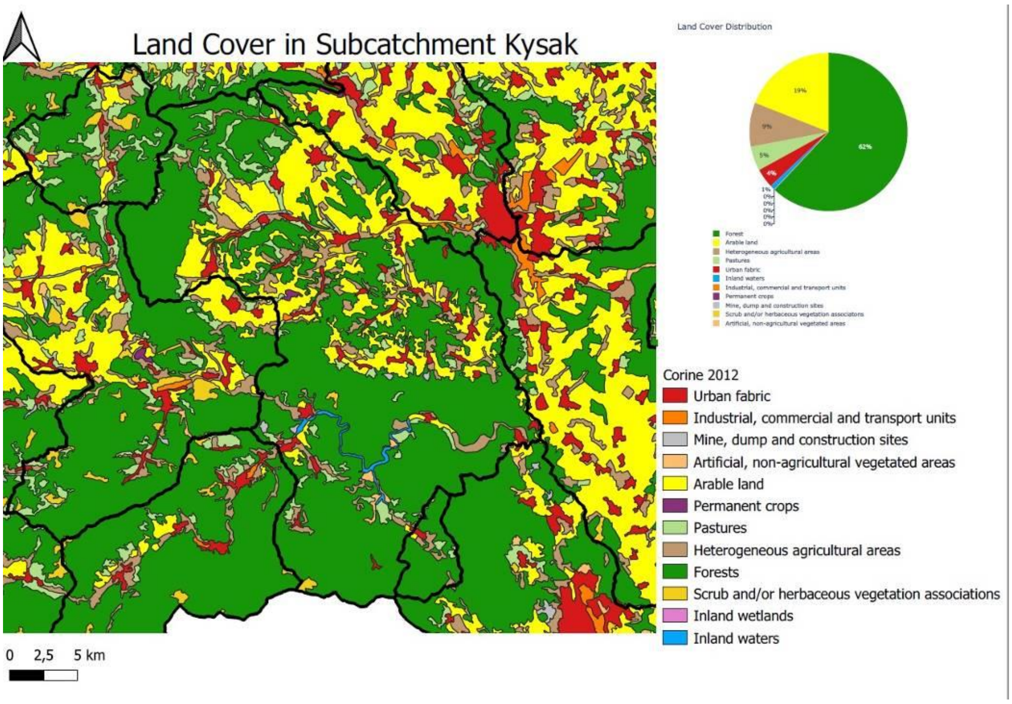

Fig. 3: Land Cover in Subcatchment Kysak 2012

Tab. 1: Summary of land use over the years 1990,2000 and 2012

Year Land Cover	**1990 [%]**	**2000 [%]**	**2012 [%]**
Forest	56,3	61	62
Arable land	20,2	21	19
Heterogeneous agriculture area	10,1	7	9
Pastures	6,43	5	5
Urban fabric	3,15	3	4
Scrub and/or herbaceous vegetation associations	2.31	2	0
Inlands waters	0,57	1	1

Discussion

By changing land use, we can mitigate climate change, for example by increasing the forest areas and parks suitable for recreation. Parks can be part of a climate solution. Parks reduce harmful carbon pollution, reduce the temperature of the area, the area does not overheat, retain water in the country, protect people and infrastructure, and can be used for recreation. The Ružín reservoir is located in the Kysak sub-basin, which is used for recreational purposes but also for industry as a water reservoir and electricity generation. Water is crucial for many recreational activities from boating and fishing to mountain biking and hiking.

Conclusion

The impact of climate change on natural resources is everywhere, specifically on recreational resources (Junáková et al., 2020). The demand for recreation depends on the climate, the increase in air temperature and longer summers should increase the demand for recreation in nature, from hiking, fishing and camping to simple visits to the beach by the water. The Kysak sub-basins can be used for these activities because the area has the potential for recreation in nature and land use indicates this.

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Souhrn
Změna klimatu a využívání půdy ovlivňují hydrologický cyklus a vodní zdroje a rekreační možnosti. Studovaná oblast se nachází na východním Slovensku v povodí řeky Hornád. Využití půdy v referenčních letech 1990, 2000 a 2012 bylo posouzeno pomocí CORINE Land Cover. Posuzované území je vhodné pro rekreační účely, protože má vhodnou turisticky atraktivní polohu.

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ANALYSIS OF ENVIRONMENTAL PROJECTS AND GREEN SPACES IN URBAN CENTERS OF ROMANIA. CASE STUDY: SOUTH MUNTENIA DEVELOPMENT REGION

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Abstract
Nature is an indispensable component of life, through the many benefits it offers, especially in the case of green spaces inside cities where the level of pollution is extremely high, and the desire to escape from everyday urban life is growing. The cities from South Muntenia development region of Romania are located in a plain unit, where there is a high need for afforestation to increase the level of green spaces according the European standards, which imposes the need to create environmental projects for the local authorities. In order to carry out the study, the sustainable development strategies of the main urban centers within the South Muntenia region were analyzed. The main objective is to analyze the purpose of projects related to green spaces and environment, which are the main sources of project financing, but also if they are related to leisure or increasing the quality of life in those areas. The central goal of the study is to raise awareness of the need to maintain a balance between urbanization and green spaces inside cities, but also around it, all for a high quality of life and for the development of the relationship between people and nature in urban areas.

Key words: pollution, nature, sustainability, ecology, renewable energy

Introduction
Sustainable development projects are extremely important for creating optimal climates, whether it is economic, social, cultural or natural environment, to maintain a balance necessary for the beneficial evolution of urban centers or the entire county. It is important to note that sustainable development strategies are documents that set strategic objectives, sources of funding for projects, implementation period, and optionally the costs or benefits of projects. For the balanced development of an urban center or a county, the main existing dysfunctions must be identified, by consulting the local population, which can highlight the main directions for which funds or projects should be redirected later, mainly for a period of at least 5 years. To carry out the study, two counties were chosen from the territory of the South-Muntenia Development Region, which is composed of the counties of Arges, Calarasi, Dambovita, Giurgiu, Ialomita, Prahova and Teleorman. In order to make a balanced parallel, two counties were chosen that have a geographical position and an approximately similar budget, for which the Danube River is extremely representative in everyday life, namely Giurgiu and Calarasi counties. Giurgiu and Calarasi counties are recognized for their annual agricultural production capacity and intense port activities, especially on the Bulgaria - Romania route, in the vicinity of the Bulgarian cities of Ruse or Silistra. The development of the counties was achieved permanently under the sphere of influence of the Municipality of Bucharest, through the desire of the local businesses to sell their products on the markets of the Romanian capital. (Allard-Poesi et al., 2022; Ducman et al., 2021; Teodorescu et al., 2021; Toxopeus & Polzin, 2021)

Material and methods
The research was conducted by analyzing and collecting data from the Sustainable Development Strategies of Giurgiu and Calarasi counties, where the central objective was to analyze all projects related to environmental quality, including green space management, waste management, biodiversity conservation and endangered species. but also projects related to environmental awareness or greening campaigns. The analyzed sustainable development strategies are still in progress, with project implementation deadlines between 2021 and 2027, which allowed a balanced comparison of the two official documents. The centralization of the data was done through the Microsoft Office bundle, especially Microsoft Excel, as well as the creation of graphics. The inkScape 0.91 software was used to create the location map of Calarasi and Giurgiu counties on a national and regional level.

Fig. 1: Localization map of Giurgiu and Calarasi counties (at regional and national level)

Results and Discussions

A first surprising aspect is that Giurgiu County pays the most attention to awareness campaigns on the need to address a more environmentally friendly attitude, where we identify five projects, including three cross-border, which are carried out with the local administration of Ruse, Bulgaria. The Danube River is an important factor in the development of Giurgiu County, which is why the projects related to biodiversity in the Danube Meadow are extremely important for the county administration, where three cross-border projects were proposed, carried out with the same Bulgarian city, mentioned above. The three projects related to green spaces propose the development of parks on the territory of Giurgiu Municipality, but also the creation of new green spaces on the territory of the county seat, while the waste collection projects aim at creating a waste collection center, in terms of recycling, in Giurgiu Municipality, which will serve the entire county, but also for the purchase of special vehicles for waste collection. The Giurgiu County Administration proposes an afforestation project, where the citizens will be involved, but also a project for the recovery of some previously unused lands, for recreational purposes. (Figure 2)

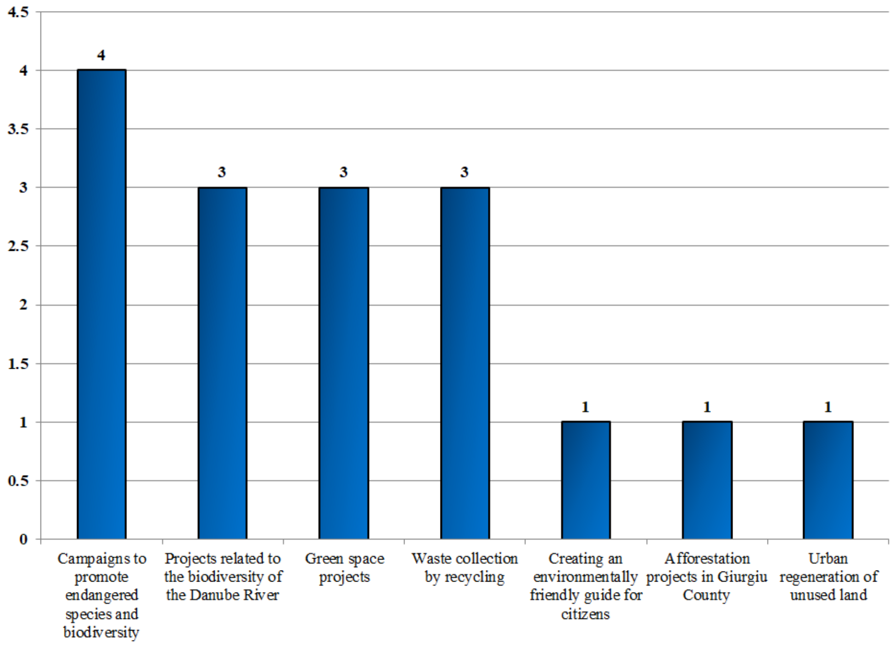

Fig. 2: The main typologies of environmental projects in Giurgiu County (2021 - 2027)
Source of data: Giurgiu County Sustainable Development Strategy (2021 - 2027)

Calarasi County proposes most projects in the field of combating pollution, especially for monitoring water pollution in the county, by the presence of the Danube branches in a large area, with a total of three projects, mainly carried out in public-private partnership or in partnership with the Inspectorate for Emergency Situations. The sectioning of the Danube into two arms, on the territory of Calarasi County, produces the need for permanent cleaning of the two watercourses, which are extremely important for agriculture, fishing, but also for daily life in rural areas in Calarasi County, which imposed the implementation of two projects for this field. Calarasi County also proposes increased attention for renewable energy projects, which could not be identified in the Sustainable Development Strategy of Giurgiu County. The projects related to renewable energies aim at supplying public institutions with eco-friendly electricity, the establishment of a park of photovoltaic panels on the territory of Calarasi County, but also awareness campaigns on the need to embrace solar or wind energy. Mosquito control is an important issue for the ecosystem in Calarasi County, which is why a long-term mosquito control project has been submitted. At the same time, in the Sustainable Development Strategy of Calarasi County (2021 - 2027) we identify a project of green spaces (maintenance of existing parks in large cities in Calarasi County), projects to protect endangered species, but also projects of urban regeneration. (Figure 3)

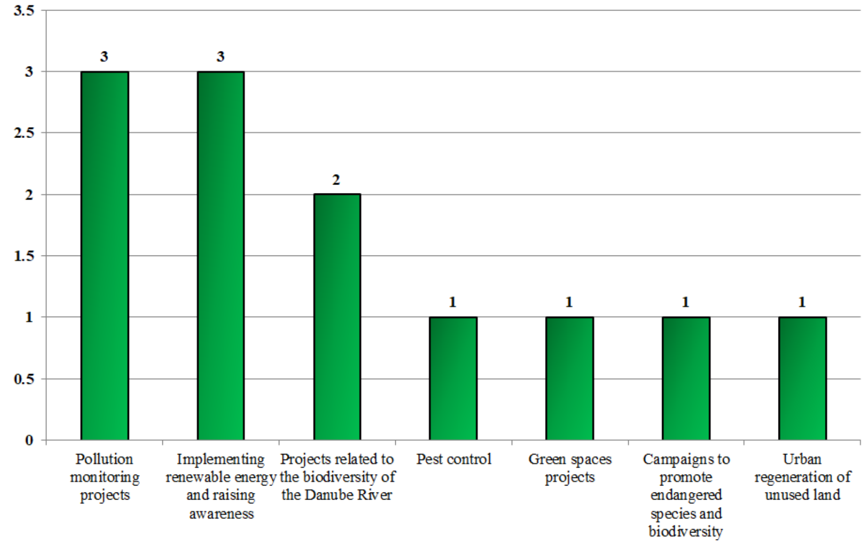

Fig. 3: The main typologies of environmental projects in Calarasi County (2021 - 2027)
Source of data: Calarasi County Sustainable Development Strategy (2021 - 2027)

The main sources of financing for environmental and green space projects in Giurgiu County is the local budget, which is provided by the local autority of Giurgiu Municipality, as the large number of projects serving the city of Giurgiu are supported from their own budgets. Cross-border projects are extremely useful because they are cost-effective, supported by both cities, namely Giurgiu, Romania and Ruse, Bulgaria, which guarantees a much easier implementation and a much faster working time, by combining the forces of both urban centers. 37.5% of environmental and green space projects in Giurgiu County are supported by the partnership with the Bulgarian city of Ruse, while 6.25% of projects are supported by the local administration, together with a number of NGOs or foundations with activity in the field of environmental protection or waste management. (Figure 4)

The local budget of the Calarasi County Council is the main source of financing for environmental and green spaces projects, as most of the promoted projects are carried out on the territory of Calarasi Municipality, but also along the Borcea and Danube watercourses, totaling 66.6% of projects . The three projects carried out by the Calarasi County Council and the Inspectorate for Emergency Situations represent 25% of the total projects submitted and are generally aimed at awareness campaigns on the need to protect the environment. 8.4% of projects are carried out through public-private partnerships. (Figure 5)

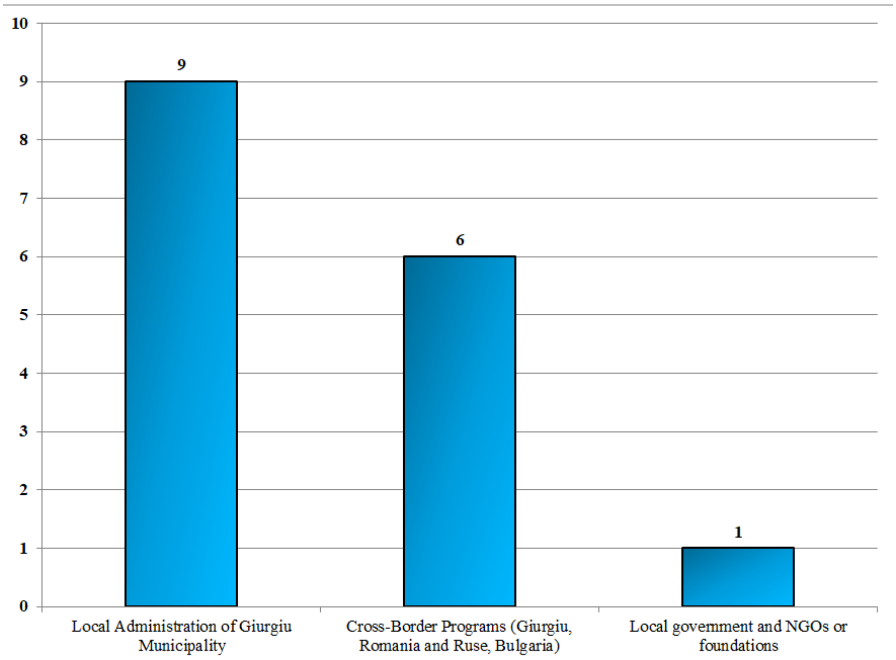

Fig. 4: Sources of financing for environmental and green spaces projects in Giurgiu County (2021 - 2027)
Source of data: Giurgiu County Sustainable Development Strategy (2021 - 2027)

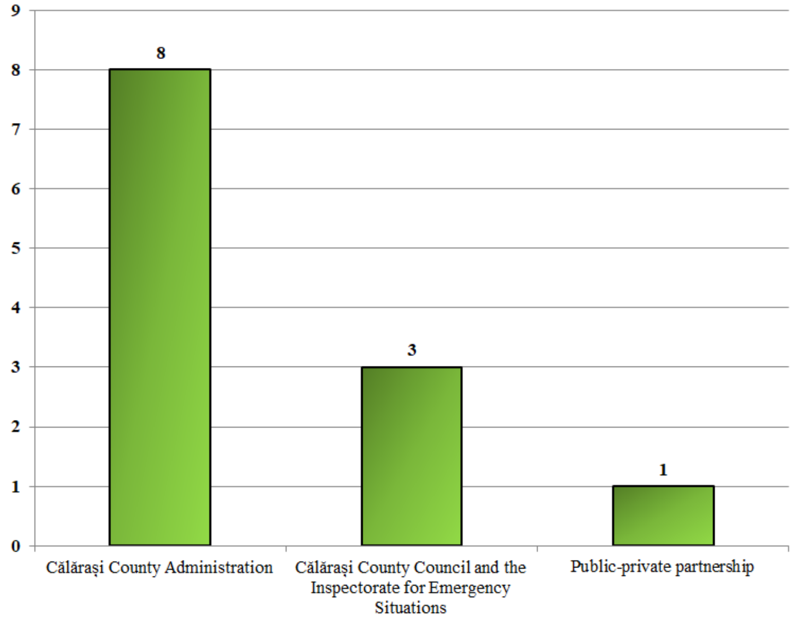

Fig. 5: Sources of financing for environmental and green spaces projects in Calarasi County (2021 - 2027)
Source of data: Calarasi County Sustainable Development Strategy (2021 - 2027)

Conclusion
The research managed to identify which are the main directions of evolution of the environment and green spaces projects, but also which are the common elements or the differences between Giurgiu County and Calarasi County. The common points between the two counties are the interest for biodiversity and the proper use of the Danube River on their territory, through projects aimed at cleaning the river banks or protecting biodiversity in the area, but also the desire of the two counties to raise awareness of the need to protect the environment, especially among young people. The large number of partnerships with NGOs, foundations or public institutions are common to both analyzed counties. An important difference between the two counties is the special attention that Calarasi County pays to the implementation of renewable energy in the public sector, but also for the creation of a photovoltaic park on its territory, which could be a viable solution for Giurgiu County. At the same

time, Giurgiu County scores through a large number of projects that promote waste recycling and waste management. The research met all the established objectives and managed to produce an objective comparison between two counties located in the South-Muntenia development region, which have many economic, geographical or social similarities.

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Souhrn

Příroda je nepostradatelnou součástí života díky mnoha výhodám, které nabízí, zejména v případě zelených ploch uvnitř měst, kde je míra znečištění extrémně vysoká a kde roste touha uniknout z každodenního městského života. Města z rozvojového regionu Jižní Muntenie v Rumunsku se nacházejí v rovinatém celku, kde je vysoká potřeba zalesnění, aby se zvýšila úroveň zelených ploch podle evropských norem, což ukládá místním orgánům vytvářet ekologické projekty. Za účelem provedení studie byly analyzovány strategie udržitelného rozvoje hlavních městských center v regionu Jižní Muntenie. Hlavním cílem je analyzovat účel projektů souvisejících se zelení a životním prostředím, které jsou hlavním zdrojem financování projektů, ale také to, zda souvisejí s volným časem nebo zvyšováním kvality života v těchto oblastech. Hlavním cílem studie je zvýšit povědomí o potřebě udržovat rovnováhu mezi urbanizací a zelenými plochami uvnitř měst, ale i v jejich okolí, to vše pro vysokou kvalitu života a pro rozvoj vztahu mezi lidmi a přírodou v městských oblastech.

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ANALYSIS OF HYDROLOGICAL DROUGHT FOR SELECTION OF RECREATION PLACES AT EASTERN SLOVAKIA

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Abstract
Hydrological drought is an isolated natural phenomenon whose severity may be intolerable for environment. Drought influence also possibilities for tourism and recreation. Tourists prefer places with water for recreation. Understanding drought past manifestations allows us to better understand its frequency and the extent of its influence on the territory. For this purpose, the current article presents Standardized Stream flow Index (SSI) computed in 12 months time scales for classification of hydrological drought episodes during the period from 1972 to 2014 in 7 water meter stations localized in the Eastern part of Slovakia. A one-dimensional frequency analysis of hydrological drought was performed in order to determine the historical extreme episode of drought and average inter-arrival time of next one episode. The results show that the occurrence of drought extreme episodes will be more frequent in the Bodva sub-catchment. In the Dunajec and Poprad sub-catchment, extreme droughts can be expexted rarely. The most serious decade can be considered the period from 1982 to 1992, where in almost every monitored station a hydrological drought was recorded, the exception was only at the Bardejov station.

Key words: Hydrological drought analysis, Standardized Stream flow Index, extreme episode, inter-arrival time, Eastern Slovakia

Introduction
Drought and floods are the most extreme hydrological risks (Zeleňáková et al, 2015, Zeleňáková and Junáková, 2018) Drought is a recurrent extreme climate event that affects large number of sectors of human activity as well as can severely affect ecosystems (Madadgar et al., 2011). Hydrological drought is defined as a long-term decrease in surface water levels and a decrease in groundwater levels (Mishra and Singh, 2010). The following two indices are currently used to identify and quantify the severity of the hydrological drought: Stream flow Drought Index (Nalbantis, 2008) and Standardized Runoff Index (Shukla and Wood, 2008). The Streamflow drought index SDI was developed by Nalbantis (2008) for the detection of onset of hydrological drought. This index was investigated in deep by Vincente-Serrano et al. (2012). They presented a mathematical approach for its standardization in time and space and called this index as Standardized Streamflow Index (SSI).
The index of drought is indispensable method for monitoring dynamics of drought and defining its characteristics including duration, severity, intensity and inter-arrival time (Mishra et al. 2010). The SSI method has recently attained popularity in the analysis of hydrological drought as evidenced by a number of researchers (e.g. Madadgar et al. (2011), Vincente-Serrano et al. (2012), Telesca et al. (2012), Solakova et al. (2013), Huang et al. (2017), Nagy et al. (2020) and Shamshirband et al. (2020), Abdelkader et al. (2022)). Risk of drought by the SSI can be classified into five categories, which have important role in drought management.

Tab. 1: Classification of hydrological drought using SSI (Nalbantis, 2008).

SSI intervals	SSI classes	Probability events
$SSI \geq 0$	Non-drought	50%
$-1 \leq SSI < 0$	Mild drought	34,1%
$-1{,}5 \leq SSI < -1$	Moderate drought	9,2%
$-2 \leq SSI < -1{,}5$	Severe drought	4,4%
$SSI < -2$	Extreme drought	2,3%

The occurrence of hydrological drought can lead to a decrease in water supply, deterioration in water quality, disruption of aquatic habitats, bar land, reduction of hydropower production and other impacts on economic and social activities in catchment (Mishra and Singh, 2010). Therefore, river basin drought management plans are used to minimize the aforementioned negative impacts in the river basin. Drought management plans include measures that are necessary in times of drought to reduce the vulnerability of the territory to this phenomenon.
In this study, the SSI in 12 – month time scales is used to identify serious lack of stream flow volumes, as well as to assess the vulnerability of the eastern part of Slovakia to this phenomenon. The index is calculated by parametric approach during the years 1972 – 2014 in 7 water meter stations and exact sequence of steps is explained in the following subchapter.

Materials and methods
The case study considers seven water meter stations in the Eastern part of Slovakia (see Fig. 1 and Tab. 2) relatively to the period (1972-2014). Values of average daily flows are provided by Slovak Hydrometeorological Institute of Košice, but only in one station Ižkovce we have shorter time scale of stream flow from (1975-2014).

Tab. 2: Geographical coordinates of analyzed water meter stations

Station	Longitude	Latitude	Average daily flow during the years 1972-2014
Bardejov	49°18'56"N	21°12'44"E	3,03
Červený Kláštor	48°45'20"N	21°55'19"E	30,57
Humenné	48°55'60"N	22°55'00"E	13,36
Ižkovce	48°33'22"N	21°57'11"E	52,27
Medzev	48°42'00"N	20°53'30"E	0,72
Svidník	49°13'19"N	21°38'13"E	1,69
Ždiar	49°16'18"N	20°15'44"E	1,87

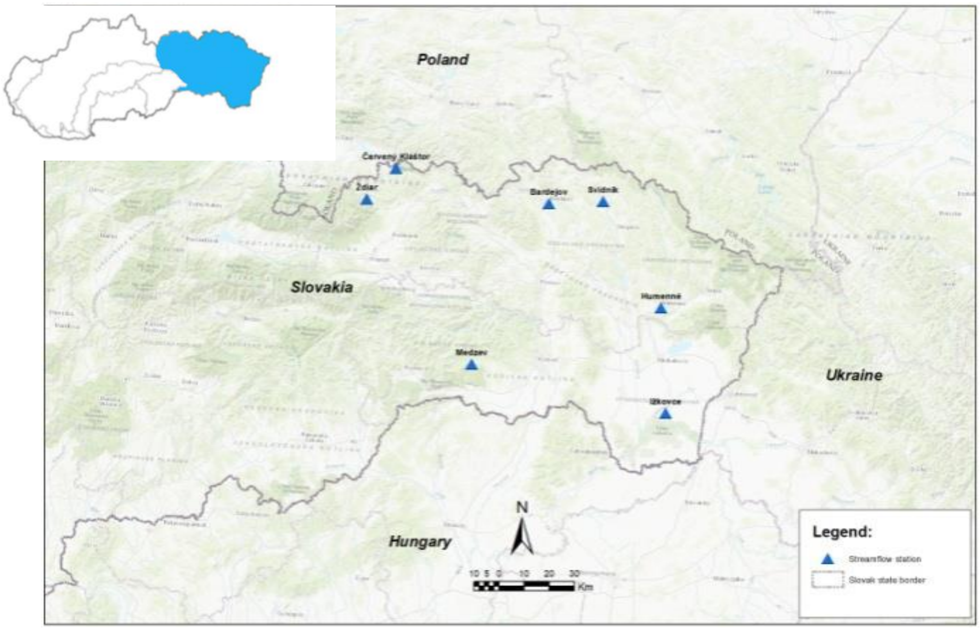


Fig. 1: Locations of water meter stations in Eastern Slovakia

The overall calculation procedure consists from six steps. First, preparation of statistical files, monthly stream flow in the period were aggregated in a 12-month moving window, for example, the value in May 2001 is generated by the streamflow from June 2000 to May 2001 and divided by the number of months. The calculated average values of streamflow over a 12-month time-interval are a statistical set. Second, determination a probability density function f(x) capable of describing the streamflow volumes in 12-month time scales and estimation of its parameters by maximum likelihood method (Kottegoda and Rosso, 1997). The selection of the most appropriate theoretical probability density function f(x) from 8 probabilities density function for each month separately (see Table 2) used Kolmogorov-Smirnov test at significant level $\alpha = 5\%$. The theoretical probability function that has the smallest distances with respect to the empirical probability function is selected. Third, calculation of the cumulative probability functions F(x) for each month separately. In Table 3, the math formulae of the selected cumulative probability functions F(x) are presented. Fourth, transforming the cumulative probability function F(x) into a standard normal distribution with random variable SSI:

$$SSI = \Phi^{-1}(F(x)) \tag{1}$$

Fifth, checking that SSI values do indeed have a normal distribution by Wu et al. (2007) who stated 3 criteria: i) Shapiro-Wilk statistic: W less than 0,96; ii) p-value less than 0,1 and iii) absolute value of median greater than 0,05. Sixth, detection of the beginning of historical extreme drought episodes during the period from 1972 to 2014 by RUN method (Yevjevich 1967) and estimating the average inter-arrival time of drought. As threshold level of drought we use SSI=–2 to capture the onset of the extreme drought episode. Thus duration of a drought, D_d, is a period during which SSI values are less than -2. The severity of a drought, S_d, is a summation of SSI index in drought condition. The inter-arrival time T_d is a time between two successive episodes of drought (Madadgar et al. 2011).

Tab. 3: Chosen cumulative distribution function

Probability density function	**Cumulative distribution function**
Gen. Extreme Value	$F_{(x)} = \exp(-(1+\mathrm{kz})^{-\frac{1}{\mathrm{k}}})$ $z = \frac{x-\mu}{\sigma}$
Weibull 3P	$F_{(x)} = 1 - \exp(-(\frac{x-\gamma}{\beta})^{\alpha})$
Gamma 3P	$F_{(x)} = \frac{\Gamma_{\frac{(x-\gamma)}{\beta}}(\alpha)}{\Gamma(\alpha)}$
Gen. Gamma	$F_{(x)} = \frac{\Gamma_{\left(\frac{x}{\beta}\right)^{k}}(\alpha)}{\Gamma(\alpha)}$
Burr	$F_{(x)} = 1 - (1 + (\frac{x}{\beta})^{\alpha})^{-\mathrm{k}}$
Lognormal 3P	$F_{(x)} = \Phi(\frac{ln(x-\gamma)-\mu}{\sigma})$
Pearson 6	$F_{(x)} = \mathrm{I}_{x/(x+\beta)}(\alpha_1, \alpha_2)$
Normal	$\boldsymbol{F_{(x)}} = \Phi(\frac{(x-\mu)}{\sigma})$

Results and discussion

The assessed water meter stations belong to the sub-catchments of Dunajec and Poprad, Bodva, Bodrog with a total catchment area of 10 112.4 km^2, which forest represent 41,3%, agricultural land 49,15%, artificial areas 5,11%, wet areas 0,15%, water 0,55%. The aim of the work was to identify the average return period of extreme drought and to analyze the vulnerability of the territory by hydrological drought. The extreme hydrological episodes were identified by 12-month Standardized Streamflow Index. The result of the analysis is presented in a Table 4 and Figures 2 to 8.

Tab. 4: Extreme episodes of hydrological drought identified by SSI -12

Station	Number of drought episodes	Duration	Cumulative severity	Average Inter-arrival time
Bardejov	3	11	-24,59	192
Červený Kláštor	2	8	-21,67	308
Humenné	5	9	-21,17	83,5
Ižkovce	3	3	-6,26	113
Medzev	5	9	-20,04	68,5
Svidník	4	14	-33,86	126,7
Ždiar	6	6	-15,66	96,4

From Table 4, it is possible to see how the extreme hydrological drought often occurred during the years 1972-2014. An extreme stream flow deficit can be expected on average from 5,7 to 25,6 years. The Figures 2 to 8 give SSI values for 12-month timescales for each observed stations, in which the periods with the SSI-12 value was less than -2 are identified in red.

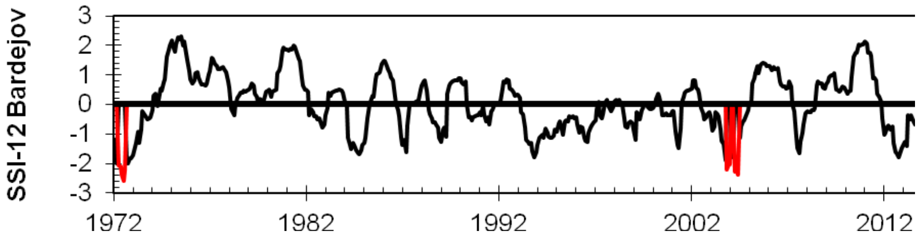


Fig. 2: SSI-12 at Bardejov gague station

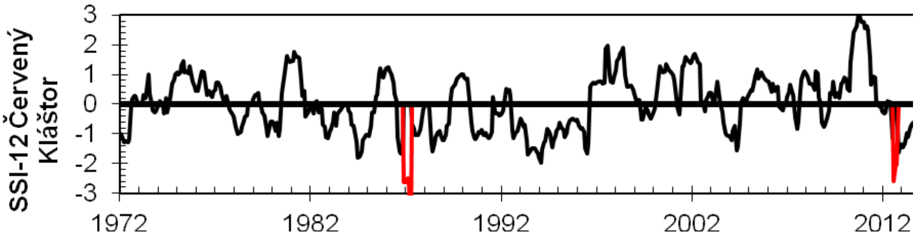


Fig. 3: SSI-12 at Červený Kláštor gague station

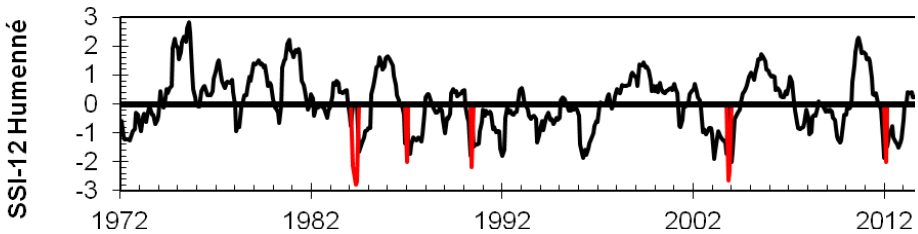


Fig. 4: SSI-12 at Humenné gague station

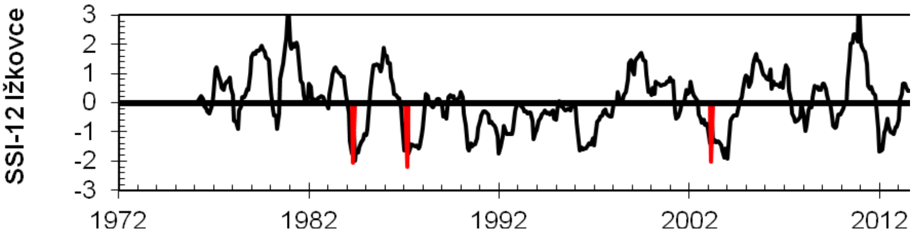


Fig. 5: SSI-12 at Ižkovce gague station

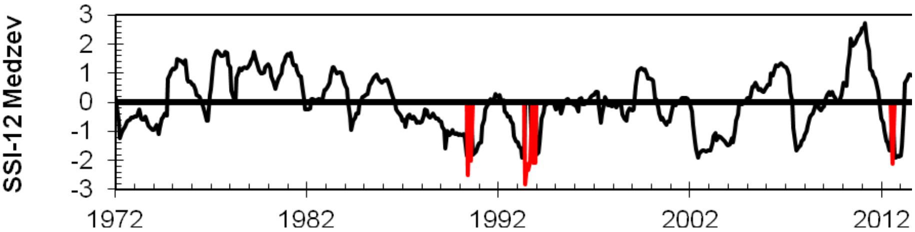


Fig. 6: SSI-12 at Medzev gague station

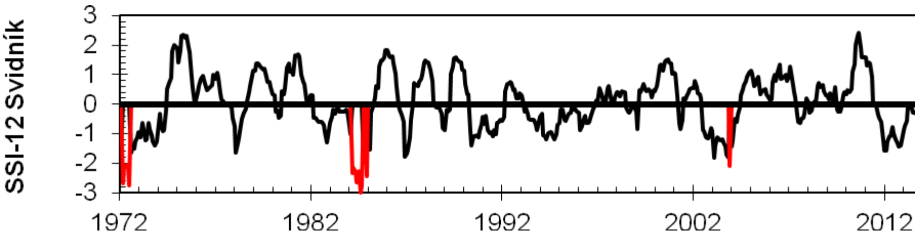


Figure 7 SSI-12 at Svidník gague station

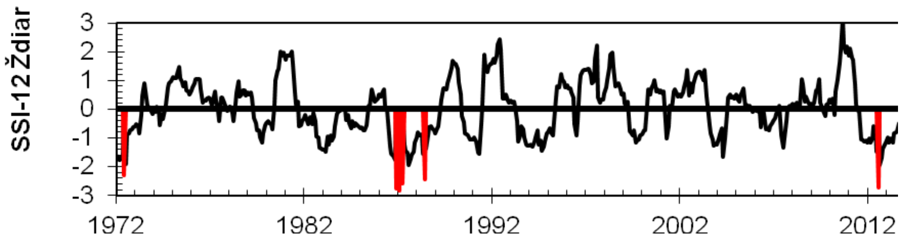


Fig. 8: SSI-12 at Ižkovce gague station

As seen in Figures 2 to 8, at the north of the Bodrog basin, in Bardejov gauge station, extreme events of the hydrological drought were recorded in 1972, 2002 and 2003 but at gauge Svidník station were recorded in 1984, 1985, 2003. At the Svidník station from March 1984 to September 1984, a drought with longest duration and with the largest cumulative severity was recorded. In the centre of the Bodrog basin, Humenné, there were five extreme hydrological events were recorded in 1984, 1987, 1990, 2003 and 2012. In the south of the Bodrog basin in Ižkovce in 1984, 1987 and 2003 can be considered the driest period. A more frequent occurrence of extreme drought events can be expected in Humenné. The average return time for drought in the Bodrog basin ranges from 83,5 to 192 months. Six extreme episodes of drought were detected in the Dunajec - Poprad basin, at the Ždiar water station during the period 1972-2014. The land around the water meter station Ždiar is more vulnerable to drought than in the station Červený Kláštor. The years 1972, 1986-1988 and 2012 represent the driest period in the catchment. The average return time for drought in the Dunajec - Poprad basin ranges from 96,4 to 308 months. The Bodva basin, which is represented by the Medzev station, has an average drought return time of 68,5 months. In the Bodva basin, the driest years include 1990, 1993, 1994 and 2012.

Calculated SSI-12 values at selected water meter stations can be considered as representative areas with attributes. For the spatial interpretation of the results, we used the Splain function in the ArcGIS program, which will ensure the analysis of the local geometry of the surface and its visibility. An illustrative example of the spatial analysis of hydrological drought in 2011 is shown in cartographic form (see figs 9 to 11). The degree of drought risk is color-coded in the maps (Figures 9 to 11), so there is no drought risk (purple, blue, light blue color) and mild drought risk (green color), moderate drought risk (yellow color), severe drought risk (orange color) and extreme drought risk (red color).

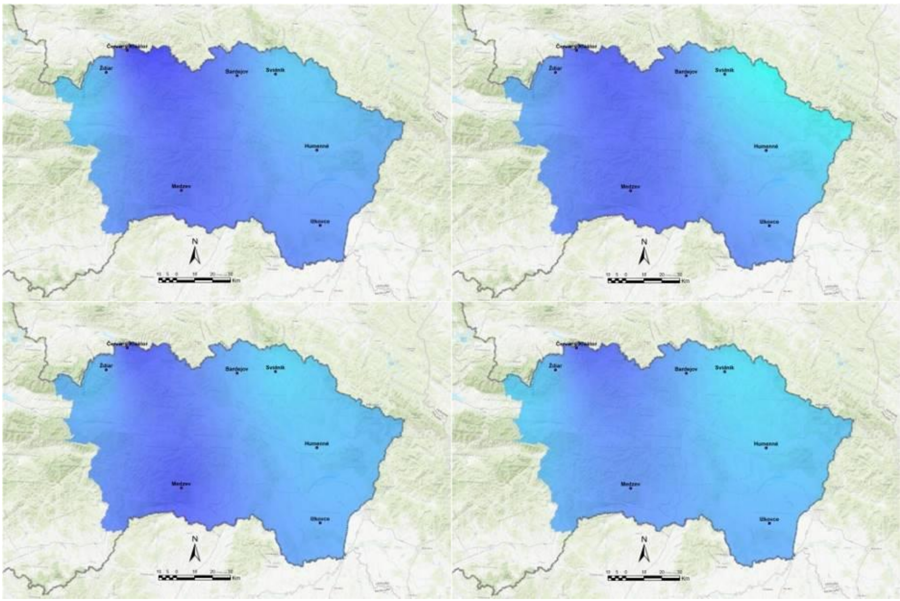


Fig. 9: Spatial distribution for the risk in the study area due to long-term hydrological drought in January, February, March and April 2011 using SSI-12

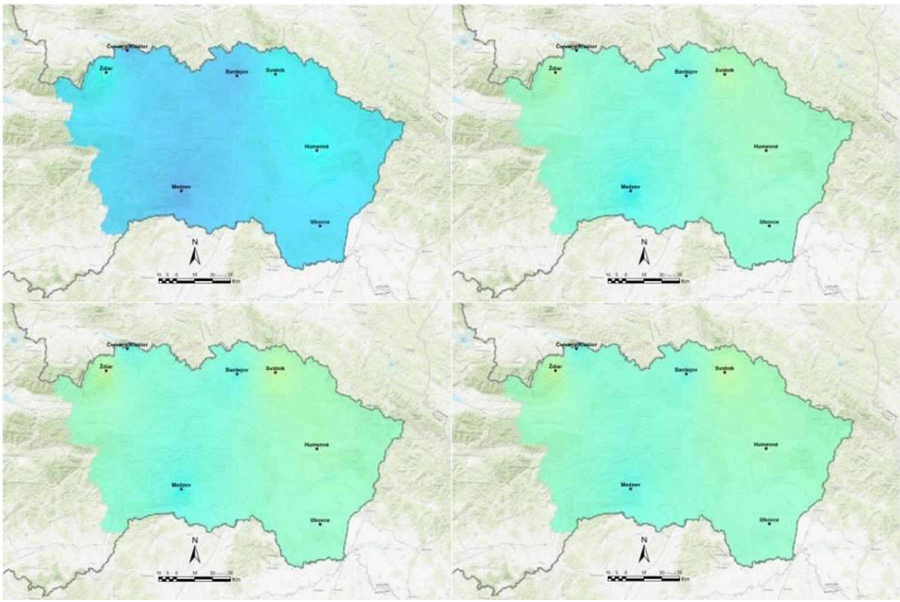
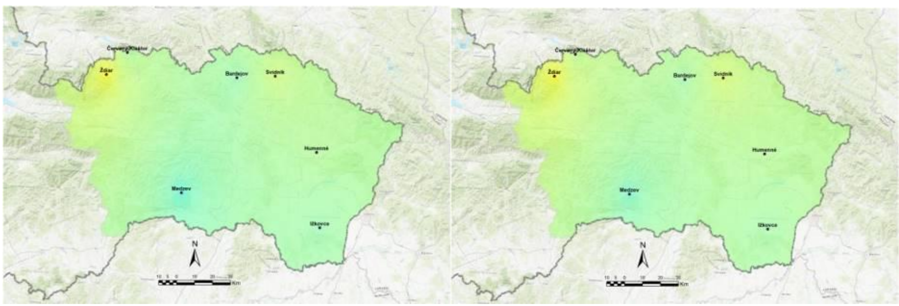


Fig. 10: Spatial distribution for the risk in the study area due to long-term hydrological drought in May, June, July and August 2011 using SSI-12



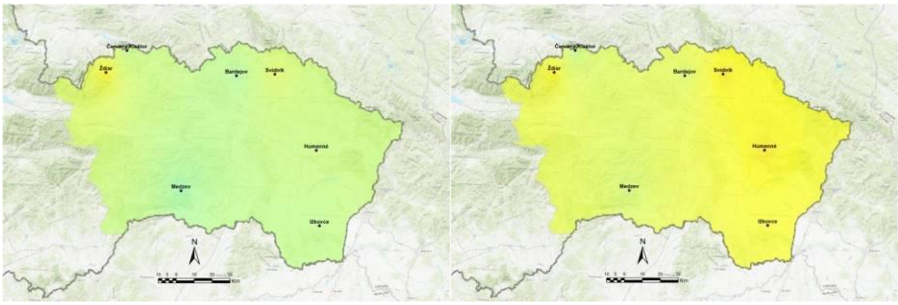


Fig. 11: Spatial distribution for the risk in the study area due to long-term hydrological drought in September, October, November and December 2011 using SSI-12

In 2011, the deficit of flows was recorded mainly in the autumn months and in December. In this year, the extréme hydrological drought did not occur at all.

Conclusion

Hydrological droughts are random natural phenomena with an increasing tendency depending on climate change. This phenomena affect also recreation. Understanding its manifestations in time and space leads to proper drought risk planning and management. For this purpose, the SSI approach was utilized to asses the extreme historical hydrological drought episodes during the years from 1972 to 2014 in Bodrog, Bodva, Dunajec and Poprad sub-catchment. Fifteen events of hydrological drought with a total cumulated severity of -85,88 were recorded in the Bodrog basin. Five extreme episodes of hydrological drought were detected in the Bodva basin with a total cumulated severity of -20,04. In the Dunajec and poprad basin, extreme hydrological drought were detected eight time with a total cumulated severity of -37,33. The most voulnerable area of the hydrological drought is the Bodva basin, where this phenomenon is expexted to occur more often. The benefits from the SSI analysis, it can be used to identify the degree of drought vulnerability. The results achieved can be the basis for the development of a drought management plan, which deals with prevention, protection and readiness for a drought risk in the catchment. From the presented analysis the south Slovakia seems to be more suitable for recreation (Junáková et al, 2020) as it is less vulnarable to drought.

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Acknowledgement

This work was supported by the Slovak Research and Development Agency under the Contract no. SK-PT-18-0008 and SK-SRB-21-0052 and a project funded by the Ministry of Education of the Slovak Republic VEGA1/0308/20 Mitigation of hydrological hazards, floods, and droughts by exploring extreme hydroclimatic phenomena in river basins.

Souhrn

Hydrologické sucho je ojedinělý přírodní jev, jehož závažnost může být pro životní prostředí neúnosná. Sucho má také vliv na cestovní ruch a možnosti rekreace. Turisté se nejraději rekreují v místech s vodou. Poznání projevů sucha v minulosti nám umožňuje lépe pochopit jeho četnost a rozsah jeho dopadu na území. Za tímto účelem je v tomto článku prezentován standardizovaný index průtoku (SSI) vypočítaný na 12měsíční škále pro klasifikaci epizod hydrologického sucha v letech 1972-2014 na 7 vodoměrných stanicích nacházejících se ve východní části Slovenska. Byla provedena jednorozměrná analýza četnosti hydrologického sucha s cílem určit historickou epizodu extrémního sucha a průměrnou dobu mezi příchodem další epizody. Výsledky ukazují, že v dílčím povodí Bodvy se budou epizody extrémního sucha vyskytovat častěji. V dílčích povodích Dunaje a Popradu lze ojediněle očekávat extrémní sucha.

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ANALYSIS OF SPATIO-TEMPORAL VARIABILITY OF SOIL ERODIBILITY VALUES BY WATER EROSION

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Abstract

In current dynamic development of GIS and remote sensing methods, especially the use of accurate LiDAR data, there is a significant disproportion in the accuracy of morphological and soil data in the assessment of erosion. In current practice, the map of main soil units (MSU) is used to determine soil erodibility (expressed by K factor), which in many cases lead to a step change in values within one field or erosion closed unit (ECU). However, the soil properties included in the calculation of the K factor usually change smoothly in the direction of the slope, but also due to other morphometric characteristics. Terrain morphology should therefore be taken into account when determining the K factor values. The K factor values change dynamically both according to the terrain morphology within ECU and depending on climatic conditions that change during the year and within the geographical location in the Czech Republic (CR) and given physio-geographical conditions. In assessing the seasonal dynamics of K factor values, they appear to be key erosion rainfalls. By including this spatio-temporal variability of K factor values, it will be possible to significantly refine soil loss calculations and proposals for erosion control measures and retention elements and their intangible services for environment and increasing the landscape character and recreational potential of the site.

Key words: soil erodibility, K factor, erosion, USLE, cultural intangible services

Introduction

The Universal soil loss equation (USLE) (Wischmeier & Smith, 1978) is one of the most widely used methods for assessing soil loss by water erosion over the world. Analysis of soil loss and erosion risk is often the first step in the design and deployment of erosion control measures and retention elements in a monocultural agricultural landscape as part of land consolidation process. The essence of this equation is the relationship between rainfall erosivity, the ability of rain to cause soil loss, and soil erodibility, the ability of soil to withstand the effects of erosion factors - erosion rainfall. Refining the individual factors of this equation will also leads to achievement of a more effective proposal for the deployment of erosion control and retention elements in the landscape, as well as achieve more effective intangible benefits of these measures. The essence of this research is the correction of soil erodibility factor (K) values according to the characteristics of variables in space and time. These characteristics include, in particular, terrain morphology and geographical location within the CR and related changes in climatic and soil conditions during the year.

In today's dynamic development of GIS and remote sensing methods, especially the use of accurate LiDAR data, there is a significant disproportion in the accuracy of morphological and soil data in the assessment of erosion. Individual countries use national soil geodatabases to determine K-factor values based on correlation and regression analysis. For the conditions of the CR, this dependence with the main soil units (MSU) was determined by Vopravil et al. (2007), similar to Germany Schwertmann et al. (1989), in Hungary Pasztor et al. (2016), using the European LUCAS database (Toth et al. 2013) Panagos et al. (2014) etc. These methods in many cases leads to a step change in values within one field or ECU. However, the soil properties included in the calculation of the K factor usually change smoothly in the direction of the slope, but also due to other morphometric characteristics. Terrain morphology should therefore be taken into account when determining the K factor values. The use of interpolation methods made it possible to determine the K values in a fully distributed form on the basis of sampling and analysis of a network of soil samples (marked by GPS coordinates) within the land block or river basin. The application of these geostatistical interpolation methods Kriging or Cokriging (Goovaerts 2005, Bskan et al. 2010, etc.) enabled the inclusion of the influence of terrain morphology in the calculation as the so-called covariates.

In addition to the spatial variability of K factor values according to the morphology of the terrain within ECU, there is also variability according to geographical location, not only due to different soil properties, but also climatic conditions. Of these conditions, precipitation is key, especially the so-called erosion rainfall and the frequency of their occurrence in a given geographical location. Because these characteristics are consistent over time and months for long-term averages, can be used to correct K values for months or parts of the year and reduce errors in soil loss calculations.
From the above, it is important to emphasize that the aim of the research in this phase was to demonstrate the importance of spatiotemporal variability of K values depending on the terrain morphology and changes in climatic conditions during the year and depending on the geographical location in the CR. And subsequently the need to revise and update the methods for determining the erosion risk and proposals for designing of erosion control measures and retention elements in the landscape.

Materials and methods
For the needs of this research, 43 sampling sites were selected (Fig. 1). Soil sampling is performed from the surface layer up to 10 cm and each sampling point is marked with GPS coordinates. Soil samples are taken in the form of a point network of soil samples (type A main), focused on testing the influence of terrain morphology (spatial characteristics), and repeated sampling of mixed soil samples from the middle part of the slope at intervals of 1.5 month (sample type B), focused on time analysis characteristics - resp. changes in the K factor values during the year. In the laboratory, the samples are first air-dried, sieved to skeleton and fine earth and then subjected to grain size analysis using the densitometer method and humus content determination based on oxidometric determination of oxidizable carbon (Cox) content. Subsequently, using these soil properties data, the values of the K factor were calculated according to the equation by Wischmeier and Smith (1978), which was applied to the CR in the form according to Janeček et al. (2012) and is used in the CR in land use planning. The resulting K values were assigned GPS coordinates and were further processed as spatial data in the GIS environment. The K values were then interpolated using the geostatistical interpolation method Kriging and Cokriging (with covariates of relevant morphometric characteristics, which exhibited statistically significant correlations with given soil properties) into fully distributive rasters with a resolution of 5 m. The interpolation procedure setting were optimized - especially empirical semivariogram (ES) model.

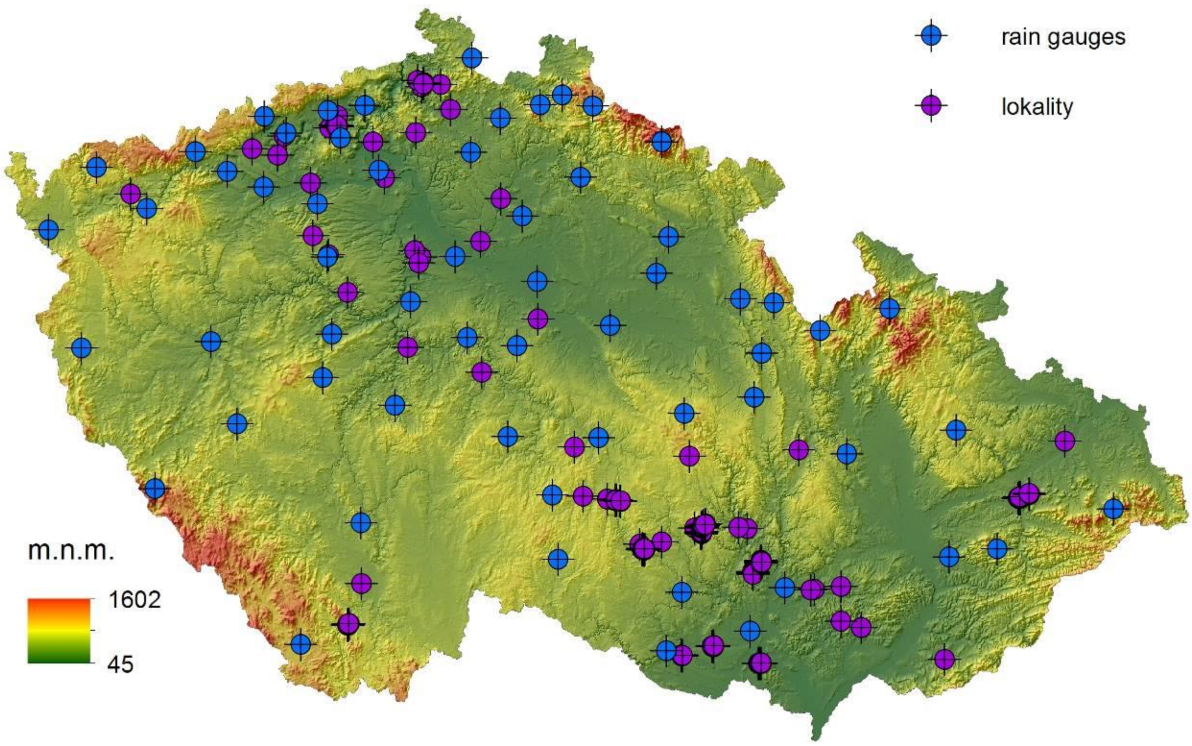

Fig. 1: Geographical location of sites of soil samples and rain gauges.

The RUSLE methodology (Renard et al. 1997) was used for evaluation of type B soil samples for the analysis of changes in the K values during the year depending in the CR conditions. For these purposes, it was necessary to process 10-min precipitation totals for 60 available weighted rain gauges stations for the period 2010 to 2020 and to determine the values of rainfall erosivity factor R (annual and monthly). The geographical location of the weather stations is shown in Fig.1. The calculation of the R factor values was performed with the kinetic energy equation according to Brown and Foster (1987) and the criterion for determining the precipitation intensity of 8.47 mm / 20 min and simultaneously minimum total of 12.5 mm. Furthermore, it was necessary to determine the values and periods of occurrence of the highest and lowest values of the K factor in various locations in the CR based on the analysis of soil samples of type B.

Results and discussion

Already in the original methodology, Wischmeier and Smith (1978) tried to express changes in the K factor values according to the distance from the beginning of the slope. However, current modern technical means and GIS tools in conjunction with highly accurate LiDAR data allow significantly more accurate differentiation of K factor values according to morphometric characteristics.

Soil samples were taken from soil blocks with an average size of 29.98 ha. The calculated K factor values based on the evaluated soil samples were subsequently interpolated using the geostatistical interpolation methods Kriging or Cokriging (Fig. 2), which were set and optimized according to the results of the cross-validation process. (Fig. 3). For these purposes, a geodatabase of 537 soil samples from 43 localities (Fig. 1) in various geographical locations of the CR was created. Using this geodatabase, the spatial variability within individual ECU of localities was verified (Fig. 2).

As mentioned above, K values change dynamically both according to the morphology of the terrain within ECU and depending on climatic conditions changing during the year and within the geographical location in the CR and given physical and geographical conditions. In assessing the seasonal dynamics of K values, they appear to be key erosion precipitation. This was proved by a number of authors who evaluated seasonal changes in the values of K factors depending on the course of values of rain erosivity during the year (Renard et al. 1997, Zanchi 1983). For these purposes, a geodatabase of meteodata was created, which includes 60 stations of weight rain gauges with a measured period of 2010 to 2020 and a geodatabase of soil samples of type B taken from 10 localities 6 times a year at intervals of 1.5 months.

The calculation of the R factor values was performed with the kinetic energy equation according to Brown and Foster (1987) and the criterion for determining the precipitation intensity of 8.47 mm / 20 min. Similar conditions were also used by Meusburger et al. (2012) or Schmidt et al. (2016).

The average K values from 10 localities from samples taken during the year are shown in Figure 4. The resulting values are average values within 30 daily intervals. The highest value K_{max} = 0.73 occurred in the term t_{max} = 23rd April and the lowest value of K_{min} = 0.1 occurred in the term t_{min} = 10th September.

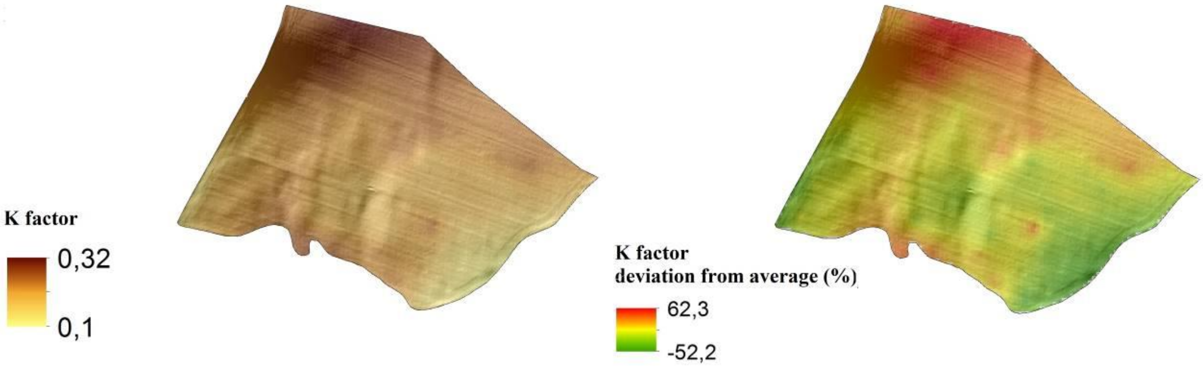

Fig. 2: Variability of soil erodibility.

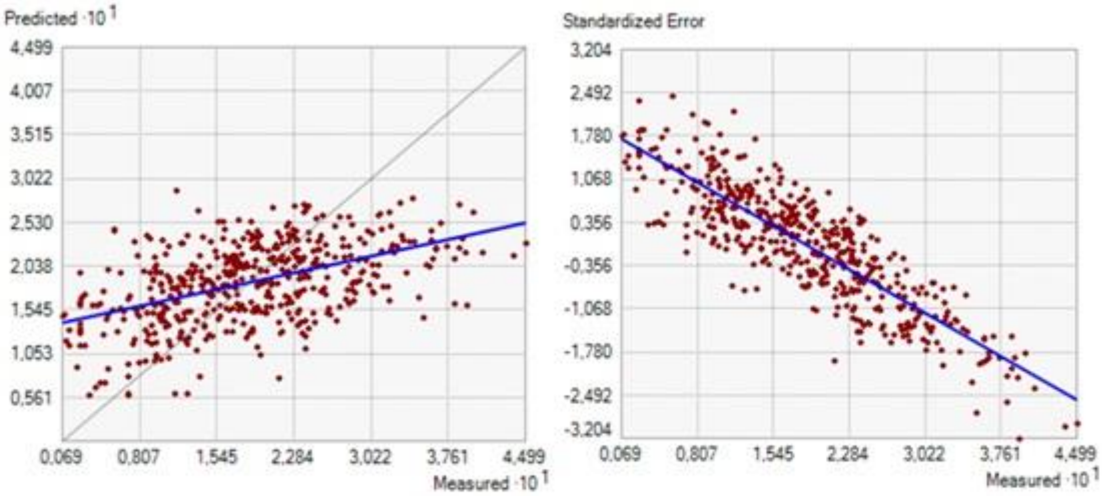

Fig. 3: Results of cross validation process.

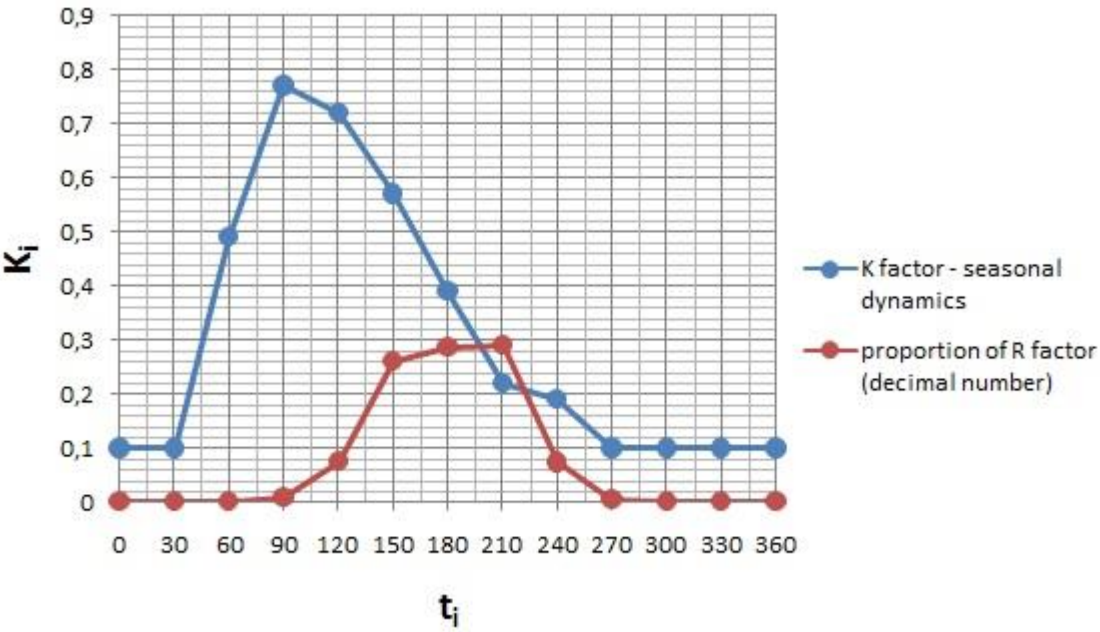

Fig. 4: The average K values and proportion of R values during the year.

Conclusion

The results of this research confirmed the significant spatiotemporal variability of soil erodibility depending on the terrain morphology and changes in climatic conditions during the year. The critical period occurs mainly in the period of combination of the occurrence of higher frequency of erosion rainfall (expressed by the R factor) and high values of soil erodibility (expressed by the K factor) as shown on Fig. 4. This variability must be implemented in current methodologies for determining the risk of water erosion using USLE. With the revised methodology will be achieved also more effective proposal for the deployment of erosion control and retention elements in the landscape, as well as more effective intangible benefits of these measures including improvement of the landscape character and recreational potential of the site with designed protection, retention and adaptation landscape elements.

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Souhrn
Výzkum byl zaměřen na prokázání významné časo-prostorové variability hodnot K faktoru v závislosti na morfologii terénu a změnách klimatických podmínek v průběhu roku v podmínkách ČR. Výsledky tuto variabilitu potvrzují a doporučujeme revize a aktualizace metod pro stanovení rizika eroze a návrhy dimenzování a umístění protierozních opatření a retenčních prvků v krajině.
Za kritické období lze označit zejména období kombinace výskytu vyšší četnosti erozních srážek (vyjádřeno faktorem R) a vysokými hodnotami erodovatelnosti půdy (vyjádřené faktorem K). Tato variabilita by měla být implementována v současných metodikách pro stanovení rizika eroze vody pomocí USLE. S revidovanou metodikou lze dosáhnout také efektivnějšího rozdělení finančních prostředků pro návrhy erozních opatření a retenčních prvků v krajině, i nehmotných užitků těchto opatření, včetně zlepšení krajinného rázu a rekreačního potenciálu místa s navrženými ochrannými, retenčními a adaptačními krajinnými prvky.

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ANALYSIS OF THE POTENTIAL OF SOLAR ENERGY IN THE COASTAL AREA. CASE STUDY: THE BLACK SEA COAST OF ROMANIA

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Abstract

Solar energy is one of the newest and friendliest ways to obtain energy, being a new way to fight against the increasing of pollution by everyday urban activities, but also against increasingly threatening climate change. Still in an early stage of development, solar energy is gaining ground for the public energy sector, not just for private businesses or private homes, which translates into an increasing number of photovoltaic panels in the areas where solar radiation has high values, and solar energy has the potential to be an supplement for the energy circuit of urban centers or even a substitute. In the area of the Romanian coast, the solar radiation is extremely high, which translates into a huge solar potential, but also through a high degree of success for the implementation projects of this type of energy. The central objective of the study is to identify the potential of solar energy and opinions from locals about a landscape filled with photovoltaic pannels, while the central goal of the study is to raise awareness of the need to promote renewable energy and and to embrace the beauty of the sustainable development of renewable energy, regardless of the impact on the landscape.

Key words: pollution, nature, sustainability, ecology, renewable energy

Introduction

Promoting renewable energy is one of the keys to success for a more sustainable future, where pollution from burning fossil fuels for energy is extremely limited, which would facilitate the creation of more consistent and eco-friendly sustainable development strategies. Through the ability of renewable energy not to run out and not to pollute, its popularity is growing in direct proportion to researchers' concern about current climate change, where man is putting extremely high pressure on the natural environment, which is becoming more and more prone to irreversible changes. since nature is indispensable to human life. The popularity of solar energy can be seen not only at the macro level, but also at the level of individual households of people in regions where the amount of solar energy is high enough to be able to self-sustain electricity in a home. One of the most important advantages of solar energy is the possibility of supplementing the traditional electricity circuit, whether it is municipal structures or individual households, and the capacity of votovoltaic panels can be constantly increased. Romania is an extremely tender country for the development and implementation of solar energy projects, through a high amount of solar radiation during the year in the southern and south-eastern regions, as is the case with the Black Sea coastline. The Black Sea coast benefits from a significant number of clear days during the year, especially in the summer season, and the support of seasonal households, which are not used outside the summer season, could be achieved with renewable energy sources, especially wind energy or solar. Awareness and understanding of the concept of sustainability in local or national strategies need to be known, and current trends are to embrace the forms of renewable energy for the territory analyzed, for the reliability of photovoltaic panels and for low maintenance and installation costs, which are accompanied by a series of important benefits, especially financial ones. (Ducman et al., 2021; Ducman et al., 2021; Dumitrascu et al., 2021; Mocanu et al., 2019)

Material and methods

The data needed to conduct the study were collected from an online statistics platform, namely the Global Solar Atlas platform, where all data on solar energy are centralized at the local level, and the sustainability of solar energy can be easily viewed. Also, the research proposes to visualize the data in four distinct ways, namely:

1) The energy obtained by photovoltaic panels installed in an individual household on the territory of Constanta Municipality, with a total capacity of 1kWh, for 12 PM.

2) Energy obtained by photovoltaic panels installed for industrial use, with a solar installation capacity of 100 kWh, for 12 PM.

3) The energy obtained by the photovoltaic panels on the ground, where the land is exclusively intended for obtaining solar energy, and the distances between the photovoltaic panels are small, with a total capacity of 1000 kWh, for 12 PM.
4) Energy obtained by floating panels that could be installed directly on the aquatic surface of the Black Sea, with a total solar capacity of 1000 kWh, for 12 PM.

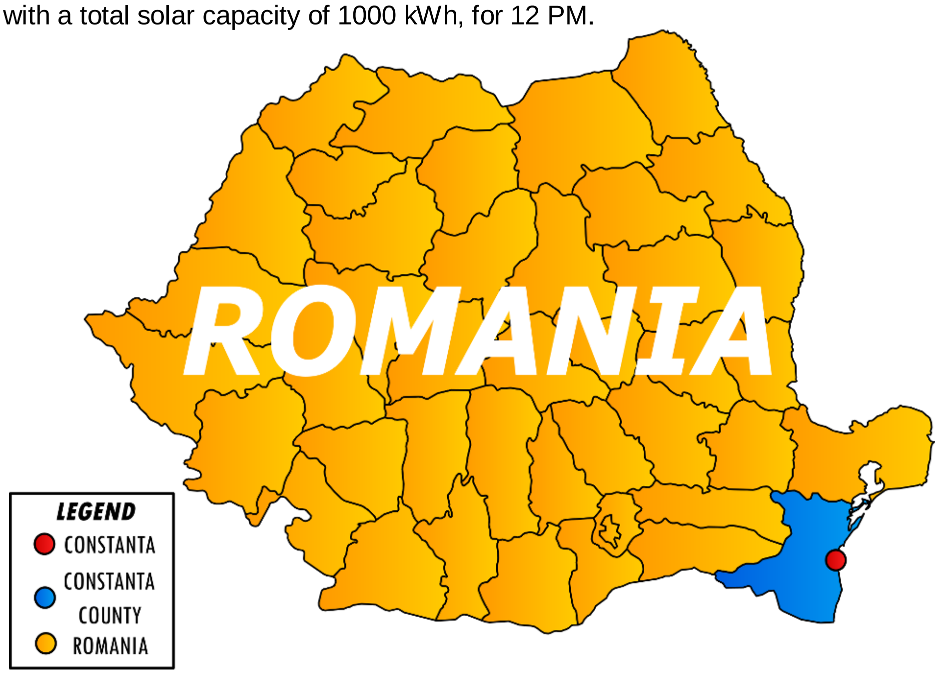

Fig. 1: Localization map of Constanta Municipality (at local, regional and national level)

By selecting the time of 12 PM the study wants to analyze the direct solar capacity, as the position of the Sun relative to the ground is perpendicular, and in this time interval the maximum solar energy can be obtained during a day, thus obtaining the maximum solar power output. Through the success of the study to show that solar energy in Constanta is suitable for supporting an industrial platform, an individual household, an extensive electricity grid, but even by occupying a segment of the Black Sea, the study promotes the idea that renewable energy it is extremely reliable for the Black Sea coastal area on the Romanian territory. The inkScape 0.91 and Microsoft Excel software were used to create the graphics.

Results and Discussions
The middle of the day will bring a solar power output between 0.3 and 0.63 kWh, which means that solar energy is an important supplement to traditional electricity or may even be a substitute for homes where consumption is not very high. The average solar power output is about 0.48 kWh for an individual household, which would have a solar installation capacity of 1 kWh. The most favorable period for the maximum use of solar energy is the period March - September, which has values above the annual average. The total annual capacity of solar energy obtained through a solar installation with a total capacity of 1 kWh would amount to 1.3 MWh, which is extremely reliable for the implementation of solar energy in an individual household on the Black Sea coastline. (Figure 2)
Economic activities have a much higher need for electricity, but by installing a higher capacity of the solar installation you can easily get a majority supplement in the energy circuit, because for 12 PM, a solar installation with a total capacity of 100 kWh produces between 30.4 and 64.5 kWh, which could be a success for the implementation of renewable energy in the industrial field of a medium scale. A solar installation with a total capacity of 100 kWh can produce an annual average of 49.5 kWh, which highlights the ability of solar energy to represent an important shoulder to the sustainable development of small and medium-sized industrial companies. A main disadvantage for the implementation of solar energy in an industrial business is the fact that calculations on solar power output must be made for each period of the year, so that there is no risk of power outages. These values could give the courage needed by companies on the Black Sea coast to embrace and install photovoltaic panels for sustainable development. (Figure 3)
The creation of a much denser solar electricity network can be achieved by offering an exclusive land for the installation of photovoltaic panels, which can obtain a total monthly amount between 314.9 and 660 kWh, which could be a primary energy source for many economic activities, such as agriculture, farms or any small or medium-sized industrial activities. The main disadvantage of the spaces for

photovoltaic panels is that they require a very large space, but by creating a belt of solar installations near urban centers could supplement an impressive number of individual homes connected to the public energy system or multifamily homes, which is an important starting point in creating a more eco-friendly environment in Constanta. An installation of 1000 kWh from a land of approximately 10 hectares can obtain an average monthly solar power output for 12 PM of 510.7 kWh, this average being exceeded mainly during the spring, summer and autumn, thus guaranteeing the supply with electricity in a high share for a large number of homes. (Figure 4)

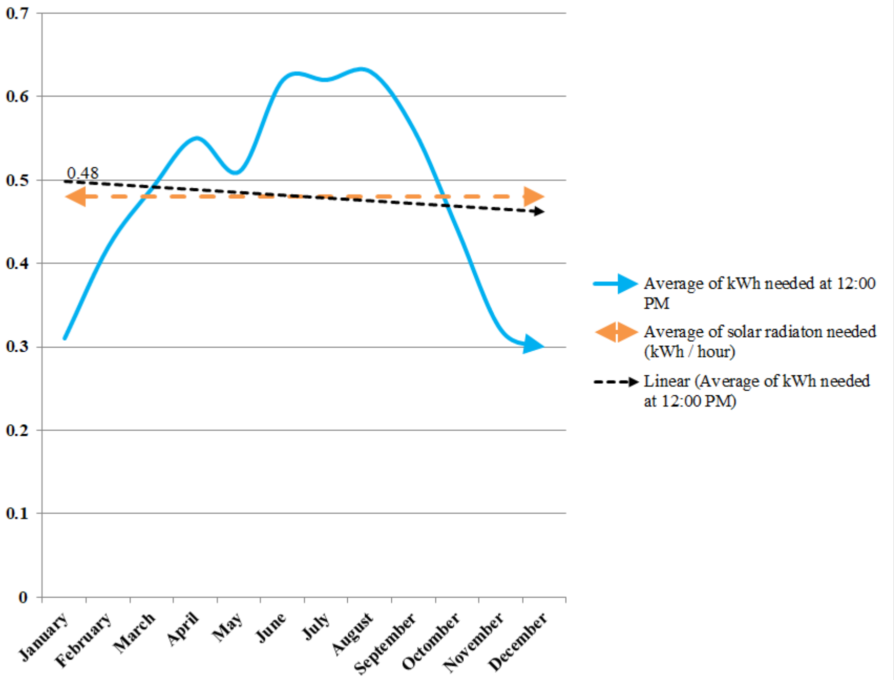

Fig. 2: The monthly evolution of the power output of an individual house at 12 PM in Constanta Municipality, with a solar installation capacity of 1kWh (for 2021)

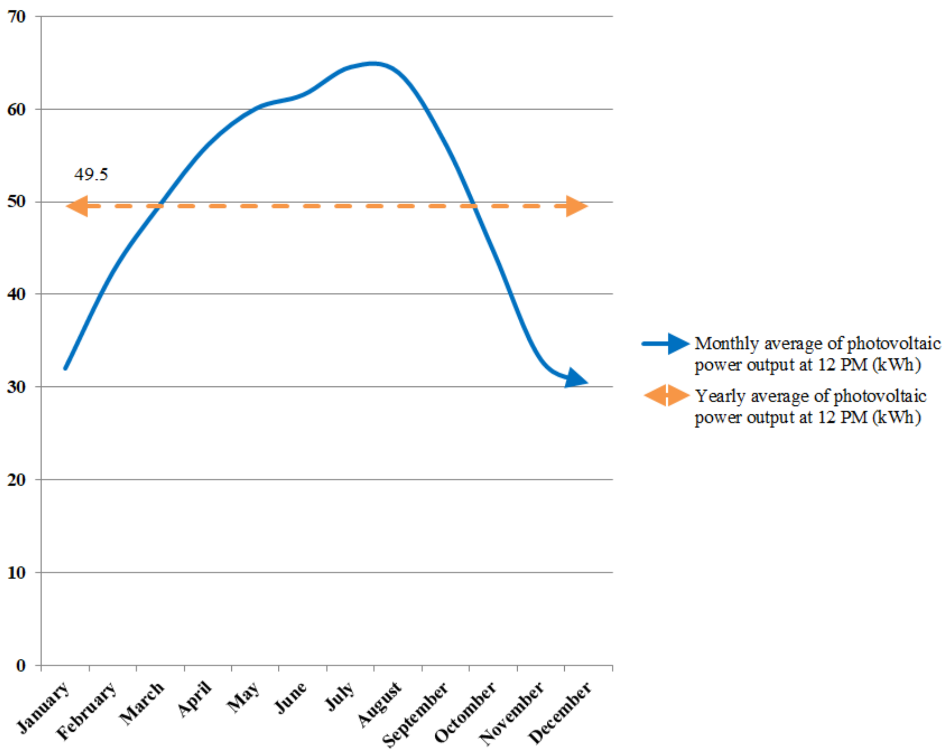

Fig. 3: The monthly evolution of the power output of an industrial platform at 12 PM in Constanta Municipality, with a solar installation capacity of 100 kWh (for 2021)

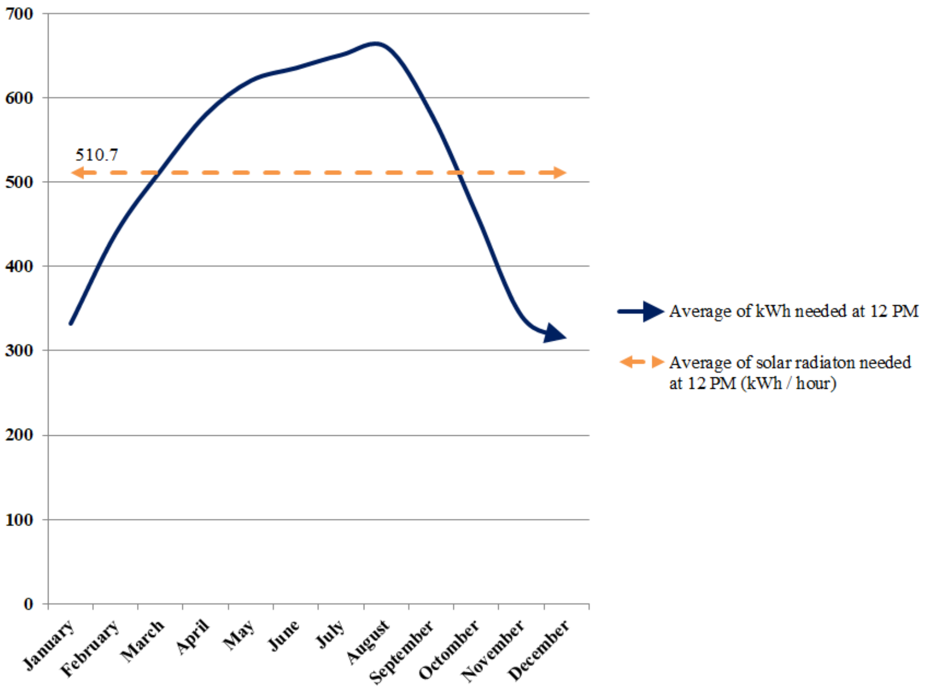

Fig. 4: The monthly evolution of the power output of an exclusive field of photovoltaic panels with a capacity of 1000 kWh, at 12 PM in Constanta Municipality (for 2021)

The possibility to develop solar energy installations on water wanted to solve the problem of large space needed to build large capacity installations, and the proximity of Constanta to the Black Sea could create a partnership between the terrestrial panels around city and aquatic photovoltaic panels. The values of the aquatic panels are lower compared to the terrestrial ones, but they can represent an extremely vital space for the implementation of the sustainable development strategies in the field of renewable energy. The values obtained by the floating installations with a total solar capacity of 1000 kWh are between 208.8 and 602 kWh for the middle of the day, while the average solar power output for the middle of the day is 426.1 kWh. (Figure 5)

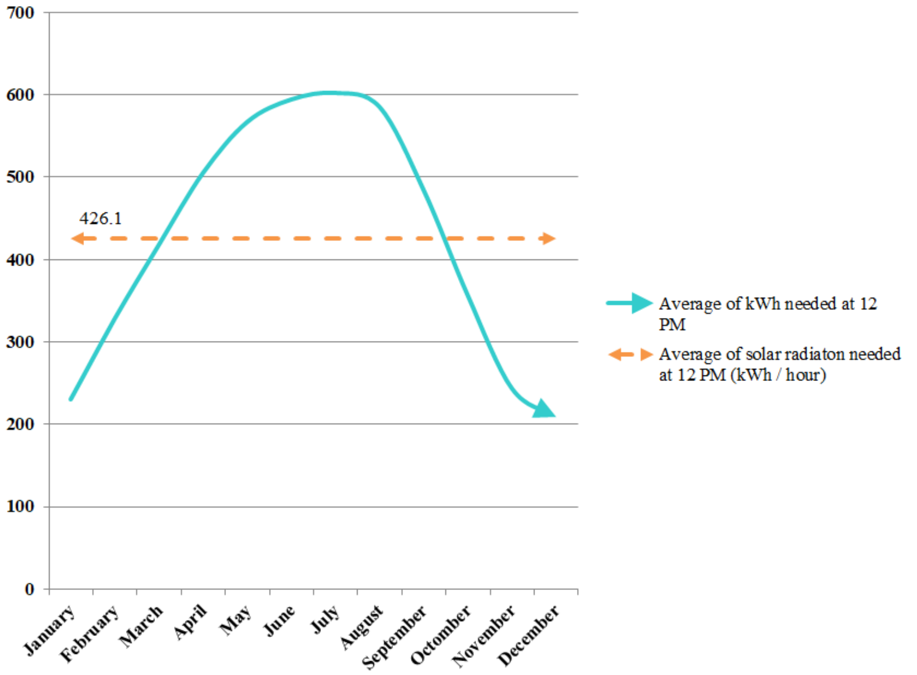

Fig. 5: The monthly evolution of the power output of an exclusive field of floating photovoltaic panels (on the Black Sea) with a capacity of 1000 kWh, at 12 PM in Constanta Municipality (for 2021)

Conclusion

The main success of the study is to confirm the potential of solar energy in the coastal area of the Black Sea in Romania, which can be an important incentive for the traditional energy circuit or even a permanent substitute for individual households or small or firm businesses. A main advantage of Constanta is the fact that it can use areas off the Black Sea to obtain solar energy, through the large number of clear days throughout the year. The research fulfills all the proposed objectives and wants to represent an ambassador of solar energy development on the Romanian coastal area, by raising awareness of the need to implement a much higher supply of renewable energy in urban areas, and beyond.

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Souhrn

Solární energie je jedním z nejnovějších a nejšetrnějších způsobů získávání energie, představuje nový způsob boje proti rostoucímu znečištění každodenní městskou činností, ale také proti stále hrozivějším změnám klimatu. Solární energie, která je stále ještě v počáteční fázi vývoje, se prosazuje nejen v soukromých podnicích či domácnostech, ale i ve veřejném sektoru energetiky, což se projevuje rostoucím počtem fotovoltaických panelů v oblastech, kde má sluneční záření vysoké hodnoty, a solární energie má potenciál stát se doplňkem energetického okruhu městských center nebo dokonce jeho náhradou. V oblasti rumunského pobřeží je sluneční záření extrémně vysoké, což se projevuje obrovským solárním potenciálem, ale také vysokou mírou úspěšnosti realizace projektů tohoto typu energie. Hlavním cílem studie je zjistit potenciál solární energie a názory místních obyvatel na krajinu zaplněnou fotovoltaickými panely, přičemž hlavním cílem studie je zvýšit povědomí o potřebě podpory obnovitelných zdrojů energie a a přijmout krásu udržitelného rozvoje obnovitelných zdrojů energie bez ohledu na dopad na krajinu.

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APPLICATION OF STRUCTURAL SUBSTRATE WITH BIOCHAR COMPONENT INTO THE URBAN WATER RETENTION MEASURES

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Abstract
The use of the structural substrate has the potential to be a valuable element in the planning and implementation of the blue-green infrastructure elements in the urban environment. The main objective of water retention measures in urban conditions includes absorption, sedimentation, infiltration, filtration, accumulation, and evaporation. The system of planting woody vegetation - the most important component of green infrastructure, into the structural substrate with biochar component shows the utilization of the filtering and absorbing capabilities of greenery and substrate itself in smaller rooting volumes. These parameters are essential in the environment with significant negative environmental conditions such as insufficient possibilities for the rooting system, urban heat islands, air and soil pollution associated with the immediate vicinity of the traffic communication, salination, lack of rainfall during the growing season. The paper presents methods focused on the utilization of structural substrates with a biochar component in the conditions of Slovakia.

Key words: blue – green infrastructure, sustainable landscape, urban planning

Introduction
The work explores the possibility of application of structural substrates to urban green infrastructures. Due to climate change, the incidence and intensity of extreme weather events are increasing. The technological use of the interconnection of blue and green infrastructure in the urban environment brings out the possibility of infiltration at the point of impact of precipitation, and thus imitates the natural hydrological regime. The benefit in the long run of blue-green infrastructure is the planned re-use of rainwater, compared to the classic drainage system and a unified sewer network. Also, microclimatic phenomena such as urban heat islands can be mitigated by measures associated with the level of development and the implementation of vegetation, water features, and permeable surfaces in the structure of green and blue infrastructure. The most demonstrable effect on the improvement of the micro and mesoclimate is woody vegetation elements, especially mature greenery. But due to the various stressors, it is often more difficult to create suitable long-term conditions for the growth of greenery in an urban environment, which provide space for short-term recreation space. This fact causes only a small percentage of planted trees to live through a period more than 10 years after planting.
The application of a structural substrate for new plantings in the urban environment creates many opportunities for the emergence of more resilient, adaptable cities in the future.

Material and methods
Soil sealing has a significant effect on the short hydrological cycle caused by residential, industrial, transport or energy infrastructures. Urbanized areas with a high degree of soil cover are characterized by large surface runoff. The high surface runoff is also covered by the reduced filtration function of the soil under the impermeable surface. Impermeable surfaces, therefore, contribute to the spread of pollution to more remote areas. The expansion of the built-up area and the construction of transport infrastructure also have a negative impact on the interconnections of natural habitats, biodiversity, and migration routes (Meli et al., 2017). Also, areas of the urban soils in residential areas with 60% of the built-up area are heavily polluted, since they have been less disturbed by anthropogenic activity, due to the high waste production and the concentration of smaller industrial parks, hospitals, and shopping centres with high energy intensity and transport infrastructure.
In Bratislava, the most risky areas in terms of soil quality are Nové Mesto, Ružinov, Nivy, Vrakuňa, Rača and partly Podunajské Biskupice. They represent sites that have a high risk of soil degradation from an environmental point of view due to the location of large industrial parks, environmental burdens, and waste management. Similarly, land corridors located near transport hubs represent unsuitable conditions. Sources of contamination are mainly carcinogenic substances (Cd), solid inorganic substances (Pb, Zn), gaseous inorganic substances, and salt contamination. Traffic lines are exposed to loads from exhaust emissions, which is reflected in the quality of the soils around them.

These pollution conditions increase the disintegration of the soil structure and have a limiting effect on the potential of nutrients absorption from the soils. Many urban areas do not provide soil conditions and flexibility for the growth of woody plants and especially trees, as most soils have an anthropogenically altered character. Such soils are characterized by a lack of nutrients, water, increased alkaline pH response, and compaction, which have a negative effect on nutrient absorption, absenting mycorrhizal fungi of root systems, and the overall health of vegetation in cities. Salt in combination with clayey soil causes the structure of the soil to collapse, minimizing pores leading to insufficient aeration, in addition to insufficient rooting volume. A functioning biota in the soil layer is essential for above-ground fauna and flora. Poor soil quality in urban areas lowers the standard of the environment, especially for housing and recreation. For this reason, increased protection measures that would at least partially eliminate the real and potential environmental hazards arising from the soil in this area are justified (Sobocká et al., 2020).
The network of green infrastructure elements is provided by elements of different scales and characters restoring ecological stability. Defining components could be applied both to the urban landscape and to the landscape. Examples of urban greenery components in conditions of Slovakia can be as follow (European Commission, 2013):

1. Green infrastructure areas connected with grey infrastructure – sustainable water management measures, street greenery, infiltration belts/areas, retention areas, vegetation based wastewater treatment plants, filter strips, swales,
2. Green areas infrastructure connected with blue infrastructure – greenery corridors of watercourses and water area (riparian vegetation), wetland vegetation, lakes/ponds, river/stream,
3. Green hubs – restored (semi)natural urban greenery areas with healthy functioning ecosystems, botanical gardens/arboretums/zoological gardens, urban green spaces (UGS), urban parks, cemetery and churchyard, green sports facility, urban forests, shrubland, abandoned and derelict area with patches of wilderness,
4. Greenery corridors next to the transport infrastructure – woody vegetation stripes, alleys,
5. Building greenery - green vertical systems (VGS) and roof greenery, atrium, green fences, green parking pavements, noise barriers,
6. Stepping stones/buffer zones - smaller landscaped areas, pocket parks, allotments, community gardens.

Green infrastructure has many multidisciplinary functions and benefits: environmental - regulation of soil erosion and other slope processes, support of soil-forming processes, decomposition of harmful substances; ecological - promoting biodiversity, life cycles, and processes; microclimatic and hygienic - improving air quality and microclimate in the urban environment; mitigation and adaptation to climate change – positive influence of hydrological cycle and runoff conditions; economical; social and psychological function. An absence of trees is the biggest negative factor in urban structure. In addition to the aesthetic value, green areas have a positive effect on physical and mental health (Hunter et al., 2019). The support of urban green spaces is the most economical and effective strategy for increasing resilience in terms of climate change (Gillner et al., 2015).

Results

The importance of greenery in the urban has been proven, but it is necessary to provide suitable environmental conditions. The potential for improving the conditions for the development of tree growth and thus better opportunities for short-term recreation can be reached by using a structural substrate for vegetation in central urban areas, areas with high pollution, sustainable water management measures, green hubs or buffer zones. The structural substrate is more suitable for urban space than the classic substrate since the fractions of aggregate cant be compacted to the extent as the urban soils and the biochar component is responsible for the filtration of harmful substances, which offers a suitable environment for long-term tree growth. Therefore, the use of a structural substrate is more suitable for areas of short-term recreation in an urban environment. The used structural substrate model consists of a mixture of gravel aggregate, organic matter, and a biochar component in the planting area. The ratio can differ but the standard is about 3/4 of the volume of 4-8 mm fraction of aggregate, 1/8 of the organic part, and 1/8 of organic biochar. The use can be combined with drained semi-permeable street spaces, which will provide space for healthy growth, tree development and support of ecosystem services. The structural substrate provides many benefits associated with the prevention of subsoil compaction, the negative impact on nutrient absorption and surface permeability, the retention of rainwater, resulting in a higher tree survival rate, easier access to technical engineering networks, and, in the long run, financial costs and support.

The concept of "Ecosystem Services", makes it possible to assess the environmental consequences of climate change and its effects on society. Ecosystem services are related to habitat and biological conditions, and a particular ecosystem may provide several ecosystem services with different values and production. The value of biodiversity and ecosystems is not negligible, but it was necessary to evaluate ecosystem services to understand their relevance within society and in decision-making processes. Classification of ecosystem services can be divided into supply services, regulatory services, habitat services, and cultural services. Urban green spaces with the potential for short-term recreation in the urban environment offer several components of human well-being. Among the ones that result from the functional interconnection of blue-green infrastructure, we can include recreation, climate control, flood control, natural habitat for organisms, water pollution treatment, recreational function, mental health promotion, social function, mitigation of extreme, natural habitat for organisms, biodiversity conservation, stabilization and soil-forming function, aesthetic function and source of inspiration and education (Mader et al., 2011). The results of the importance of greenery in the urban environment confirmed the short-term benefits and enhancing effects of residential greenery on the psychological side of human vitality such as increased attentional capacity, reduced internal noise (van den Berg et al., 2010), and reflection, increased mental activity (Oguma a Shinoda-Tagawa, 2004), stress reduction. In the case of loss of greenery around human developed countries, a negative impact on health is detected. The results demonstrate the increased mortality associated with cardiovascular and respiratory diseases caused by the sudden loss of large areas of greenery caused by pests (Donovan et al., 2013). With a sufficient number of green areas in the urban structure, especially the woody vegetation in the scale of parks interconnected with pocket parks and buffer zones has been a significant increase in ecological stability and ecosystem services (Liu a Shen, 2014).

Discussion

Abroad, it is possible to see these connections and support systems of blue, green and grey infrastructure with new urban development entities and revitalizations of inefficient existing sites. The implementation of such projects in Slovakia is not common. In the example of Bratislava, we can see the efforts to transform a more sustainable city from the municipal office itself. The demands of the population for recreation began to increase in the middle of the 20th century as long term recreation, but since most of the population lives in urban areas, short-term recreation has become more and more sought after. Various measures have been implemented to increase the quality of short-term recreation in the urban environment for children and adults, and also in public greenery.

Conclusion

To ensure ecosystem services of an urban landscape, the application of sustainable modern urban development measures in areas with complex problems of each component of the local environment is the priority. The use of structural substrate is a potential solution to this goal. In the Slovakia region, mainly in Bratislava´s central urban area, problems have been defined and the process of planning and implementing initial projects are currently being worked on.

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Souhrn
Využití strukturálního substrátu má potenciál být cenným prvkem při plánování a realizaci prvků modrozelené infrastruktury v městském prostředí. Hlavním cílem opatření pro zadržování vody v městských podmínkách je absorpce, sedimentace, infiltrace, filtrace, akumulace a výpar. Systém výsadby dřevinné vegetace - nejdůležitější součásti zelené infrastruktury, do strukturního substrátu s biouhlovou složkou ukazuje využití filtračních a absorpčních schopností zeleně i samotného substrátu v menších kořenových objemech. Tyto parametry jsou zásadní v prostředí s výraznými negativními podmínkami prostředí, jako jsou nedostatečné možnosti kořenového systému, městské tepelné ostrovy, znečištění ovzduší a půdy spojené s bezprostřední blízkostí dopravní komunikace, zasolení, nedostatek srážek ve vegetačním období. Příspěvek představuje metody zaměřené na využití strukturních substrátů s komponentou biocharu v podmínkách Slovenska.

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ASSESSING THE IMPACT OF CLIMATE CHANGE AND SEA LEVEL RISE ON THE SHORELINE OF ALEXANDRIA CITY – RECREATION AREA

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Abstract

Coastal areas, the most attractive for a tourists, are becoming increasingly threatened by climate change and sea level rise (SLR) which led to increase the coastal erosion. Shoreline change is used in the detection of coastal erosion in coastal areas. The Digital Shoreline Analysis System (DSAS) with ArcGIS can be used in monitoring the shoreline change using a number of statistical measures including; Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM), End Point Rate (EPR). This study aims to assess the impact of SLR due to climate change on Alexandria coasts. GIS and RS with DSAS were used in monitoring changes in the shoreline of Alexandria. The satellite images of 30 m resolution were used for the period (1985-2021) and geomatically corrected using Supervised Classification to determine the land uses and land cover changes. GIS was used for change detection, monitor changes in the land use and shoreline and predict the future changes in the shoreline for 10 and 20 years. The results showed that Alexandria shoreline has moved inland with different values along the coasts in the period (1985-2021) and the predictions showed more increase in 2031 and 2041. Results of this study could help policymakers to plan adaptation strategies to mitigate these impacts.

Key words: Climate change, sea level rise, shoreline change, RS, GIS, DSAS.

Introduction

Climate change and sea level rise presenting a number of challenges in coastal areas. Climate change is increasing as a result of human activities and natural processes and If it continues, it could have a variety of undesirable impacts including; flooding, drought, erosion and wetlands loss. In the 20th century, the global mean sea level rise has been increased to be (10-20 cm) (IPCC, 1996). By 2100, SLR is expected to be between 20 and 88 cm (IPCC, 2001). SLR could have long-term effects on coastal areas including; coastal erosion, submergence, saltwater intrusion into coastal aquifers, loss of agricultural land, and rise in the coastal water table (Abd-Elhamid 2010).

The Mediterranean basin is one of the most vulnerable regions to climate change. The southern parts of the Mediterranean basin is more threatened than the northern parts (Nicholls and Hoozemans, 1996). Egypt's North coasts are subject to highly risk due to its relatively low elevation (El Raey et al., 2005). Alexandria is the most important Egyptian cities on the Mediterranean that has big investments in different sectors such as tourism, industry and agricultural. Egypt Second National Communication Report, 2010 has expected sea inundation will lead to emigration of 6.5 million people from Alexandria in 2100 working in the tourism field.

A number of studies assessed the impacts of sea level rise on Egypts northern coasts including Alexandria (e.g. El-Raey et al., 1995-2005-2010; Frihy, 2009, Abou-Mahmoud, 2021). These studies showed that Egypt will face the following consequences: inundation and loss of beaches, loss of tourism, loss of agricultural and fishing land. Also, contamination of fresh water aquifer, soil salinity, water logging, agricultural losses and loss of land productivity due to saltwater intrusion. Egypt is among the top countries in the world expected to be most affected by sea level rise (Dasgupta et al., 2007). Some studies have been conducted to assess the potential impact of SLR on Egyptian coasts and reported areas of high-risk in the Nile delta, Alexandria, Beheira, Port Said and Damietta.

RS and GIS could help in risk monitoring and management. Satellite data is helpful to give overview of large and regional scales. Satellite data have been used in monitoring the effect of climate change on Nile Delta (Abdel Hamid et al., 1992). Shoreline geometry is an important parameters in the detection of coastal erosion and deposition and the study of coastal morphodynamics. Digital Shoreline Analysis System (DSAS) with ArcGIS can be used in measuring, quantifying, calculating and monitoring shoreline change. A number of statistical change measures within DSAS including; Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM), End Point Rate (EPR) (Temitope, 2004). This study aims to assess the impact of climate change and sea level rise on the shoreline and innundiation of Alexandria city. GIS with DSAS were used in this study for shoreline change detection after collecting the required data from satalite images for the period (1985-2021).

Material and methods

Case study

Alexandrial is located on the northern coasts of Egypt (30°50\ to 31°40\ N, 29°40\ to 32°35\ E) and extent for 60 km length along the Medereranian Sea (see Figyre 1). It is the third-largest city in Egypt after Cairo and Giza, the total area is 2679 km^2 and population about 5.2 million (2022). The climate is influenced by the Mediterranean Sea, moderating its temperatures, causing variable rainy winters and moderately hot summers, with daily maximum temperatures (12 to 18°C) and minimum temperatures 5°C. The land use of the city is varied between agriculture areas, urban areas, water areas and desert as shown in Figure 1.

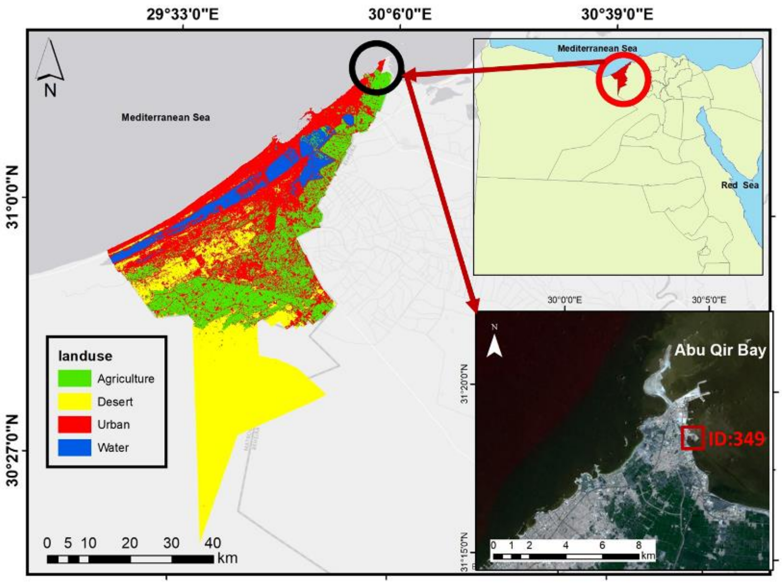


Fig. 1: Location map of the study area

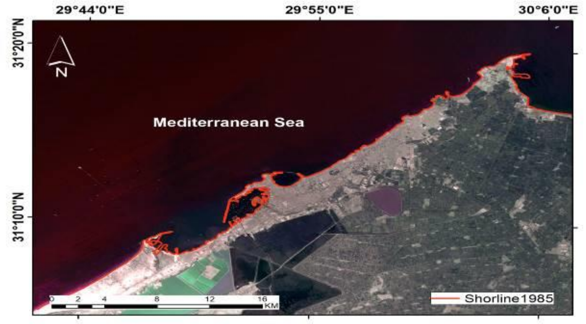
Methodology

The Digital Shoreline Analysis System (DSAS) is an important GIS tool that can be used in a number of studies including; monitor past and present shoreline positions and geometry, evaluating coastal behaviour, shoreline dynamics, historical trend analysis, coastal system dynamics, shoreline changes, cliff geometry modelling and estimations, mapping of historic configurations of shoreline position over the period covered by available spatial data, evaluation of historic changes and trends, evaluate the time-series of change at specific locations of shoreline and predict patterns of shoreline behaviour (Temitope, 2004). DSAS provides a number of statistical measures, including the Shoreline Change Envelope (SCE); is a measure of the total change in coastline movement taking into account all known shoreline positions. Net Shoreline Movement (NSM); is the distance between the oldest and youngest shorelines is known as. End Point Rate (EPR); is calculated by dividing the distance between the oldest and youngest coastline points by the time elapsed between them (Thieler et al., 2009). GIS and RS are one of the modern techniques that links climate data with its spatio-temporal framework to show the changes that may occur due to climate change. GIS and RS with DSAS are used to assess and model climate changes and sea level rise impacts on the shoreline of Alexandria city during the period (1985-2021) and its future projections.

The work has been done on four steps as following. (I) Data collection, which represents the collection of topographic maps of Alexandria and LANDSAT satellite images with a resolution of 30 meters from1985 to 2021 for five periods (1985-1995-2005-2015-2021) from USGS. Then Geometric Correction and Atmospheric Correction have been done for the collected data to be used in creating database of shoreline using ArcMap. (II) Data storage and retrieval; this step includes the process of digitizing the data and storing with linking to each other to facilitate recall, using GIS and RS. (III) Data processing and analysis; this step represents changing the pattern and level of the data and removing input errors through the process of creating and updating the data. This step includes digital processing of satellite images, including the Supervised Classification process to determine the land uses and shoreline, and then a change detection process for the images. ENVI.5 program is used to detect changes in the land use and shoreline for the collected satalite images for the period (1985-2021). ArcGIS 10.8 is used to create geodata base for the shoreline and base line of the study area. DSAS tool was connected to ArcGIS and used to detect the changes in the shoreline and forecast the future movement of the shoreline for 10 and 20 years. (IV) Data presentation; in this step database is represented and displayed in forms of maps, tables, graphs, images and reports and presenting them to decision makers.

Results and discussion

GIS with DSAS have been used to detect shoreline change in Alexandria city due to climate change and sea level rise for the period (1985-2021). DSAS was used to digitize shoreline changes from maps, and NSM and EPR were calculated. The distance between the oldest (1985) and youngest (2021) shorelines is calculated by NSM, and it shows the total change in shoreline position over a 36 year. By dividing the distance of shoreline movement from the earliest to most recent shorelines by the time period, EPR is the net shoreline movement into an annual rate of shoreline change. Figures 2a-e show the shoreline of Alexandria for the selected five periods (1985-1995-2005-2015-2021). The maximum Net Shoreline Movement (NSM) is 213.7 m and the maximum errosion rate (End Point Rate, EPR) is 5.94 m/year.



(a) 1985

(b) 1995

(c) 2005

(d) 2015

(e) 2021

Fig. 2: The shoreline of Alexandria city (1985-2021)

It has been observed that eastern parts of Alexandria are highly affected by coastal errosion and the shoreline has moved more inland but the west and middle parts have less effects due to the excistance of some defence structures that constructed in the last decade. A pilot area (Abio Qir Bay) has been selected in the eastern part of Alexandria as it is highly affected by the coastal errosion. Figures 3a-e show the shoreline at Abio Qir Bay for the five periods from 1985 to 2021. The maximum Net Shoreline Movement (NSM) is 129.24 m and the maximum errosion rate (End Point Rate, EPR) is 3.59 m/year. Then DSAS and GIS were used to forcast the shoreline after 10 and 20 yeras as shown in Figures 4a and b. The results reveal that the eastern part of Alexandria has exposed to high errosion in the study period.

(a) 1985

(b) 1995

(c) 2005

(d) 2015

(e) 2021

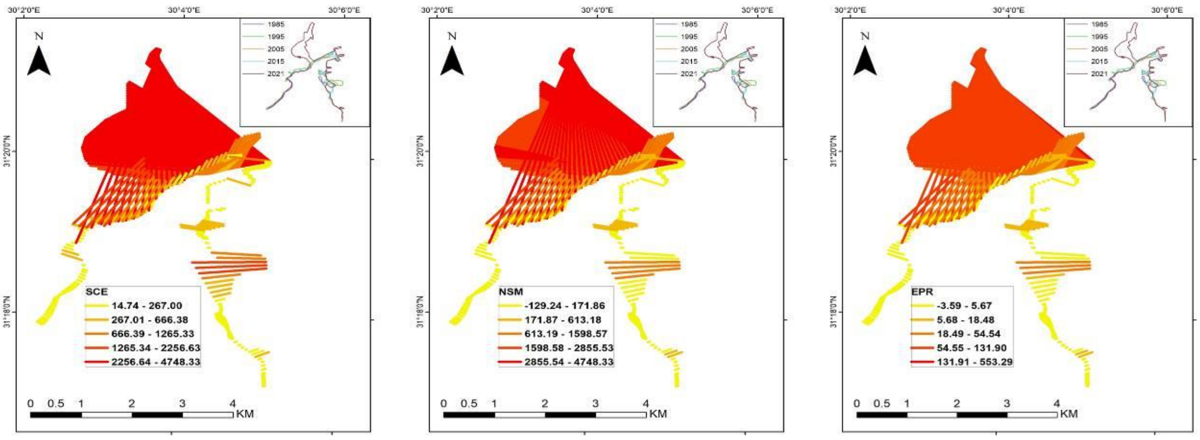
Fig. 3: The shoreline at Abio Qir Bay (1985-2021)

(a) 2031

(b) 2041

Fig. 4: The forcasted shoreline at Abo Qir Bay (2031 and 2041)

To highlight the rate of change in the shoreline, one profile (ID:349) has been selected in Abu Qir Bay as shown in Figure 1. The results of SCE, EPR and NSM are shown in Figures 5a, b and c. The red colours show the movement of shoreline to the sea due to construction of defence structures and yelow colour show the movement of shoreline to the land which increased the errosion at this peofile.



(a) SCE (b) NSM (c) EPR

Fig. 5: Results of shoreline cgange at Abu Qir Bay, Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM) and End Point Rate (EPR)

To summarize the effect of sea level rise on Alexandria shoreline, a relation between the shoreline change measured from the base line is ploted with time as shown in Figure 6 for five periods from 1985 to 2021 and the predicted shoreline after 10 and 20 years (2031 and 2041). The results revealed that the shoreline is changed inland and more errosion has occured in this area which needs urgent protction measures to stop the shoreline errosion and protect these areas.

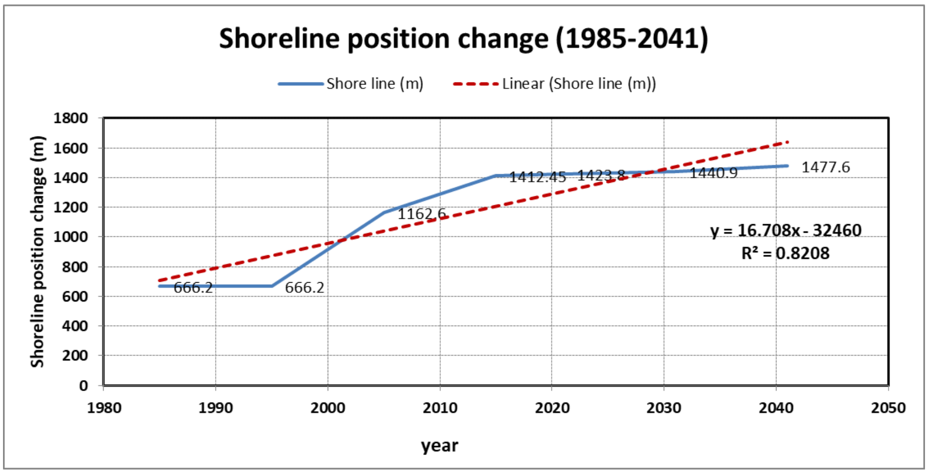


Fig. 6: The shoreline change with time at profile A (1985-2041)

Conclusion

Coastal regions are among the most affected regions by climate change and sea level rise. Egypt's Mediterranean coastline will be mostly affected by sea level rise, as a large portion of it including the Nile Delta is below mean sea level. This study examined the effects of climate change and sea level rise on the shoreline of Alexandria city for the period (1985-2021). ArcGIS and RS with Digital Shoreline Analysis System (DSAS) were used in monitoring the shoreline change. A number of statistical measures have been discussed including; Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM), End Point Rate (EPR). GIS was used for change detection of the shoreline and predict the future changes in the shoreline for 10 and 20 years. The results of this study revealed that the shoreline of Alexandria has extreamly affected by sea level rise especialy in the Estern part and the predictions showed more increase in 2031 and 2041. Results of this study could help in protcting the affected area by applying appropriate measures to stop the coastal errosion.

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Souhrn

Pobřežní oblasti, které jsou pro turisty nejatraktivnější, jsou stále více ohrožovány změnou klimatu a zvyšováním hladiny moří (SLR), což vede k nárůstu pobřežní eroze. Změny břehové čáry se používají ke zjištění pobřežní eroze v pobřežních oblastech. Systém digitální analýzy břehových linií (DSAS) s ArcGIS lze použít ke sledování změn břehových linií pomocí řady statistických měření, mezi něž patří: obálka změny břehové linie (SCE), čistý pohyb břehové linie (NSM), rychlost koncového bodu (EPR). Cílem této studie je posoudit dopad SLR v důsledku změny klimatu na alexandrijské pobřeží. Při sledování změn na alexandrijském pobřeží byly použity GIS a RS s DSAS. Byly použity satelitní snímky s rozlišením 30 m pro období (1985-2021) a geomaticky korigované pomocí Supervised Classification pro určení změn využití půdy a půdního pokryvu. GIS byl použit ke zjištění změn, sledování využití půdy a změn pobřeží a k předpovědi budoucích změn pobřeží na 10 a 20 let. Výsledky ukázaly, že pobřeží Alexandrie se v průběhu období (1985-2021) posunulo do vnitrozemí s různými hodnotami podél pobřeží a předpovědi ukázaly větší nárůst v letech 2031 a 2041. Výsledky této studie by mohly pomoci tvůrcům politik při plánování adaptačních strategií ke zmírnění těchto dopadů.

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ASSESSMENT OF SELECTED GEOHERITAGE ELEMENTS IN THE SLOVAK PART OF THE TOKAJ REGION

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Abstract
Natural heritage plays a key role when considering any type of nature-based tourism form development in any territory of the world. This paper discusses the assessment of abiotic natural heritage in the Tokaj region in Slovakia in order to set specific value to selected location of the territory and to, in more detail, know the geotourism development potential. Considering used methodology, not only the "overall" value was identified but some specific values, including scientific, economic, and educational, too. Assessment results indicate that the region of Tokaj includes significant geoheritage that, in combination with other values of this area such as cultural-historical heritage, represent admittedly strong basis for complex tourist experience.

Key words: geoheritage assessment, geotourism development, Tokaj, Slovakia

Introduction
In general, tourism is currently considered to be a socio-economic phenomenon and one of the most dynamically developing sectors. For many countries, tourism represents an important sector of the national economy, as it significantly affects their regional and/or national economics (Linderová 2013). Unfortunately, the mass development of tourism often negatively impacts the environment leading to efforts to transform tourism into a more sustainable and greener.
As reported by Gúčik et al. (2016), the sustainable development of tourism is based on the careful use of the natural and cultural values of the country, thus helping the long-term prosperity of the area. In this context, the following forms of tourism apply in particular: green tourism, rural tourism, nature tourism, agrotourism, geotourism, or ecotourism (Gregorová & Klaučo 2017).
When developing any of the above-mentioned forms of tourism, it is essential to know the primary offer of a particular area as well as its value. This article is focused on the assessment of selected elements of geological heritage in the Slovak part of the Tokaj region, which, from various perspectives, represents a specific area of international importance.

Methods
At present, it is possible to find several approaches to determine the value of geosite, as methodology of geosite assessment is a subject of interest to several authors. Although several methods of geosite assessment have been defined, universal use of any of them is not possible, as every method defined has its limits (Štrba et al., 2015). For the purpose of this study, authors use assessment of geological heritage defined by Štrba and Rybár (2015). Used assessment method includes 10 categories giving five types of results – total value, scientific value, educational value, economic value and added value. So, the assessment results give comprehensive insight onto value of individual locations of the geological heritage from various perspectives.

General characteristics of Slovak part of the Tokaj region
The Tokaj region is an extremely interesting area shaped by unique conditions and typical land use - cultivation of basic vine varieties - Yellow Muscat, Furmint, and Lipovina. The specific climatic conditions, the soil of volcanicorigin, long dry autumn, exposure of the slopes and their slope contribute to the cultivation of the vines.
Slovak part of the Tokaj region in its current form represents a small area in the southeastern part of the Slovak Republic (Fig. 1), on the border with Hungary and at the southwestern tip of the Zemplínske vrchy Mts. From an administrative point of view, the Tokaj region belongs to the Trebišov district within the Košice Self-governing Region. With its area of 908 ha, it is the smallest wine-growing area in Slovakia, but it is one of the few areas where grapes can be grown to produce naturally sweet wines. The Tokaj region includes seven municipalities, namely: Bara, Čerhov, Černochov, Malá Tŕňa, Veľká Tŕňa, Slovenské Nové Mesto and Viničky (Mitríková & Nadzon 2013).
Geologically, the Tokaj area was created by repeated volcanic activity and alpine orogenesis. It consists of rock fragments, solidified lava and ashes. Tertiary rhyolites, andesites, trachytes and their

tuffs are mainly represented in the volcanic complex (Vereš 2002). Part of the Tokaj vineyard hunts consists of fine-grained sands, clays, gravels and loess clays (the lowest positions of the vineyards, the least suitable for growing vines). Andesites, rhyodacities and dacitoandesites, which are most suitable for growing Lipovina, Furmint and Muscat Yellow, are located in the Piliš hunting grounds (cadastral area of Bara) (Žadanský 2009). The relief in the Tokaj region is relatively rugged due to the uneven weathering of various rock material.

In this region, a relatively large number of areas with the occurrence of protected species of flora and fauna related to exceptional territorial climatic and geological conditions is present, e.g., Latorica Protected Landscape Area and small-scale protected areas, e.g., Protected area Boršiansky les (forest) (protected under NATURA 2000) or law-protected Kašvár National Nature Reserve with the occurrence of thermophilic fauna communities and rare xerothermic and calcareous flora.

Fig. 1: Location of the Tokaj region

Geological heritage of the Tokaj region

The area of the Slovak part of the Tokaj region includes diverse geological phenomena creating geological heritage of this territory. Following text brings overview of the most significant of them based on review of publications of Gazdačko (2016), Kobulský et al. (2016), and Liščák and Antalík (2018) and the information from the State Nature Conservancy of the Slovak Republic (available in Slovak language at www.sopsr.sk).

Nature Reserve Tarbucka, with an area of 146.98 ha, is an area of European importance. It is located in the cadastral areas of Veľký Kamenec and Streda nad Bodrogom. The territory was declared a nature reserve in 1986. It includes a rare geomorphological phenomenon in Europe - andesite ridges with heaving sands. Sandy substrate and suitable microclimatic conditions are a prerequisite for the development of rare sand-loving fauna and flora.

Ladmovce limestone occur within an area of European importance located in the village of Ladmovce with an area of 337.7 ha, for which the relief of non-karst plains is typical from a geomorphological point of view. In some parts, the original xerothermic oak and cerium-oak forests have been preserved. The occurrence of xerothermic and calcareous vegetation is known. Important species include, for example, the large-flowered iris (*Pulsatilla grandis)*, the Hungarian leafless iris (*Iris aphylla* subsp*. hungarica*), and the Siberian bellflower (*Campanula sibirica)*.

Below the Roháč hill (161.7 m above sea level) about a kilometer northeast of the village of Streda nad Bodrogom is the famous **Tajba National Nature Reserve**. The size of the reservation is 27.36 ha. The area has been protected by law since 1966 and represents a valuable example of the last remnants of swamps, in which the endangered European pond turtles (*Emys orbicularis*) occur and regularly reproduces.

Malá Bara-Stredný vrch represents a still unextracted deposit of perlite located near the middle hill elevation in the north of the Borsuk extrusion body. Surface perlite is crumbly, crumbling, light gray and gray in color. The area is characterized by the occurrence of porous spherulitic and non-perlitized felsic rhyolites. Non-hydrated obsidians in the form of marekanites are also present.

Ladmovce - Babský vrch is an abandoned quarry in the southeastern part of the Šomoš hill, located west of the village of Ladmovce. The quarry contains muddy Mesozoic limestones with unique shale positions and calcite veins. Various fossils have been found in the limestones, including foraminifera, crinoids, ostracods, and lamellibranchiates.

Ladmovce - Šomoš is located west of the village Ladmovce about 400 m southeast of the Šomoš hill. The quarry, which was extracted in the past, represents the highest part of the Triassic Ladmovce

Formation (thick layers of dolomitic limestones and dark gray limestones) based on layers of brightly colored clayey and sandy shales.

In the forest above Veľká Tŕňa there are **fossilized remains of various Carboniferous plants**. The locality is the heaps of tailings that remained here after the trial mining of hard coal. Mining was not carried out and the mines closed. Here we can find the remains of tree horsetails (*Calamites*), imprints of the bark of *Lepidodendron*, small, rose-shaped leaves of the *Sphenophyllum*, or the roots of *Sigillaria*. The plant fossils are white and clearly visible in a dark gray sandstone base.

In an abandoned quarry on the southern slopes of **Šimonov vrch** hill**,** well-layered rhyolite - dacite pyroclastics of the Tŕňa Formation are exposed. Thin shards of shale, rich in clastic mica, appear between the thick and evenly developed layers of volcanoclasts. Volcanoclastics have been redeposited into the lake environment, documented in some places by the well-preserved horizontal lamination and rare relics of ostracods.

Viničky is a classic locality with a natural occurrence of three types of volcanic glass - pumice, obsidian and perlite. The presence of obsidian is genetically associated with rhyolite volcanism in the immediate area. The autochthonous occurrences of obsidian are concentrated on the surface on the southern slopes of the extruding body above the village of Viničky in the area of the road and in the area of the vineyards on an area of approximately 500 x 200 m. The second concentrated occurrence is in the basement of the cellars of the private company Tokajská spoločnosť Viničky.

Results of the assessment

Selected geoheritage sites were assessed using the methodology defined by Štrba and Rybár (2015). Results of assessment are summarized in Table 1.

As assessment results show, many of identified geoheritage locations in the Tokaj region are of significant value form various points of view. The most important sites are: Viničky, Tarbuca NR, Tajba NNR, Malá Bara-Stredný vrch, and Ladmovce-Babský vrch. From the scientific perspective, the most valuable sites are Tarbucka NR and Viničky. These two sites, together with Tajba NNR, are of the highest educational importance also. The highest economic and added value has the location Viničky.

Results of the assessment show that the most valuable geosite in the region of Tokaj is location Viničky-obsidian. It is caused by the fact that this site is located directly in tourist attractive location of the Viničky village.

In general, assessment results show that the geological heritage located in the Slovak part of the Tokaj region is of significant value. In this regard, appropriate attention and management should be adopted in order of preservation and potential use for, e.g., diversification of tourism products in the area. For this purpose, the knowledge of the geoheritage value is an important information source for effective and sustainable tourism development based on natural resources of the area.

Tab. 1: Assessment of geological heritage located in the Slovak part of the Tokaj region after Štrba and Rybár (2015)

Geosite name	Assessment criteria										Assessment score				
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	Total	Sci	Edu	Eco	Add
Tarbucka NR	4	6	6	6	5	5	6	6	0	4	48	0,72	0,58	0,44	0,47
Ladmovce limestone	4	2	6	6	5	0	4	6	0	0	33	0,53	0,43	0,31	0,19
Tajba NNR	4	6	6	6	5	5	6	6	0	4	48	0,72	0,58	0,44	0,47
Malá Bara-Stredný vrch	4	2	6	6	5	5	4	6	0	4	42	0,53	0,43	0,44	0,47
Ladmovce-Babský vrch	4	2	6	6	5	5	4	6	0	4	42	0,53	0,43	0,44	0,47
Ladmovce-Šomoš	4	2	6	6	5	0	4	6	0	4	37	0,53	0,43	0,44	0,31
Veľká Tŕňa fossils	4	4	6	6	8	0	2	6	0	0	36	0,63	0,50	0,31	0,19
Šimonov vrch	4	2	6	6	5	0	4	6	0	2	35	0,53	0,43	0,38	0,25
Viničky - obsidian	4	2	6	8	8	8	4	6	6	6	58	0,63	0,70	0,75	0,81

Explanations: Sci – scientific value, Edu – educational value, Eco – economic value, Add – added value, assessment categories C_1*-*C_{10} *adopted from Štrba and Rybár (2015)*

Conclusion

Tokaj region is internationally recognized territory, especially due to production of the Tokaj wines. Cultural and historical heritage of this region, which in many cases attracts the visitors to visit this area, plays the primary role in the development of various tourism products in the area. However, long-term viniculture history directly depends on the natural conditions, including specific geological features. Some of them, as presented in this paper, can be considered as significant geological heritage. Assessment results indicate that geoheritage located in the study area has potential to be a part of future, e.g., geotourism based, sustainable tourism products. However, an assessment, as presented in this paper is only the very first step in the whole process.

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Souhrn

Cestovní ruch je v současnosti považován za socioekonomický fenomén a jedno z nejdynamičtěji se rozvíjejících odvětví. V poslední době se v rámci udržitelného cestovního ruchu uplatňují zejména tyto formy cestovního ruchu: zelený cestovní ruch, venkovský cestovní ruch, přírodní cestovní ruch, agroturistika, geoturismus či ekoturismus. Tento článek je zaměřen na zhodnocení vybraných prvků geologického dědictví slovenské části Tokajské oblasti, mimořádně zajímavé oblasti formované unikátními přirodními podmínkami a typickým využitím krajiny - pěstováním základních odrůd révy - Muškát žlutý, Furmint a Lipovina. Výsledky hodnocení ukazují, že mezi devíti vybranými lokalitami je několik velmi významných. Obecně výsledky hodnocení naznačují, že geologické dědičství nacházející se ve studované oblasti má potenciál stát se součástí budoucích produktů udržitelného cestovního ruchu založených napr. na principech geoturismu. Samotné hodnocení, jak je prezentováno v tomto příspěvku, je však pouze prvním krokem v celém procesu rozvoje přírodních forem cestovního ruchu.

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ASSESSMENT OF TERRITORIAL STABILITY FROM LANDSCAPE AND ECOLOGICAL POINT OF VIEW

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Abstract
The aim of the study lies in analysing and evaluating the ecological status of the landscape with the specification of stress and anthropogenic dominant factors. The analysis was done for a case study in the upper Myjava River basin in the western part of Slovakia. To maintain the landscape's self-regulatory capabilities, it is crucial to know the historical development of the ecological stability and the stress factor influencing the current state. Ecological stability was assessed by several methodological procedures established for the conditions of the Slovak Republic, which serve to analyse landscape ecological status in the areas. Determination of ecological stability values is necessary for the comparison of development and changes of the landscape and the development of the landscape structure. The landscape ecological conditions were evaluated for the first and second military mapping, data from topographic maps of 1990, 2006, 2012, 2018 and a map of the current landscape structure. The results reflect the changes and development of the landscape structure within the individual evaluated periods and the analysis of stress factors (natural and anthropogenic). In addition, they include a proposal for measures to improve the current state of ecological conditions in the analysed area as also lift up cultural ecosystem services including recreation and ecotourism's.

Key words: ecological stability, landscape planning, stress factors, military mapping, anthropogenic activity

Introduction

In recent centuries, the country has undergone and is still undergoing significant changes, which have been caused by transformation in political, economic and property conditions. The current landscape structure is the result of gradual changes in the original natural land due to human activities. To understand the current structure of the landscape, it is necessary to pay attention to its development (Feranec, Oťaheľ, 2001), (Žigrai, 2000). Historical maps represent one of the essential materials with powerful information and interpretive ability for the needs of several scientific disciplines. In this study, maps from the first and second military mapping were used. The first military mapping called Josephine (completed during the reign of Joseph II.) was carried out in Slovakia in the years 1763 - 1785 (Boguzsak, Císař,1961). The mapping was performed without complex mathematical foundations. Second military mapping (also called Františkovo according to Emperor František I.) was mapped in 1837-1858 to eliminate the deficiency of the 1st military mapping, especially inaccuracy in the connection to the cadastre and geodetic basis. Based on the historical maps, it is possible to monitor and evaluate the landscape's development and assess the ecological stability of the landscape in particular periods. In addition, ecological stability assessment represents the fundamental base for landscape ecological planning. Nowadays, it is necessary to focus on the recreational potential of the landscape and its connection with the ecological value of the area. According to Svels, Åkerlund (2018) recreation is often considered as an important landscape element and should be included in the landscape planning in order to ensure the recreation and relaxation of its inhabitants. The assessment of ecological stability involves the application of the theoretical principles of landscape ecology. Its importance is emphasized by the growing problems that arise from the non-respect of natural laws and processes in developing the human population and civilization processes (Ferancová et al., 2010). Therefore, the paper aims to assess the landscape from an ecological and landscape point of view from the first military mapping to the present. Such a detailed landscape ecological analysis, including historical maps, provides a valuable basis for further landscape planning and improvements of management practices. A significant part of the planning includes a proposal of recreational areas as an important part of a balanced area providing possibility for recreation in correlation with the preservation of the ecological value of the landscape.

Material and methods

Description of the territory

The analyzed area is located in the western part of Slovakia close to the border with the Czech Republic (Fig. 1). The Myjava River basin is tributary of the Morava River and covers an area of more than 745 km^2. The course of the main flow of the Myjava is characterized by a multiple change of direction in its upper and middle parts of the Myjava Uplands. Among its tributaries is the Brezovský Creek, which flows from the left and is 20 km long (Hanušin et al., 2008). The dominant part of the river basin lies in a mildly warm and warm climatic zone with less than 50 summer days per year with a maximum daily temperature above 25°C. The average annual precipitation is around 660 mm, and agricultural land use is typical for this part of Slovakia.

Map inputs

Data for graphical representation of landscape ecological elements and stress factors are processed using the geographic information system ArcGIS. Map data from I. (1769-1784) and II. Military mapping (1837-1858), topographic maps (1953-1957), CORINE Land Cover maps from 1990, 2006, 2012, 2018 and ESPRIT maps of the current landscape structure are used.

Assessment of ecological stability

The methodologies developed for the territory of the Slovak Republic were chosen to calculate the ecological stability of the domain. Each method contains specific criteria for calculating ecological stability coefficients, based on which the ecological stability of the Myjava area was assessed. The following methodological procedures proposed by authors such as Míchal (1982), Miklós (1986) and Reháčková, Pauditšová (2007) were used.

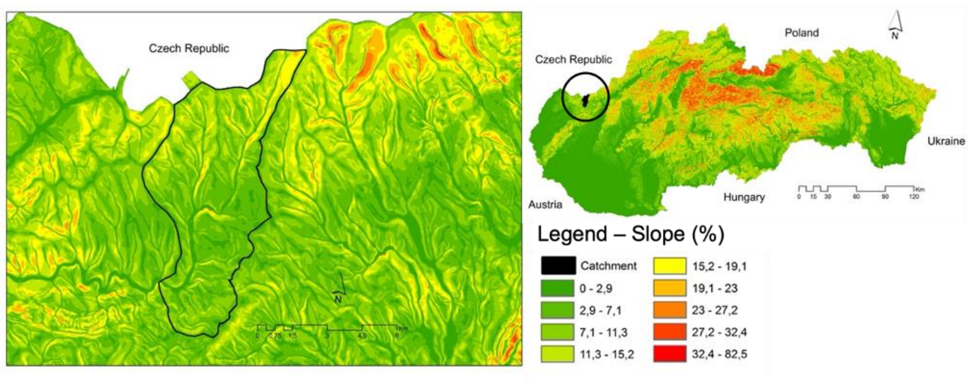

Fig. 1: Location of the mapped study area with slope representation

Results and discussion

Maps (Fig. 2) reflect the unique landscape ecological elements, their division, and subsequent changes in the spatial structure. From the first military mapping to the current territorial division, an increase in positive factors and a decrease in negative factors by 28% was observed. From 1990 to 2018, the area was mapped without significant changes. The least favourable condition of the territory is recorded during the first military mapping. After military mapping, an increase in the elements such as coniferous forests, bare soil, deciduous forests, water bodies were found. Since 1990, the values of the positive elements have started to rise again. The current territorial division clearly shows the predominance of positive elements (59%) over negative ones (41%). The positive (stable) elements include coniferous, deciduous and mixed forests, orchards and plantations and transitional forest cover, low grass, water areas. The negative (unstable) elements consist of agricultural land and urban area. The majority of the territory represents arable land (more than 30% of the total area). Areas reserved for sports and recreation are included in the current landscape structure (Fig. 2F). These zones are located within the urban area near human settlements. The location of the areas is advantageous, but it would be appropriate to complete recreational elements near forest units and thus improve the recreational potential of the area.

According to the methods of the authors Míchal (1982), Miklós (1986) and Reháčková, Pauditšová (2007) there was no change in the CES category, but the numbers improved to a better (most favourable) conditions and the overall improvement can be concluded. The consequence of the improvement to the decrease in the area of agricultural land. The presumed reason for the improvement lies in the reduction of the arable land (in the past arable land accounted for 49% and today approximately 30%).

The area was also evaluated in terms of anthropogenic and natural stress factors (Fig. 3). One of the stress factors is the pollution of the Myjava River to the extent of the entire length of the river flowing through the area. One wastewater treatment plant and three landfills have a dominant position in agricultural and industrial areas. Sources of pollution prevail in the southern part of the territory.

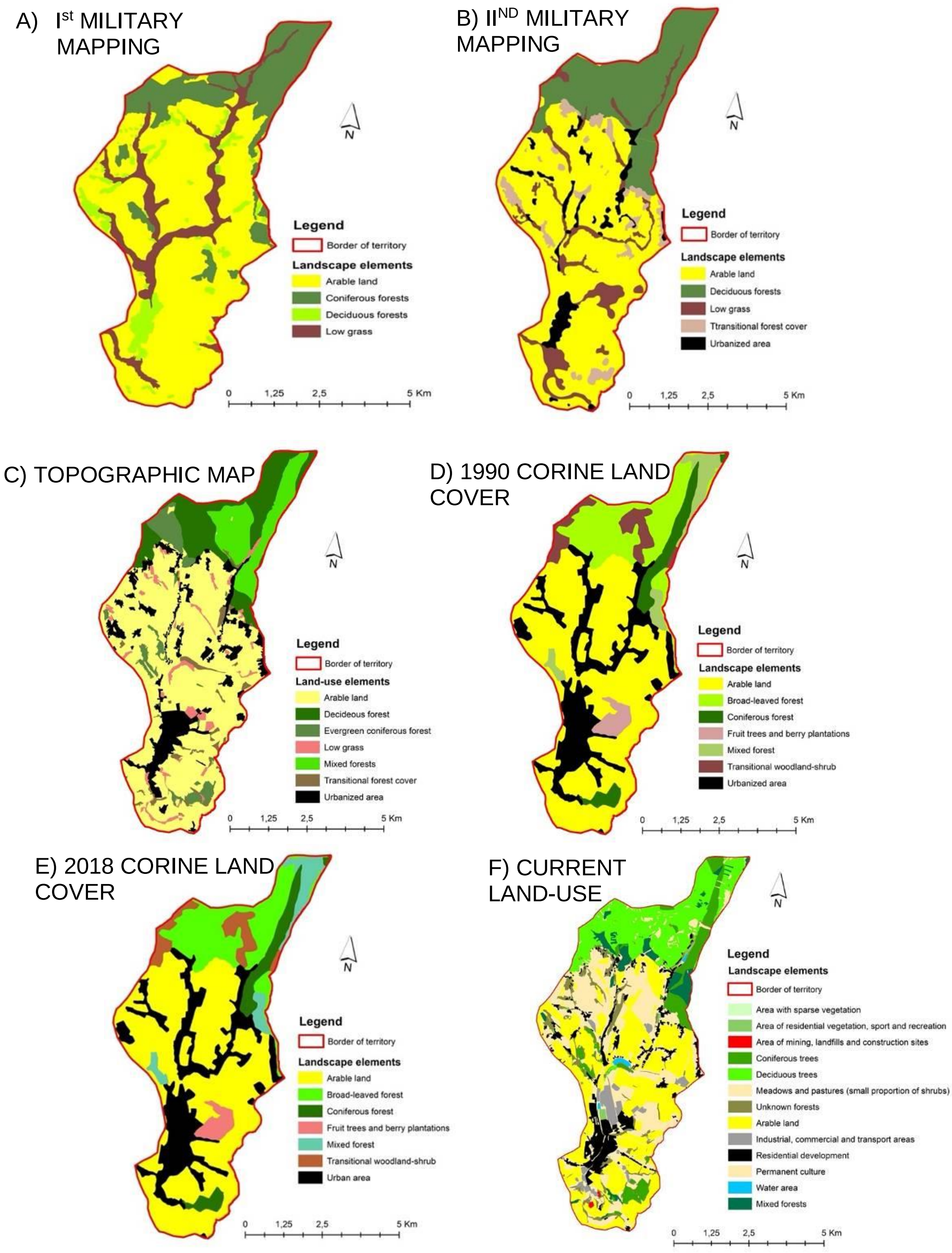

Fig. 2: Development of the landscape structure from the Ist Military mapping to the present A) Ist Military mapping, B) IIND Military mapping, C) Topographic map, D) 1990 Corine Land Cover, E) 2018 Corine Land Cover, F) Current land-use

Tab. 1: Summary of the results of CES evaluation for the Myjava River basin; A) Míchal (Míchal, 1982), B) Miklós (Miklós, 1986), C) Reháčková, Pauditšová (Reháčková, Pauditšová, 2009)

METHODOLOGY	TIME PERIOD	CES	RESULT	
A) Míchal	IST millitary map	0.45	Intensively used area	Overall improvement of landscape
	IIND millitary map	0.65		
	Topographic map	0.52		
	Corine 1990	0.47		
	Corine 2018	0.48		
	Current land-use	1.45	Quite balanced landscape	
B) Miklós	IST millitary map	0.37	Poor quality	Overall improvement of landscape
	IIND millitary map	0.43	Low quality	
	Topographic map	0.41	Low quality	
	Corine 1990	0.37	Poor quality	
	Corine 2018	0.40	Low quality	
	Current land-use	0.55	Moderately high quality	
C) Reháčková, Pauditšová	IST millitary map	1.74	Landscape with low ecological stability	Overall improvement of landscape
	IIND millitary map	1.99		
	Topographic map	1.80		

	Corine 1990	1.63		
	Corine 2018	1.69		
	Current land-use	2.34		

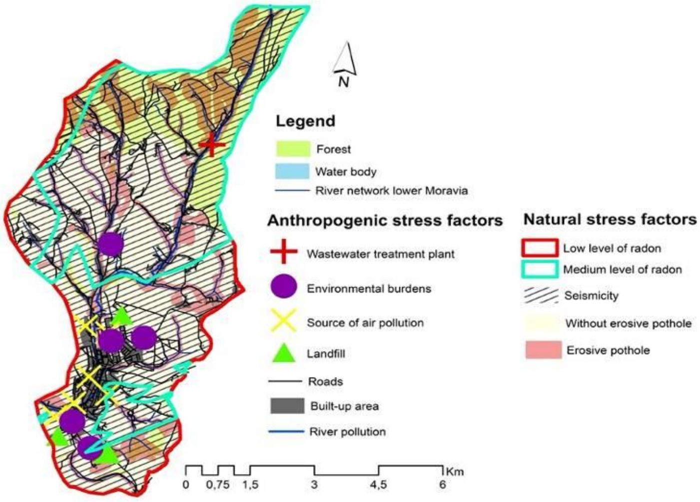

Fig. 3: Map of stress factors in the Myjava River basin (anthropogenic and natural ones)

The endogenous stress factors affecting the area are divided into a neotectonic active area (10.07 km^2) and without manifestations of neotectonic activity (32.66 km2). Other stress factors within the group of endogenous stress factors are seismicity and radon. The whole territory corresponds to the seismic risk of 0.3 m.s-^{2}, medium radon risk covering the area of 24.41 km^2, and the area with low radon risk includes 18.18 km^2. The exogenous stress factor of the mapped area is erosion deformation of slopes (erosive potholes) occurring in the southern and northern parts with a total area of 0.48 km^2.
The article deals with the evaluation of the landscape from the ecological and landscape point of view for the period from the first military mapping to the present. The largest changes in the composition of the Slovak's landscape structure are recorded since the 1950s when the intensification has become a dominant feature of agriculture. Intensification, specialization, mechanization, and chemistry have become the driving forces of agricultural production. The trend of decreasing intensification has been recorded since 1990 which has led to a decrease in the burden on the environment (Kanianska, 2006). To maintain a healthy landscape, it is necessary to incorporate an ecological element in landscape planning without disturbing and interfering with natural ecosystems (Termorshuizen et al., 2007). The balance in the landscape is important for all processes taking place in the country, including maintaining the development of water management (Kandera et al., 2021) and water resources (Keszeliová et al., 2021).

Conclusion

Knowing the state of the landscape from the ecological point of view is extremely important for maintaining the landscape's self-regulatory capabilities, thanks to which it can resist anthropogenic activities, negative consequences of human intervention and eliminate the disruption of ecosystems. The study used several methodological procedures to calculate ecological stability and assess the landscape's state in particular periods (from 1st Military mapping to the present) in the area. The results points to the changes in the landscape structure during these periods (graphic map outputs). The same results can be seen in the evaluation of cultural ecosystem services in this region, which include recreation as also tourism and we can see the importance of ecological stability of this area by proposing new measures. These can serve also as the basis for further landscape planning and proposals to improve the current situation e.g. for flood protection, erosion reduction, sustainable agricultural management etc..

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Souhrn
Cílem studie je analýza a hodnocení ekologického stavu krajiny se specifikací stresových a antropogenních dominantních faktorů. Analýza byla provedena pro případovou studii v povodí horního toku řeky Myjavy v západní části Slovenska. Pro zachování autoregulačních schopností krajiny je klíčové znát historický vývoj ekologické stability a stresový faktor ovlivňující současný stav. Ekologická stabilita byla hodnocena několika metodickými postupy stanovenými pro podmínky Slovenské republiky, které slouží k analýze ekologického stavu krajiny v daných oblastech. Stanovení hodnot ekologické stability je nezbytné pro porovnání vývoje a změn krajiny a vývoje krajinné struktury. Krajinně ekologické podmínky byly hodnoceny pro první a druhé vojenské mapování, údaje z topografických map z let 1990, 2006, 2012, 2018 a mapa současné krajinné struktury. Výsledky odrážejí změny a vývoj krajinné struktury v rámci jednotlivých hodnocených období a analýzu stresových faktorů (přírodních i antropogenních).

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COMPARISON OF THE PERMITTING OF SELECTED RECREATIONAL BUILDINGS FROM THE PERSPECTIVE OF THE NEW AND OLD BUILDING ACT

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Abstract
The paper will be devoted to the issue of permitting selected buildings for recreation from the perspective of the current Building Act No. 183/2006 Coll. and from the perspective of the new Building Act No. 283/2021 Coll., which is to come into force on 1 July 2023. The author will focus on specific selected types of buildings for recreation, which are located and implemented in recreational areas. A comparison will be made between the different forms of permitting of these structures according to the old and the new Building Act.

Key words: Building Act, recreational facilities, sports grounds

Introduction
Rules for construction were codified in the Czech lands as early as the Middle Ages, not only as rules for construction, but also technical conditions for construction and control of compliance with these conditions by the authorities. Already in the Middle Ages it was the builder's duty to obtain a permit before building most structures. The legal regulation of building permits changed and became more specific over the centuries.

Methods
In recent years, the issue of recodification of public building law and the approval of the new Building Act has been a very topical issue. This is an issue that affects the rights of many citizens, either as builders or as neighbours affected by construction, even in terms of buildings for recreation. The process of adopting the new building law was very complicated and long. In 2019, the substantive draft of the Construction Law was published, which introduced new basic rules for public construction law, including a proposal for reform of public administration in the field of construction. The draft amendment was prepared at the end of 2019. The legislative process of approving the new regulation was completed on 13 July 2021, when the new approved Construction Act was published in the Collection of Laws under the number 283/2021. The new Construction Act will come into force gradually, and the comprehensive law is expected to come into force on 1 July 2023. However, in recent days, the possibility of postponing the entry into force and the preparation of amendments to the Act have been discussed.

Results
In general, one of the main changes of the new Construction Act can be described as a reform of the construction public administration consisting in the integration of selected concerned authorities into construction authorities and a change in the structure of construction authorities. There should be a Supreme Construction Authority (§ 32), a specialised and appellate construction authority (§ 33), a regional construction authority (§ 34) and other construction authorities (§ 35) as the first instance authority. Another change should be the acceleration of building permitting, which consists in the so-called one-stage permit, i.e. a building will no longer require a permit with location and a permit for implementation, but only one permit for the construction plan. In certain statutory cases, it will also be possible to obtain this permit under the accelerated procedure (§ 211 et seq.). Another change concerns the so-called digitisation of processes and the digitisation of public building law. All these changes will also affect the permitting and construction of buildings for recreation.
In connection with the above-mentioned approved amendments to the Building Act and the topicality of the issue of building permits, the author focuses on selected types of buildings for recreation and their forms (methods) of permitting, including a comparison of the forms of permitting under the existing Building Act[1] and under the new Building Act.[2]

[1] Act No. 183/2006 Coll., as amended
[2] Act No. 283/2021 Coll.

Building for recreation - general definition
As in the existing Building Act, the term "building for recreation" is not enshrined in the new Building Act. Other laws also do not have a separate definition. Thus, we can consider as buildings for recreation basically any buildings that allow their use for recreational purposes. This can be, for example, buildings for family recreation, buildings for other residential recreation and other buildings for sport and recreation, which are buildings serving recreation in the form of an additional function, e.g. buildings serving selected sporting activities (motocross track, ski lift, water lift, etc.).
The author has chosen to compare the forms of permitting of buildings for family recreation, accommodation facilities and a motocross track.

Building for family recreation
A building for family recreation is a building whose volumetric parameters and appearance correspond to the requirements for family recreation and which is intended for this purpose; a building for family recreation may have a maximum of two above-ground floors and one underground floor and an attic [Section 2 (b) of Decree No. 501/2006 Coll.]; for example, a holiday home, a cottage, a holiday cottage, a garden cottage.
Construction for family recreation under the current Building Act requires a simplified form of permitting, namely the placement in the form of a zoning consent under the provisions of Section 96 of the Building Act and the notification of construction under the provisions of Section 104 (1) (a) of the Building Act. Both the location consent and the building permit are issued by the general building authority (provisions of Section 13 of the Building Act). According to the provisions of Section 96a of the Building Act, a joint planning consent and a consent for the execution of the notified construction project can be issued. The conditions under which a building for individual recreation can be authorised by these simplified procedures (consents) are determined by law. It is possible to permit the location of a building by means of a planning consent if the building is in a built-up area or in a buildable area, the conditions in the area are not substantially changed and the project does not require new demands on public transport and technical infrastructure. One of the requirements for the granting of planning consent and building notification consent is the consent of neighbours who may be affected by the permitted development. A problem in the case of some family recreation buildings may be the requirement for the consent of affected neighbours, which is not obtained and therefore the building does not meet the condition for authorisation in the form of planning consent and building notification. If this is the case, it is then necessary to obtain a siting permit in the form of a planning consent and building permit to permit such a structure.
Under the new Building Act, the above-described building for family recreation (maximum two storeys above ground and one underground storey and an attic or set-back storey) is classified as a simple building in Appendix 2. According to the new Building Act, the building should be authorised by one decision, namely the planning permission. Permission can also be obtained in a so-called simplified procedure, for which the prior consent of the affected neighbours is also required. Compared to the current procedures, this will simplify the process, whereby it will not be necessary to obtain a location permit and then a permit for implementation.

Construction of accommodation facilities
An accommodation building is a building or a part thereof where accommodation and related services are provided (hotel, motel, guesthouse, tourist hostel, dormitory, boarding house, camping site and group of cottage-bungalows, cultural or monumental building used for temporary accommodation, etc.); an accommodation building is not an apartment house, family house or a building for family recreation (Section 2(c) of Decree No. 501/2006 Coll.).
Since the construction of accommodation facilities does not meet the conditions for a permit in a simplified manner under the current Building Act, it is always necessary to obtain a location permit in the form of a zoning permit and a building permit in the form of a building permit. Both the zoning decision and the building permit can be replaced by a public law contract (provisions of § 78a and § 116 of the Building Act), provided that the statutory conditions are met. The building permit can also be replaced by a certificate of an authorised inspector in accordance with the provisions of Section 117 of the Building Act.
According to the new Building Code, the above-described building for recreation serving as an accommodation facility should be authorised in the same way as a building for family recreation, i.e. by a single decision, namely the planning permission. The permit can also be obtained in a so-called simplified procedure.

Sports ground - motocross track

Various sports facilities, such as motocross tracks, are also used as specific buildings for recreational use. In terms of the current Building Act, the basis for the construction of such a sports ground is usually landscaping, which, however, requires a permit from the building authority. Furthermore, other administrative authorities must also comment on the construction project in question, from the point of view of nature and landscape protection, protection of the agricultural land fund, noise protection, etc.
From the point of view of the new Building Act, according to Section 213, it will be a change of land use that requires a permit, with the exception of landscaping up to 1.5 m in height or depth with an area of up to 300 m2 on land that does not have a common boundary with a public road or public open space.

Conclusion

Buildings for recreation are very broadly defined from the point of view of law. It can be both buildings for recreational housing and buildings for recreational activities that fulfil a certain additional function of recreation. These may be, for example, sports grounds or other buildings that enable sporting activities, etc. Due to the variety of types of buildings for recreation, it is not possible to uniformly determine the methods of permitting these buildings under either the existing or the new Building Act. It will always be necessary to assess which particular building is involved, which particular sporting activity is involved and to approach the permitting of buildings accordingly. Related issues such as nature and landscape protection, forest protection, water protection, etc. cannot be overlooked.

Souhrn

Stavby pro rekreaci jsou z pohledu nejenom práva pojaty velmi široce. Může se jednat jak o stavby pro rekreační bydlení, tak stavby pro rekreační aktivity, které plní určitou doplňkovou funkci rekreace. Může se jednat např. o sportoviště či jiné stavby, které umožňují sportovní aktivity, aj. Vzhledem k různorodosti typů staveb pro rekreaci, nelze jednotně určit způsoby povolování těchto staveb ani dle stávajícího ani dle nového stavebního zákona. Vždy bude nutné posuzovat o jakou konkrétní stavbu se jedná, o jakou konkrétní sportovní aktivitu se jedná a dle toho se bude přistupovat k povolování staveb. Nelze taktéž opominout i otázky související jako je ochrana přírody a krajiny, ochrana lesa, ochrana vod, apod.

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COMPARISON OF THE RESILIENCE MODULUS AT DIFFERENT MOISTURE CONTENTS USING THE CYCLIC CBR TEST TO PROMOTE NATURE TOURISM

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Abstract
The detailed and sensitive determination of input characteristics for low volume road design is important especially for the natural environment in conjunction with recreation activities. Existing methodologies for the pavement structure design consider the Resilience Modulus to be the fundamental property to characterize the materials of low volume roads. In order to obtain this modulus the cyclic CBR test has been used. Two different test variants have been carried out, the first one applying a constant 2.5mm penetration repeatedly until the elastic deformation reaches a constant value, and the second one applying a constant stress of 210 kPa. The material examined has been tested at fifteen different moisture contents and for each moisture content two different material compaction levels have been considered. Thus it has been possible to analyze the difference between the Resilience Modulus values obtained from the two different variants of cyclic CBR tests, for different moisture contents as well as for different material compaction levels.

Key words: Natural Environment for recreation, Low Volume Road, Californian Bearing Ratio, Resilient Modulus, Moisture, Density Dry of Soil, Subgrade

Introduction
Low-volume roads (LVR) are roads with lower traffic volume that mainly include forest and country roads. These roads are designed to carry low volumes of traffic and are defined as being in the range of less than 400 vehicles per day, and its design is based on knowledge of the Californian bearing ratio (CBR) value (ČSN EN ISO 13286-47, 2015). These types of roads are essential for the social and economic development of small, often mountainous, or semi-desert human communities where access to basic health and education services is very difficult.
Although LVR have different functions in different countries, they have specific characteristics in common and must meet general criteria for reliability, load capacity and durability. Moreover, their importance for forest management cannot be in contradiction with society's environmental and economic priorities.
LVR are also the main road networks in mountainous areas. Thanks to these roads it is possible to access to these mountainous areas or forests where visitors can go hiking and enjoy nature. It can be said that they are vital to promote nature tourism, as they conserve it to a large extent by using local materials to ensure that the original state of nature is not changed. It is also important that these natural materials are sourced close to where the road is to be built, as the use of other materials, even if they are natural, can have a negative impact on the ecosystem.
In addition, soil is a highly variable material, which makes it very difficult to study. A small change in the basic properties of the soil, such the compaction level or moisture, directly influences the behaviour of the soil. That is why all its properties have to be constantly controlled in order to make a good study and to obtain good results.
The design and evaluation of these pavements requires careful determination of such factors as: material properties, traffic type and volume, environmental conditions, etc. Material properties are one of the most important factors in the structural design of a pavement, as well as in its performance during its life. The current methodology for pavement design used by the AASHTO method (American Association of State Highway and Transportation Officials) (AASHTO, 2003), considers that the fundamental property for characterising the constituent materials of a road section is the parameter called resilient modulus.
This module must be obtained by triaxial tests done in cyclic load condition, however, number of test equipment such as CBR apparatus, is easier to obtain and cheaper to buy than sophisticated cyclic triaxial apparatus. One of solutions of this problem may be cyclic CBR test which is using CBR apparatus in extraordinary way. By CBR test method researchers are able to receive mechanistic factors such as Young modulus (E) or Resilient modulus (M_R).
These tests have been done with different moisture and therefore with different levels of compaction, this is due to the fact that in nature, depending on the season of the year, the conditions will change.

Each year in nature the process of volume increase is repeated, reaching the maximum volume in winter when the rainwater freezes. Thanks to the cyclic CBR tests, these conditions can be simulated and the volume can change as it does in nature.

Material

The first thing that was done before the CBR tests were started was to classify the material. This classification is based on the USCS (Unified Soil Classification System) (ČSN EN ISO 14688-2, 2005), is used in engineering and geology to describe the size and texture of soil particles. Once all the tests for classification have been carried out, it was determined that the soil to be used is a clayey material of medium plasticity (CI).

Methodology

Two modifications of the CBR test were used to analyze the deformation behaviour of the soil, which are being verified and developed in the MENDEL laboratory. One with a constant penetration of 2.5 mm and the other with a constant tension of 210 kPa. The first test ($M_{R,2}$) is based on Molenaar's theory (Molenaar, A.A.A., 2007), where a constant penetration of 2.5 mm will be applied repeatedly until the elastic recovery is zero. The second test ($M_{R,3}$) however, is an innovative test proposed by the Mendel laboratory in Brno, which is based on applying a constant stress of 210 kPa repeatedly (PUV 304642, 2014). This stress simulates the stress that the sub-base layer of a low volume road has to withstand.

These roads are normally composed of four or three layers the first layer is the superficial layer, the second is the base layer, the third is the sub-base and the last is the sub-grade, where the other two are laid. However, on rural roads, the first layer or base layer is usually the same surface due to the lack of any surface material. After an analysis, it has been calculated that the sub-base layer is subjected to a stress of 210 kPa when a vehicle passes through.

In order to quantify the influence of the change in moisture, an experiment was planned. To be able to analyse the influence of this parameter, it has been decided to carry out tests with different moisture contents, for this purpose, the same test was carried out with fifteen different moisture levels. Some of them below the optimum soil moisture and others above, from a humidity of 1.29 % to 19.56 %.

Furthermore, soil characteristics are also thought to vary according to its compaction. To verify this, CBR cyclic tests (Ševelová, Florian, Hrůza, 2020) have been carried out on the top and bottom of the mortar, that is, on the part where the soil is less compacted (CBR MIN) and on the part where it is more compacted (CBR MAX). This compaction is done in 3 layers. The 3 layers must have a similar amount of soil, and each layer must be compacted with 56 blows. Furthermore, these blows have to be made in the same order. The compaction energies are as follows:

- CBR MAX = 0,582886 MJ/m3
- CBR MIN = 0,194295 MJ/m3

Results

The laboratory analysis consisted of two different geotechnical tests- the classification of subgrade soil materials and determination of the resilience modulus using the cyclical CBR test.

To classify the subsoil according to Unified Soil Clasification System (USCS). Three different tests have been done: Humidity , Granulometry with aerometry and Atterberg limits (ČSN EN ISO 14689-1, 2004). The soil used was classified as F6-CI, with an optimum humidity of 15.3 % and a maximum dry density of 1785 kg/m^3 (ČSN EN ISO 13286-2, 2015)

As already mentioened, samples were prepared for the experiment from a humidity of 1.29 % to 19.56 %, with a dry density varying from 1550 kg/m^3 to almost 1800 kg/m^3.

A total of 60 cyclic CBR tests were carried out, 30 tests of 2.5 mm constant penetration ($M_{R,2}$) and 30 tests of 210 kPa constant stress ($M_{R,3}$). Of these tests, 15 were carried out on the upper part of the mortar, i.e., with the minimum compaction level (MIN), and another 15 on the lower part, with the maximum compaction level (MAX).

Once the tests had been carried out, the results obtained were analysed. Tab. **1** shows some of the parameters obtained in the $M_{R,2}$ tests with the two compaction levels. As can be seen, the stresses obtained are higher in the tests performed at the maximum compaction levels. Furthermore, the Resilience Modulus obtained have been analysed, in most cases the modulus obtained with the maximum compaction are higher than those obtained with the minimum compaction, reaching a difference of 60 %.

Tab. 1: MR,2 results

Test	Cycle range	Stress range (kPa)	$M_{R,2}$ range (MPa)
MR,2 MAX	10-22	41.23-2200.53	7.45-116.61
MR,2 MIN	10-37	26.68-1880.77	4.66-119.11

Tab. 2 presents some of the results obtained in $M_{R,3}$ tests. In this case the compaction also influences the modulus value in direct proportion. The highest results have been obtained when the compaction is maximum.

Tab. 2: MR,3 results

Test	Cycle range	Deformation range (mm)	$M_{R,3}$ range (MPa)
MR,3 MAX	4-71	0.074-17.59	11.1-300
MR,3 MIN	4-34	0.863-8.081	7.66-190

As for the deformations during the $M_{R,3}$ test, in most cases the largest deformation occurs on the less compacted surface, and the average difference with respect to the most compacted surface is 54 % (Fig. 1). This occurs until the optimum humidity is reached, after that, larger deformations occur on the more compacted surfaces.

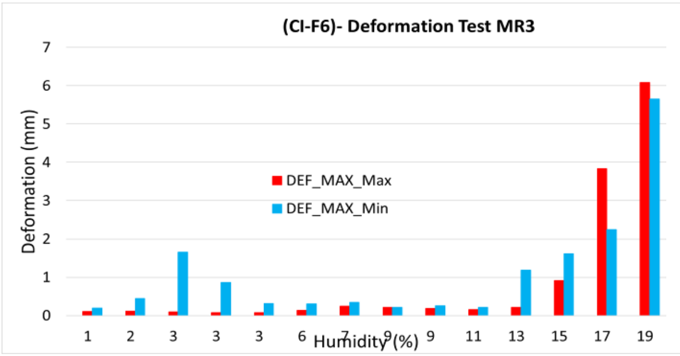

Fig. 1: Deformation $M_{R,3}$

Comparing the results of $M_{R,2}$ and $M_{R,3}$ tests it can be said that the $M_{R,3}$ test is more reliable with respect to the compaction conditions (Fig. **2**) and does not break the analysed material during the test. This test is able to better describe the elasticity of the material, and therefore the resilient modulus.

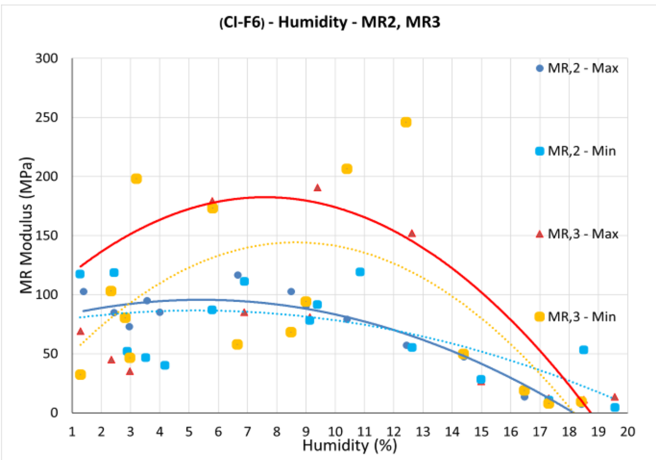

Fig. 2: Results of M_R

Discussion

Comparing the results of the $M_{R,2}$ and $M_{R,3}$ tests it can be said that the $M_{R,3}$ test is more reliable with respect to the compaction conditions and does not break the analysed material during the test. This test is able to describe better the elasticity of the material, and therefore the modulus of resilience. As for the deformations during the $M_{R,3}$ test, in most cases the biggest deformation occurs on the less compacted surface, and the average difference with respect to the more compacted surface is 54 %

(Fig. **1**). This occurs until the optimum moisture content is reached, after which larger deformations occur on the more compacted surfaces.

Conclusion

The level of compaction influences many soil parameters. A very important relationship was found between the more compacted layers, where the deformations were minimised and the modulus reached higher values in most cases.

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Souhn

Stávající metodiky pro návrh konstrukce vozovek považují modul pružnosti za základní vlastnost pro charakterizaci materiálů nízkoobjemových vozovek. K získání tohoto modulu byl použit cyklický CBR test, ale předtím byl použitý materiál klasifikován na základě USCS (Unified Soil Classification System) jako (CI).

Byly provedeny dvě různé varianty cyklických zkoušek CBR, první s opakovaným konstantním 2,5 mm průnikem, dokud pružná deformace nedosáhne konstantní hodnoty (MR,2), a druhá s konstantním napětím 210 kPa (MR,3). Bylo provedeno celkem 60 testů, zkoušený materiál byl testován na patnáct různých obsahů vlhkosti a pro každý obsah vlhkosti byly uvažovány dvě různé úrovně zhutnění.

Po ukončení zkoušek byl analyzován vliv zhutnění a vlhkosti. Při zkouškách MR,2 jsou napětí získána vyšší při zkouškách prováděných při maximálních úrovních zhutnění. Dále byly analyzovány získané moduly pružnosti, ve většině případů jsou moduly získané s maximálním zhutněním vyšší než moduly získané s minimálním zhutněním a dosahují rozdílu 60 %. To se také děje v testech MR,3.

Pokud jde o deformace při zkoušce MR,3, ve většině případů dochází k největší deformaci na méně zhutněném povrchu a průměrný rozdíl vzhledem k nejvíce zhutněnému povrchu je 54 %.

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COULD A SPATIAL DATABASE OF HISTORICAL PHOTOGRAPHS BE USED FOR RURAL TOURISM PROMOTION?

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Abstract
Historical photographs contain valuable information about the past state of a municipality and its surroundings. Over time, old structures and land patterns in the landscape become untraceable or indistinguishable, and determining the exact location from which a historic photograph was taken becomes complicated or impossible. People who are unfamiliar with the history of the location are unable to pinpoint where the photographs were taken or what it depicts. This reduces the informative value of historical photographs and prevents their wider use. To conserve photographs, along with their localisation and direction, a spatial database was created based on historical property records maps, digital elevation model, and panoramas from Seznam.cz. The study was carried out in the Luková cadastral area, located in the Czech Republic. Overall, 395 photographs were acquired, of which 225 were historical photographs ranging from 1845 to the 1980s. The remaining photographs were taken in 2015. All acquired photographs primarily capture rural buildings and sacred objects. From photographs, the historical rural character of the municipality could be determined, as well as objects of interest for rural tourism. In a comparison of photographs of buildings from the 1980s and 2015, loss of local architecture and traditional gardens can be seen.

Key words: spatial database, countryside, Sudetenland, rural identity, photograph

Introduction
Historical photographs are highly valuable as they contain a high density of valuable information about the past (Maiwald et al., 2017; Bruschke et al., 2018a; Bayr, 2021) and capture details that cannot be found on historical topographic maps (Skokanová et al., 2021). From the 1930s onward, aerial photography became more common, but ground photographs are still an important source of information, as they capture the landscape and objects from the human perspective (Bayr, 2021).
The first photographs began to appear in the first half of the 19^{th} century. At the beginning, this technology was not as widely available as it is today, primarily due to cost. This led to scarcity of the oldest photographs, making them valuable for various fields of research. Historical photographs are usable, for example, for architectural research (Bruschke et al., 2017; Bruschke et al., 2018a; Palupi, 2021), for evaluation of land use and land cover changes (Lacina and Halas, 2015; Skokanová et al., 2021; Bayr, 2021), for evaluation of landscape aesthetics or landscape heterogeneity (Ferreira and Sánchéz-Martín, 2022), for examining tourist perceptions of destinations (O'Donoghue et al., 2020), for landscape preference studies (O'Donoghue et al., 2020) or for studying tourist behaviours (Zhong et al., 2020).
Landscape aesthetics and landscape heterogeneity influence the recreational potential of the area (Ferreira and Sánchéz-Martín, 2022) and are also closely related to ecosystem stability and the provision of various ecosystem services. Diverse cultural landscapes with high aesthetic value are preferred for rural tourism due to their cultural aspects (O'Donoghue et al., 2020; Ferreira and Sánchéz-Martín, 2022; Zheng et al., 2022). O'Donoghue et al. (2020) also highlight the importance of animals in the landscape as an element of interest for rural tourism. On the other hand, intensively utilised landscapes lower tourist interest (Ferreira and Sánchéz-Martín, 2022). Promotion of traditional and sustainable agricultural practices could become an opportunity to boost local rural tourism and enhance the aesthetic value of the landscape, together with a boost to landscape heterogeneity (Ferreira and Sánchéz-Martín, 2022).
The landscape, together with urban areas, is under constant development, making old photographs hard to localise in the space. This lowers their informative value and usability, as some landscape features or objects no longer exist. Spatially-oriented photographs enable comparison with present or past topographical maps or photographs (Skokanová et al., 2021) and significantly enhance their legibility. Retaking historical photographs in the same location enables researchers to perform detailed analyses of the landscape, cityscape, or building changes across different time periods (Lacina and Halas, 2015; Bruschke et al., 2018b). If the repeat photography is done precisely, it can be effectively used for communication with a broad audience (Bayr, 2021), graphically illustrating changes

in the landscape or new proposals still in the planning stages. Historical photographs can also be used for conservation or restoration of typical local character, as they contain information about the placement of old features, such as roads with alleys, hedgerows, or other landscape features typical for the area. Also, they could contain information about typical vernacular or rural building characteristics (Palupi, 2021).
The aim of this article is to promote the creation of spatial databases with historical photographs that can be easily accessed.

Material and methods
The Luková cadastral area was selected (12.78 km^2) as a study site. The Luková cadastral area is part of the Luková municipality located in the Lanškroun District in the Pardubice Region, Czech Republic (Fig. 1). Luková is an old municipality first mentioned in 1304 (Celý, 2017), and its name, Luková, indicates its Czech origin. Despite that, the municipality was mainly inhabited by ethnic Germans (89%) in 1930, before their expulsion from 1945–48. The municipality of Luková and its surrounding land were part of the German-language region known as *Schönhengstgau*.
The urban area of the Luková municipality was characterised by farms with enclosed yards. In 1622, the *meierhof* of the Lichtenstein family was built here, with associated fields in the southeastern part of the Luková cadastral area and a large Lukovský pond with a water area spanning 100–120 hectares. The Lukovský pond was probably drained in the first half of the nineteenth century before the railroad was built. Today, as land in the municipality is mainly used by a large agricultural cooperative, the primarily agricultural character of the urban area is disappearing. The buildings are slowly being rebuilt into family houses, though some buildings associated with agricultural use are being demolished.

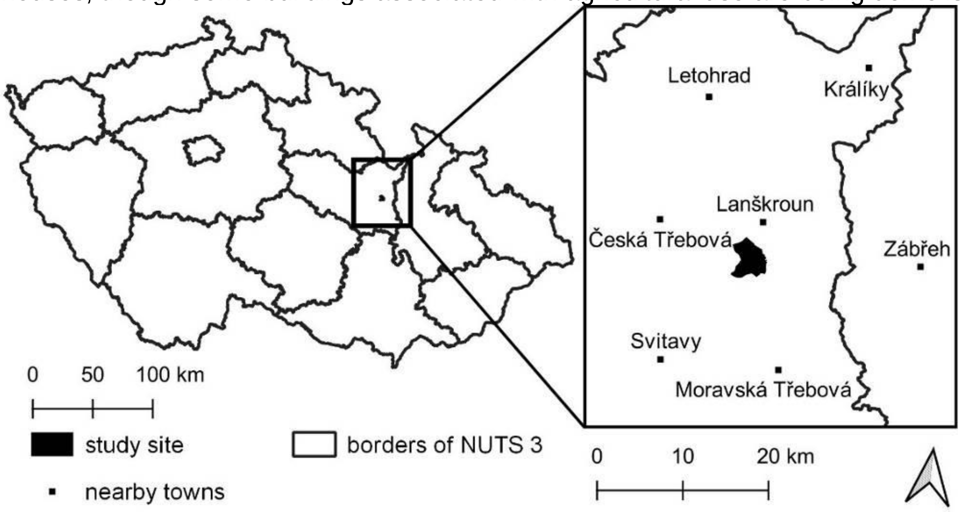

Fig. 1: Location of the Luková cadastral area in the Czech Republic.

A spatial database of historical photographs was created from 395 images, of which 225 date from 1845–1984. The remaining photographs were taken in 2015. Most of the photographs are from 1984 and were captured by Jan Němeček, former Luková municipal historian. Those photographs capture every building existing at the time. The present historian and photographer, Ing. Stanislav Vimr, recaptured all those buildings after 30 years from the most similar spot possible. The rest of the photographs were from publicly available sources, the Luková municipal website and the collection of Ing. Stanislav Vimr.
To find the location where the photographs were originally taken, a digital elevation model (DEM), historical property record maps in vector format (Revised Cadastre, Cadastre of Lands and Real Estate Registry), and a Seznam.cz panorama view were used. The method of location and orientation determination using DEM and historical property record maps (Cadastre of Lands) is shown in Figure 2. In this case, three landmarks were used: the church of Saint Margaret, the wooded hillside of the Červený hill, and a now non-existent wooden building with house number 26.

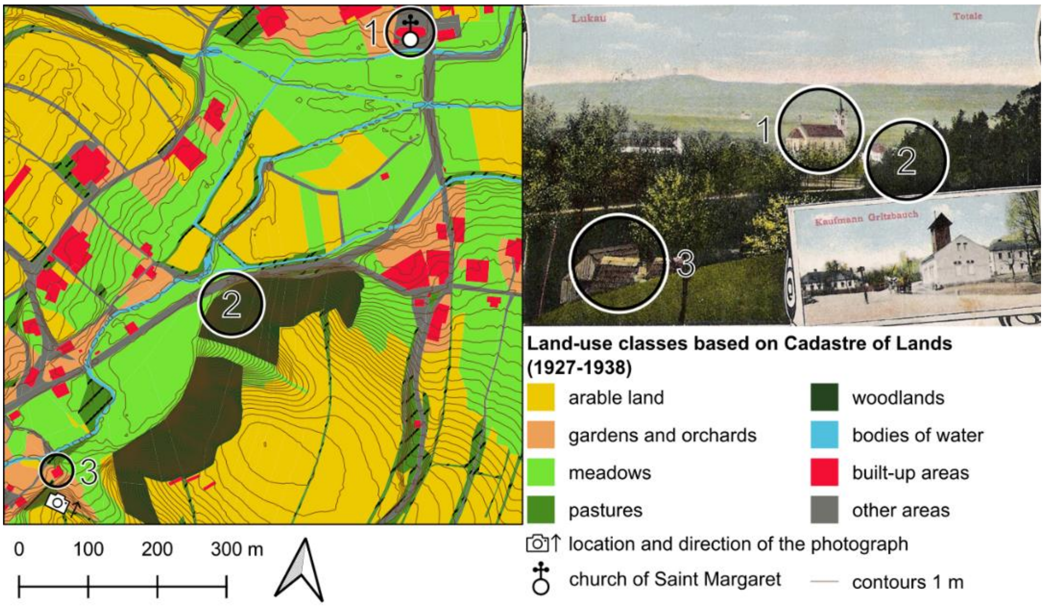

Fig. 2: The process of determining the location and orientation of a historical photograph (captured before the year 1940) using DEM and Cadastre of Lands map.

Results and discussion

From the available photographs, a spatial database was created and both location and direction were determined. The process proved to be robust and simple despite the lack of detailed knowledge of the area, as all the available photographs were localised.

Spatial databases of historical photographs can be used for a variety of purposes, but they have added value in terms of tourism. They capture historical features of the landscape that can be restored or conserved, preserving landscape character and promoting tourist interest on a local scale. Also, those photographs, together with the re-photographing method, could be used to create informative tables in key locations in the municipality or in the surrounding land, such as the water mill near the *meierhof*, the dam of the former Lukovský pond or the church of Saint Margaret, which was long ago surrounded on three sides by the Lukovský pond. Information from historical photographs could also be used as a source for spatial planning activities at the municipal, not just for tourism.

Residents of the municipality could use this spatial database to compare the current state of their property with its past state or use those photographs for building reconstructions if they wish to preserve the historical character of their property while also preserving the rural identity of the place. This primarily applies to areas where the building's character is not regulated.

Historical photographs could be analysed using various photogrammetric methods. For example, by using structure-from-motion (SfM) evaluation, a point cloud could be created (Bruschke et al., 2017), which could be further used for building reconstruction (Maiwald et al., 2017). The SfM evaluation could also be used to automatically determine points where the photographs were taken (Bruschke et al., 2018b). Both uses described above require a set of several photographs that capture the same object from different angles and sides (Bruschke et al., 2018b), preferably from the same time period. From all the photographs, not a single object in the whole Luková municipality does not have sets of photos capturing all its directions and sides. Broader use of this method is limited and practical only for highly popular structures.

Next, we highlight digital monoplotting, which enables photographs to be transformed into coordinate systems, enabling the digitalisation of information captured by the historical photographs. Bayr (2021) used digital monoplotting to monitor forest expansion based on historical and current photographs. This could be used in later research, for example, to locate alley trees, old roads, or for determining the extent of fields.

The photographs were not deeply analysed using a uniform approach, but from brief inspection we can see that some reconstructions were inconsiderate, overlapping or destroying vernacular symbols typical for this area. Another negative development is the disappearance of fruit trees at the expense of ornamental non-native species. This could be clearly seen by comparing photographs from 1984 and 2015. This has a significant impact on the perception of urban areas or their aesthetic value, as traditional gardens in the past were composed mainly of native species, incorporating both productive and ornamental aspects.

Usage of spatial databases of photographs is common and there are many publicly available, such as Google Maps and Flickr (Bruschke et al. 2017), but the most favourable way is to place spatial databases on municipal geoportals or map viewers. Following completion of this research, this database will be imported into the geoportal of the Luková municipality.

Conclusion

Placing historical photographs in a spatial database greatly increases their legibility and usability. The database can be continuously updated and thus help with the conservation of photographs. It is important to emphasise the importance of historic preservation, as images are mainly in the possession of elderly people or in municipal archives, which are not always easily and freely accessible to the public. Placing a spatial database in a public space enables everyone to interact with it for research or other purposes.

Spatial databases of historical photographs can also be used for rural tourism promotion as they contain information about the past that could be conserved, restored, or highlighted, thus increasing the attractiveness of the locality. The re-photographing method can be used for the creation of informative tables located in the key locations of the municipality.

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Souhrn
Historické fotografie zachycují a uchovávají informace o minulosti obce a jejího okolí. Postupem času se stávají staré objekty a krajinné tvary v krajině nedohledatelné nebo nerozeznatelné a určení přesné pozice, odkud byla historická fotografie pořízena, se stává komplikované až nemožné. Osoby, které neznají historii obce, nedokážou určit odkud byla fotografie pořízena, eventuelně co zachycuje. To snižuje informativní hodnotu historických fotografií a znemožňuje jejich širší využití. Proto byla v rámci tohoto výzkumu vytvořena prostorová databáze historických fotografií, která uchovává místo a směr pořízení fotografií. Místo a směr pořízení bylo určováno na základě historických map majetkoprávních evidencí, digitálního modelu terénu a panoramat od Seznam.cz. Prostorová databáze byla vytvořena pro katastrální území Luková, které se nachází v České republice. Obec byla původně součástí německého jazykového regionu „Schönhengstgau," s převažujícím podílem německých obyvatel.
Historické fotografie jsou primárně v osobním vlastnictví lidí, v obecních archivech nebo je vlastní obecní kronikáři, proto je důležité historické fotografie schraňovat a uchovávat tak, aby nedošlo k jejich ztrátě nebo zničení. Navíc nejsou jednoduše a volně dostupné pro veřejnost. Obzvlášť komplikovaná je situace v obcích, které spadaly do Sudet a měli primárně německé obyvatelstvo. Celkově bylo získáno 395 fotografií, z nichž 225 je historických fotografií pořízených mezi lety 1845 a 80. lety 20. století. Zbylé fotografie byly pořízeny v roce 2015 Ing. Stanislavem Vimrem. Fotografie primárně zachycují vesnické stavby a sakrální objekty, pouze pár jich je zaměřeno na okolní krajinu obce Luková.
Z historických fotografií lze určit historický vesnický charakter obce a také objekty potenciálně zajímavé z hlediska venkovské turistiky. Prostorová databáze může být také využita pro podporu venkovského turismu, jelikož historické fotografie obsahují informace o prvcích v krajině nebo objektech, které mohou být zachovány nebo obnoveny, což ve finále může zvýšit atraktivitu lokality. Historické fotografie lze využít i k informačním a propagačním účelům, např. v kombinaci s využitím metody pořizování fotografií ze stejného místa. Při porovnání historických fotografií budov v 80. letech 20. století a v roce 2015 je patrný úbytek znaků místní architektury na venkovských stavbách a také úbytek zahrad s ovocnými stromy.

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CULTURAL HERITAGE MONUMENTS IN FORESTS, THEIR PROTECTION AND THEIR POSSIBLE USE IN TOURISM

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Abstract

In the Czech Republic, a number of archaeological and cultural heritage monuments are located in forest environment. The protection of cultural heritage monuments especially in economic forests is not clearly defined in practice. Their occurrence is often associated with increased attendance of the localities, which in turn affects forest management activities. The paper addresses a specific situation at three localities in the Drahanská vrchovina (Drahany Highlands) in context of possibilities of their protection and their use in accordance with the principles of sustainable tourism. Specifically, the localities are 1) Vildenberk castle ruins and its closest surroundings (a cultural monument with well-identifiable remains of buildings and significant anthropogenic morphology of the relief), 2) Polom, a deserted medieval village (with distinct anthropogenic morphological shapes), 3) Bohdalůvka, a deserted medieval village (practically without surface anthropogenic relicts). The current state of tourist use was assessed at all three localities, and their potential and risks associated with tourism were evaluated.

Key words: deserted medieval village, forest, sustainable management, sustainable tourism

Introduction

In the Czech Republic, a number of archaeological, historical and cultural heritage monuments are located in forest environment. For their preservation and protection, their unambiguous identification and the greatest possible knowledge of specific surface and subsurface conditions is important. A basic precondition for their maintenance and protection is the sharing of the database of cultural monuments of The Monument Care Department with the economic forest entity. Many cultural monuments located in the forest environment offer the potential for tourist attractions that, if properly managed, can meet the aspects of sustainable tourism

Materials and methods

The article evaluates 3 cultural heritage monuments located in the forest environment of the Drahanská Highlands (see Fig. 1). They are intentionally selected so that they represent 3 different localities in terms of accessibility of the area by tourist routes and awareness of the localities. Their accessibility in the context of sustainable tourism was determined, as well as the manifestations of the presence of visitors and the potential of individual localities was evaluated in terms of their interest, educational potential and sustainable tourist capacity. Furthermore, the question of how the owner (forest manager) perceives the given cultural heritage monument was addressed (Kubalíková et al. 2021).

Characteristics of archaeological objects of human economic activity in forests

Vildenberk castle area ruins

During the 13th century, the area of interest became one of the gateways to the colonization region of the Drahany Highlands. Today, the basic directions of communication can still be identified in the terrain thanks to the preserved sunken lanes. We can therefore conclude that the main routes were directed in a north-south direction to Jedovnice and from there on to other key areas of the region (Martínek and Létal, 2014). At the beginning of the 14th century at the latest, the medieval castle of Vildenberk was founded above the valley of the Kovalovice stream.

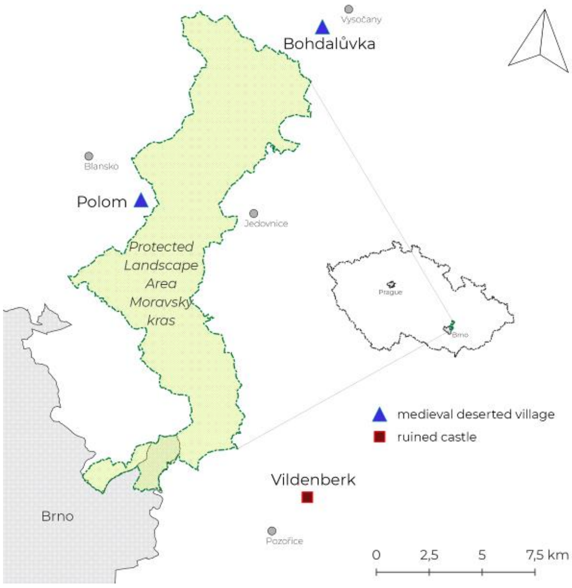

Fig. 1: Map of the localities

The quarries and mining fields for conglomerate and graywacke, which were concentrated in the vicinity of the castle core, can probably be linked to its construction (Kovář et al., 2013). The unfortified northeastern part of the castle's hinterland is characterised mainly by objects associated with brick production. There are smaller depressions around the perimeter of the site which are the remains of the extraction of local slope loess and clay. There are also three larger depressions which are interconnected by a shallow water channel. Brick production is directly evidenced by the remains of three kilns sunk into the hillside (Kos 2018). The three levees, which are remnants of the original medieval ponds, can be linked to the management in the wider castle hinterland. Under one of these levees, a relic of a construction that has already been presented in the literature as the remains of a mill has been identified, although no clear evidence for this interpretation has yet been offered (Bolina and Doležel, 1988; Kovář et al. 2013. In the whole area of South teritory only two charcoal platforms could be identified.

Deserted medieval village Polom

The cores of two medieval villages – Klepačov and Polom – were located in the area of interest. Both villages were founded during the 13th century and at the beginning of the 16th century they are mentioned in written sources as deserted. Klepačov was later re-inhabited, while Polom completely disappeared. Remains of the fields system of both original villages are preserved in similar ploughlands. Directly in the field they are very difficult to identify, thus LIDAR images proved to be crucial for reconstructing their actual state of preservation (Malina 2015), (see Fig. 2). An artificial long linear depression, probably a water ditch (canal) with a total cubic capacity of 2650 m^3, which fed a small pond in the village, leads in a north-south direction to the build up area of the extinct medieval village of Polom. Southwest of the Polom there are many evidences of iron ore mining. These mining activities can be tentatively dated to the 18th-19th centuries (Souchopová et al., 2002).

Deserted medieval village Bohdalůvka

The remains of human economic activities have been imprinted on the landscape through the extinct medieval village of Bohdalůvka and its agricultural background, which can be reconstructed on the basis of the preserved fields system. In the Middle Ages, these belonged not only to the above-mentioned village, but also partly to the more southerly town of Holštejn. Here, too, individual relics were already very difficult to recognize in the terrain and could be located mainly on LIDAR images. Particularly outstanding are the remains of collapsed stone rubble to the east of the presumed eastern row of houses, which here acted as a boundary between the allotments. Also perhaps related to agricultural activities in the hinterland of the village may be the odd stone-clay mounds documented both at the northern edge of the original development and approximately 5 km to the south-west at the foot of a prominent mound. One of the last objects of interest in the area to the north is a pond that lay in the southern part of the Bohdalůvka village intravillage. At present, a calcareous pond is located on part of the original area (Černý 1992; Kolomazníček 2022).

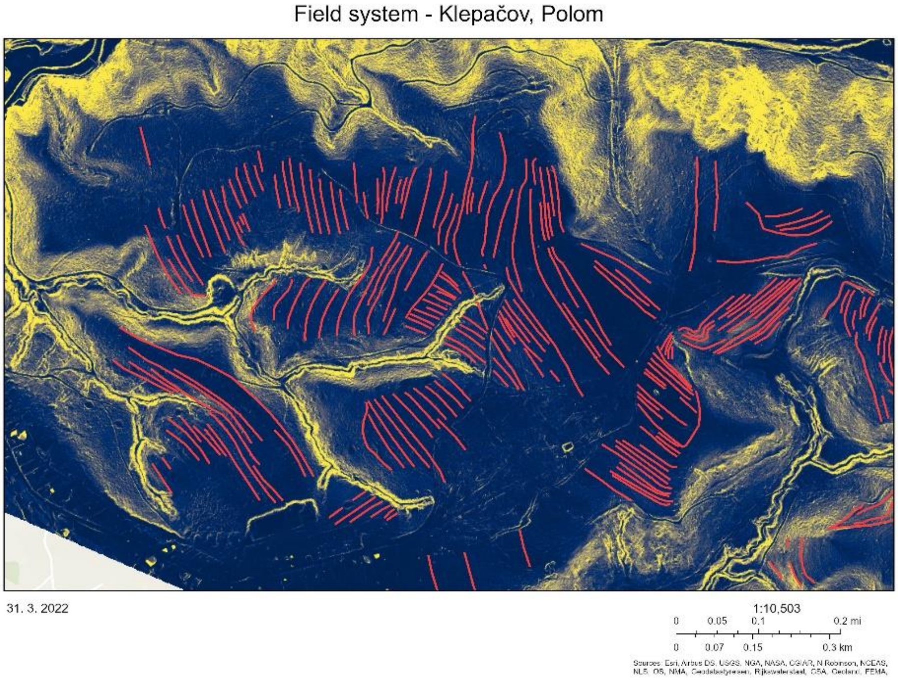

Fig. 2: Fields system of the deserted villages of Klepačov and Polom according to LIDAR data

Results

The first locality - the ruins of Vildenberk Castle and its surroundings - is a declared cultural monument, there are a number of sources, both print and online, easily accessible by hiking trail, directly on the ruins there are 3 tourist signs and the nature trail of Forests of the Czech Republic. The marked cycle path leads to a distance of 2 km from the locality, but thanks to the network of forest paths, the castle itself is much visited by cyclists. There are 2 information boards, a rest area with a shelter and benches in the locality. In the area of the ruin, there are visible well-trodden paths and paths even outside the official marked path. There are several fireplaces and campgrounds near the relics of the buildings. Garbage can be found within the area and around the access roads. However, the technical background of the castle, east of the access road, is almost without signs of movement of visitors and practically without garbage, as well as the remains of technical buildings in the castle are practically without signs of visitors, only forest paths are clearly visible. The whole area is located in a forest environment and we can find damage to forest vegetation (mainly erosion, soil degradation and plant surface cover degradation), especially in the inner part of the castle. The locality is very well publicized (print and online media). Říčky Nature Park is located about 0.5 km from the locality and the border of the Moravian Karst Protected Landscape Area is about 5 km away. There is no official access by car to the locality, the nearest car park is more than 2 km away.

The second location - the deserted medieval village of Polom - is on the tourist and bike trail, there is 1 information board in not very good condition, directly in the field is visible only a few hundred meters long and 1.5 m deep and 5 m wide "channel" (depression), the inner part of the village is practically not visible and unidentifiable for the visitor today. Although the movement of tourists and visitors on marked paths is relatively high, the presence of visitors to the locality is not particularly noticeable, slight evidence of minor pollution is still at the signposts or a nearby resting place. Attendance is greatly influenced by the presence of the recreational town of Blansko, attendance is not primarily associated with a visit to the deserted medieval village. The locality is located directly on the borders of the Moravian Karst Protected Landscape Area. Entry by car is possible only with permission. The nearest car park is more than 2 km away. It occurs rarely in tourist guides it is necessary to look for a locality in the forest.

The third locality - the deserted village of Bohdalůvka – here is the absence of tourist trails to the locality, a cycle path is several km away, practically does not occur in tourist materials and is mentioned only in professional archeological literature. There is no information board at the site. There is a relatively dense network of forest roads and footpaths. Parking is possible on the 2nd class road, about 1 km away. In a forest environment, the deserted village is practically without building and morphological remains. Experts are able to recognize 2-3 base plates and swamp pond on the former village square. There are no signs of visitors at the locality. At present, calamity spruce logging has a strong impact on the closest surroundings.

Discussion

We can look at the protection and use of cultural monuments in the forest from two perspectives. For the preservation and protection of cultural heritage monuments within the land intended for the fulfillment of forest functions cooperation between the authorities of monument care and the owner or management entity in a specific commercial forest is essential. At present, the owner or forest manager may not even know that there is a declared national cultural monument or cultural monument in the forest. The situation is even more complicated when it comes to sites of cultural significance, such as burial grounds, relics of technical constructions, etc., which are not declared. Obligations of the owner arising from the Act on Monument Care Act No. 20/1987 Coll. is to keep the cultural monument in good condition and take care of its preservation, which means that it must not even damage it. Thus, forest land management according to the approved forest management plan (FMP) does not release the owner from this obligation. The main problem can be the fact that the projection of the interests of state monument care into valid FMP is not clearly addressed in the legal system, and also that FMPs are not a binding legal instrument. The authors of the article see a possible solution in the legal regulation, which will stipulate the obligation to include the presence of cultural heritage monuments in the valid FMP, so that during economic interventions in these localities they are always consulted in advance with the relevant authorities of state monument care. The use of modern GIS methods seems to be an excellent support tool for the protection of cultural heritage monuments in the forest environment (Balková et al. 2020).

The cultural heritage monuments in the forest environment can also be included in the network of tourist destinations with access for hiking and biking in accordance with the principles of sustainable tourism. The initiative should come primarily from local actors (municipalities, LAGs, tourist associations, PLAs,..), who can expand the tourist potential of the region and at the same time disperse visitors to more localities and thus prevent congestion of top tourist destinations.

Conclusion

Cultural heritage monuments in the forest environment have significant tourist potential as a destination for sustainable tourism. Their involvement in the regional tourist offer should be ensured by local actors, always in cooperation with the Monument Care Department, but also with forest owners / managers. For the consistent protection of cultural heritage monuments in the forest environment, the cooperation of owners / managers and the Monument Care Department is necessary, preferably by incorporating the existing network of cultural heritage monuments into forest management plans.

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Souhrn
Kulturní památky v lesním prostředí mají významný turistický potenciál jako destinace udržitelného turismu. Jejich zapojení do regionální turistické nabídky by měli zajišťovat místní aktéři, a to vždy ve spolupráci se státní památkovou péčí, ale i vlastníky/hospodáři lesa. Pro důslednou ochranu kulturních památek v lesním prostředí je nezbytná součinnost vlastníků/hospodářů a státní památkové péče nejlépe formou promítnutí stávající sítě kulturních památek do lesních hospodářských plánů.

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DENDROCHRONOLOGY IMPROVES UNDERSTANDING OF THE CHARCOAL PRODUCTION HISTORY, INCREASING THE TOURIST POTENTIAL IN THE DRAHANY HIGHLANDS

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Abstract

Over the last two years, three selected forest sites from Drahany Highlands were examined for traces of human activity. The most frequent traces found, and common to all three sites, were remains of charcoal production. This paper provides an anatomical and dendrochronological analysis of the charcoals found in two charcoal pile remains from each site. The species composition of the charcoals at the southern site was dominated by oak, followed by birch and hornbeam. Fir was more common than oak, beech, poplar, birch and hornbeam at the central site. Fir and beech were found at the northern site. By using dendrochronology, 23 fir, oak and beech charcoals were dated with the oldest sample coming from a central site and dated from the period 1753–1758. Charcoals from the three other charcoal piles fell into the first half of the 19th century. Radiocarbon dating of charcoals selected gave a very wide age range (1640–1955), except for one case (1399–1435). Providing information on the age of a charcoal pile can help raise public awareness and interest in viewing the sites where charcoal burners used to be active in the forests.

Key words: Charcoal pile, culture heritage, tree rings, wood species, tourism

Introduction

Traces of human activity in forests have been searched for in three selected sites in the Drahany Highlands during the last two years. Most frequently, ponds, fortified as well as unfortified settlements, extraction sites, sites of raw material processing and agricultural management have been identified. The most frequent sites, common to all the three sites examined, were remains of charcoal production - charcoal piles or rather charcoal pile remains, proving that charcoal production was a frequent activity in the area, even in recent times (Bobek et al., 2021).

When tourists hike through the forests, they hardly ever have a notion that the remains of charcoal piles can be quite easily distinguished within the countryside. Such sites are of an oval or round shape, usually recessed in a slope, and their surface consists of a mixture of crushed charcoals, soot and dirt (Matoušek and Woitsch, 2020). However, as the charcoal piles were made in managed forests, where the management activities still continue, their remains are gradually disappearing.

That might be the reason why the research into charcoal piles has recently started to be of more interest in Central Europe. Most often, their number, location in the terrain, size and charcoal species composition have been documented (e.g. Raab et al., 2015; Matoušek and Brejcha 2017; Matoušek and Woitsch, 2020). Although a suitability of dendrochronological dating for carbonised wood is supposed (Blondel et al., 2018), it has scarcely been used to date charcoal piles in the Czech Republic (Matoušek and Brejcha 2017; Bobek et al., 2021). The main aim of this paper is to present the dendrochronological dating of six selected charcoal pile remains in the Drahany Highlands as a tool to increase the tourist potential of the area and to propose the protection degrees of the sites of traditional charcoal production.

Materials and methods

Three sites, each 5 km^2 in area, have been selected in the Drahany Highlands (Fig. 1), based on the forest cover, terrain modularity, altitude gradient between the sites, the differing ownership structure in the past, and the existence of archived information on the occurrence of historic structures and relicts of management activities.

For a detailed investigation, two charcoal piles have been chosen from each site (Fig. 1) so that they represented the site as regards the dominant forest type, average charcoal pile size along and perpendicular to the contour line, the mean slope gradient; additionally, a thick layer of charcoals was detected on them and their borders were easily identified. The charcoal piles damaged by windfalls or forest machinery passage, those along the roads and paths or a steep terrain break were excluded.

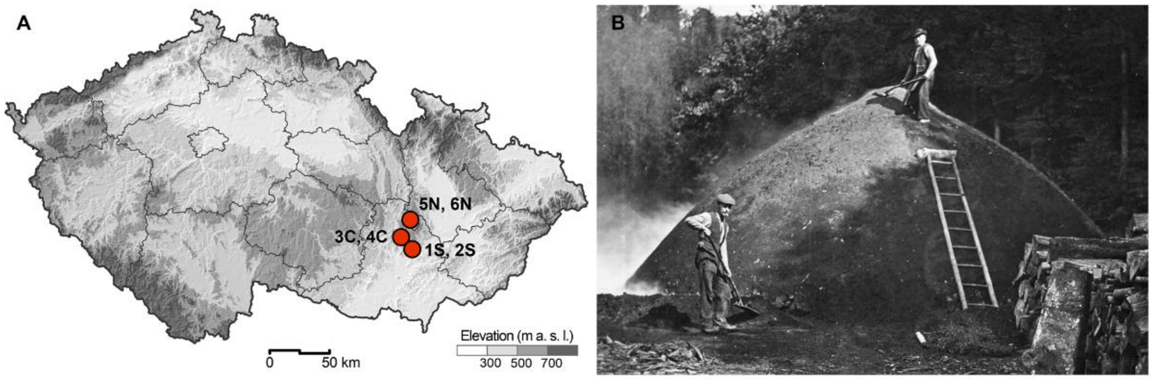

Fig.1: (A) The investigated charcoal piles on a map of the Czech Republic, (B) Thonet’s charcoal pile, Halenkov-Dinotice (photo archive of the Wallachian Regional Museum, photo: K. Puszkailer).

The archaeological survey of the selected charcoal piles was conducted in a form of a longitudinal half-metre-wide probe, which led from the approximate centre of the pile beyond the fill (a slope formed by charcoal raked away from the pile). The stratigraphic layers were uncovered mechanically and each separately. The charcoals for anatomical and dendrochronological analysis were taken from the uncovered layers and the fill.

The charcoals were deposited in a moist environment and those that contained at least 10 tree rings were then chosen for dendrochronological dating. The cross section of the samples was worked with a razor blade or a break was made for a good visibility of the tree rings. The samples were processed in compliance with the standard dendrochronological methodology (Cook, Kairiūkštis 1990). The mean TRW series were dated according to the Czech fir, spruce and oak TRW chronologies (Kyncl, 2016). The samples were taxonomically identified based on wood anatomical features characteristic of the species (Schweingruber, 1990) under an episcopic microscope. At the same time, samples of charcoals from the charcoal piles were selected randomly and sent for ^{14}C analysis.

Results

The charcoal piles were located at an altitude of 346–586 m asl. All the charcoal piles we have investigated were recessed in the slope, had an oval shape and a size along the contour line of 6–13 m. Their distance from the nearest road and the nearest water current was 10–76 m and 14–105 m, respectively (Tab. 1).

In total, 1016 charcoal fragments have been analysed anatomically. The charcoal piles at site SOUTH were dominated by oak charcoals (49 %), followed by birch (34.5 %) and hornbeam (13 %). The highest variability of charcoals (6 species) was recorded at the CENTRAL site - with dominance of fir (40.7 %), oak (22 %) and beech (17.7 %). By contrast, only two species were observed at site NORTH, fir (70.2 %) and beech (29.8 %) (Fig. 2).

100 charcoals from all charcoal pile remains were analysed by dendrochronology. Out of them, 23 charcoals were dated successfully (JIH 0, CENTRAL 12, NORTH 11) (Tab. 1, Fig. 2). The oldest samples dated by dendrochronology came from the period after 1676; the most recent were from the first half of the 19th century (Tab. 1). The samples successfully dated most frequently were fir (11 samples), oak (10) and beech (2). By contrast, radiocarbon dating yielded a very wide range of results, from 1640 to 1955, except for one sample, which was dated to the first half of the 15th century with a calibrated age tolerance of 36 years (Tab. 1).

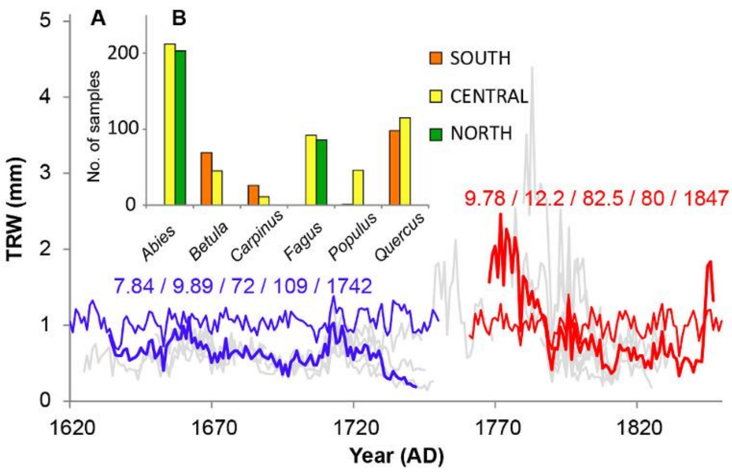

Fig. 2: (A) Synchronization of oak (blue) and fir (red) mean TRW series (bold) from charcoal piles with Czech TRW oak (blue) and fir (red) chronology (T-test according to Baillie & Pilcher (TBP), T-test according to Hollstein (THO), synchronization of tree-ring series in % (Gleichläufigkeit), overplap and date year, (B) the results of anatomical identification of charcoal from each site.

Tab. 1: A detailed overview of all 6 charcoal piles (S – SOUTH, C – CENTRAL, N – NORTH) including GPS, altitude, size, distance form the road and water, slope, current type of forest, number of dendrochronological analysed samples, species, number of dendrochronological dated samples, the youngest dendrochronological dating, and ^{14}C dating of the charcoal piles.

charcoal pile (site)	GPS	altitude (m asl)	size - fall line	size - counter line	dis. from the road (m)	dis. from the water (m)	Slope (°)	current type of forest	no. of analysed charcoals	no. of dendro. dated samples	the young. dendro. dating	^{14}C dating
1S	N 49°14'0.67"; E 16°49'33.13"	446	4	6	26	54	8.8	mixed	2 (oak 1; beech 1)	0	undated	1399–1435
2S	N 49°13'34.81"; E 16°49'3.73"	390	6.5	8.5	10	14	19.6	mixed	2 (oak 2)	0	undated	1700–1955
3C	N 49°20'44.54"; E 16°39'44.17"	346	10	12.5	30	56	9.3	mixed	68 (fir 12; oak 55; beech 1)	10	1753–1758	1640–1954
4C	N 49°20'22.15"; E 16°40'58.34"	446	10	12	17.5	62	9	mixed	9 (fir 2; beech 7)	2	after 1807	1666–1950
5N	N 49°25'11.13"; E 16°46'24.38"	549	10.5	13	76	18	8.6	conifer.	7 (fir 6; beech 1)	3	after 1848	not analysed
6N	N 49°25'24.82"; E 16°46'3.29"	586	12	12	32	105	7.7	conifer.	12 (fir 12)	8	after 1832	1667–1950

Discussion

Most of the charcoal pile remains were located away from the main transport routes, often in places with poor access – e.g. below a hill top, on a slope – and because of the high density of charcoal production sites, we assume the wood burnt in them was gathered from nearby (Rybníček et al., in review). Therefore, the anatomically identified charcoals provide us with very good evidence that the species found used to grow there, in the vicinity of the piles. Additionally, the results agree with the potential species composition, as the representation of oak decreases from the south towards the north, gradually favouring fir and beech.

The dendrochronological dating of charcoals from individual charcoal pile remains can precisely identify the season of the pile use only if several dated samples with a waney edge from the same period are found in one pile (Rybníček et al., in review). Such a situation did not occur in any of the six investigated charcoal pile remains. That is not surprising as the waney edge is rarely preserved in charcoal samples (Raab et al., 2015). Dating can be relatively precise if the samples contain sapwood tree rings as their number is typical of individual regions and it ranges from 5–25 in the Czech Republic (Prokop et al., 2017). Charcoal pile 3C, where oak samples dominated, yielded three successfully dated samples with sapwood tree rings. Therefore, the period when the trees were felled could be specified (1753–1758) (Tab. 1). Another case where a charcoal pile can be dated quite precisely even without a waney edge is when the youngest tree rings of several samples demonstrate approximately the same period (charcoal pile 6N). Although the exact number of missing tree rings in samples cannot be identified with certainty, they provide a good idea of the period when the charcoal pile was used (Tab. 1). In the case of two charcoal piles (4C and 5N), the samples were dated from a wider period, therefore, the time of their use could not be determined more exactly. No samples from charcoal piles 1S and 2S could be dated - however, only two samples had been taken from them (Tab. 1).
In the case of charcoal pile 1S, radiocarbon dating has yielded a very specific period (1399–1435). However, in all the other cases, radiocarbon dating produced a very wide range of results, from 1640 to 1955 (Tab. 1). Beyond 1650, the radiocarbon calibration curve is characterised by strong wiggles, followed by a broad plateau, and finally a sharp drop (Světlík et al., 2019). As a result, the calibrated age probability distributions for these post-1650 piles are very wide and it is not possible to differentiate between the age of piles postdating 1650 CE (Deforce et al., 2021).

Conclusion

Out of the six charcoal piles investigated within the Drahany Highlands, four were successfully dated using dendrochronology. In two of them, the period when they were used for charcoal production could be specified more precisely. Dating of charcoal piles can help raise tourist attraction of the site given, as the people can see the place where the traditional charcoal production craft was conducted not so long ago. The results of this research can also help to propose a protection degree of these sites so that the remains and reminders of charcoal production could be maintained for next generations.

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Souhrn
Na třech vybraných zájmových územích v oblasti Drahanské vrchoviny byly hledány relikty hospodářské činnosti člověka v lesích. Nejčastějším objektem, který byl společný pro všechny tři území, byly plošiny po výrobě dřevěného uhlí, které nazýváme milířiště. Příspěvek se zabývá anatomickou a dendrochronologickou analýzou uhlíků, které byly odebrány vždy ze 2 vybraných milířišť na každém zájmovém území. V druhovém složení uhlíků na lokalitě JIH dominoval dub, dále bříza a habr. Na lokalitě STŘED se nejčastěji vyskytovaly jedlové, dále dubové, bukové, topolové, březové a habrové uhlíky. Na lokalitě SEVER byly pouze jedlové a bukové uhlíky. Dendrochronologicky se podařilo datovat celkem 23 jedlových, dubových a bukových uhlíků ze čtyř milířišť. Nejstarší datovaný uhlík pocházel z lokality STŘED a byl datován do období 1753–1758. Vzorky z dalších tří milířišť byly datovány do období první poloviny 19. století. Radiouhlíkové datování, s výjimkou jednoho případu (1399–1435), poskytlo velmi široký interval datování (1640–1955). Určení stáří milířišť může pomoci zvýšit zájem turistů o návštěvu lokalit, kde se ještě v nedávné minulosti běžně provozovalo tradiční uhlířské řemeslo. Výsledky tohoto výzkumu mohou přispět při případném návrhu stupně ochrany těchto lokalit, tak aby mohly být dochovány pozůstatky po výrobě dřevěného uhlí i pro další generace.

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DESIGN OF A CYCLE PATH IN THE PLIEŠOVSKÁ KOTLINA MICROREGION OF SLOVAKIA

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Abstract
At present local municipal authorities have been creating corridors and infrastructure for alternative ways of transport, including cycling. Such arrangements can significantly contribute to road traffic improvement, increasing road safety, creating a healthier environment, and improving conditions for leisure time activities and the economy in the regions of Slovakia. The project deals with the design of a cycle path which will provide a new opportunity for a safe and hazard free transit route for cyclists and pedestrians between the villages in the Pliešovská basin micro region and will serve the residents and general public alike. The project also includes the proposal for public street lighting, thus also enabling the path to be used during evening and night hours, as well as in poor visibility, which will improve safety both for cyclists and pedestrians. The project also includes a design for a resting place equipped with mobiliari, such as the information board, cycle racks, a seating area and traffic signs which in their design and colour will fit harmoniously with the local architecture and in their choice of material will compliment the surroundings.

Key words: cycling, recreation, mobiliari (objects in the public realm), environment

Introduction
Neither our road network system nor cyclists in Slovakia have been prepared for the unprecedented popularity of cycling. Currently cycling presents a danger for cyclists and other road users, in particular, safety issues remain unresolved, in what is referred to as shared traffic by inundating the cities with bicycles. (WWW.UAMKSR.SK). Nowadays developed countries, cities and villages have been creating the corridors and infrastructure for alternative ways of transport, including cycling. (ĽUPTÁK, 2010).
The objective of this paper is a practical proposal for the safe movement of cyclists and pedestrians in an area of interest outside the transport corridor including the planning and architectural design proposal for a rest area fitting with the nature of the locality.

Material and methods
The applied work methods in the terrain research include the mapping of the area of interest between the villages of Pliešovce and Sása, which are considered attractive and are used for cycling, and also demarcation works. In addition, the engineering and geological survey was conducted in order to ascertain the physical and mechanical quality of the bedrock and the findings were used in the design of the cycle path.
On the basis of the research findings the proposal of the route was prepared in accordance with the STN (Slovak Technical Standard) no. 736108 and the methodology according to ĽUPTÁK (2010).
The basic source for the design was the project documentation under the name of "The educational footpath in the Pliešovská basin between Sása and Pliešovce"(SLÚKA, 2009). The proposal also included the design for the recreational mobiliary amenities and public street lighting. The proposals were designed using the software Roadpac, Microstation, Kalkulus and Google SketchUp 3D Design.

Results
The cycle route is located in the south-eastern part of the Pliešovská basin, between the villages of Pliešovce and Sása, in the location called ''Na chotári''. The route design of the cycle path deals with directional routing, elevation routing and spatial route layout according to the STN 736108 (picture no. 1 and 2). With respect to directional routing, the proposed route starts in Pliešovce village, joining the local road (Obrancov mieru street), it continues towards the watercourse Neresnica, then it runs alongside the river at a distance of at least 10 metres from the existing bank, after that it crosses a small stream Lomniansky potok turning left behind it and finishes by joining the local road (Nová street) in Sása village. The left-hand and right-hand directional curves alternate on the route. There are 13 of them, with radii ranging between 5 and 300 metres. The total length of the route is 1,136 m.

With respect to elevation the route is planned in flat terrain, it has an undemanding smoothly descending profile and the incline range of 0, 13 – 7, 30 %. The 11 altitude curves are designed with the radii ranging from 150 – 15,000 m. The route starts at an altitude of 408.27 MAMSL and finishes at an altitude of 385.48 MAMSL.

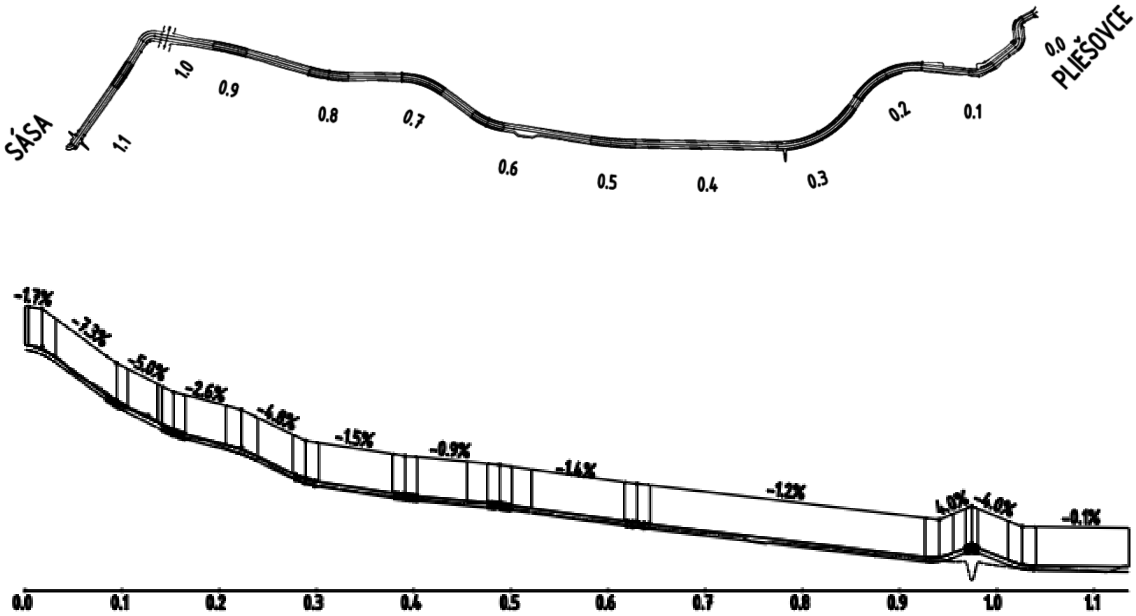

Fig. 1: Situation and longitudinal profile of proposed cycle path

As for the spatial layout, the proposed unobstructed width of the cycle path is 4.25 m, of which the road is 3.0 m widening in the directional curves and in the sections with longitudinal incline above 4.0 %. The width of the shoulder verges reinforced with aggregates is to be 0.50 m on the left and 0.75 m on the right to allow for lighting to be installed. The transverse incline of the road is 2 % in the direction of the embankment; the proposed centripetal incline is 2.0 % in the directional curves. The surface of the path is designed to be tarmac with an overall thickness of 500 mm. The cycle path construction is shown in picture no. 2. According to an engineering and geological survey the bedrock is made up of gravel clay and clay of medium plasticity, which are deemed as suitable under certain conditions, but sometimes even unsuitable as the underlying base for the road. Based on the survey recommendations lime stabilization of the road surface (the active zone up to 300 mm depth) is proposed,

The inclines of the road slopes are designed to be excavated (in the ratio) 1:1.5 and in the embankment in the ratio 1:2. Drainage is provided by crosswise and lengthwise draining. Crosswise drainage is secured due to the crosswise incline of the road. Lengthwise drainage in the excavation is provided by an open triangular drainage ditch and paved curb drainage piping with a pothole in three short sections. Lengthwise drainage is completed by drainage objects, which are three culverts with direct inflow/inlet. The cycle path intersects the small watercourse – Lomniansky potok (stream). The original bridging is provided by a wooden footbridge laid on concrete pillars. The old footbridge is to be removed and replaced with a steel arch-shaped prefabricated construction made of corrugated steel sheets known as MultiPlate, with a width clearance of 7.40 m, the overhead clearance of 2.48 m with the proposed volumetric flow rate Q_{100} = 36,0 $m^3.s^{-1}$. A double-sided metal safety handrail will be installed on the bridge.

On the route section 0.580 – 0.595 km the design includes a proposal to build a 3-metre wide rest area for pedestrians and cyclists. The rest area will be equipped with the mobiliary (objects in the public realm), such as an information board, bike racks, seating and a signpost in keeping with the landscape of the locality. It is intended that the cycle path will be used in a practical way and at the same time it will blend in with the surroundings. Three types of seating are proposed, which are evenly distributed within the whole area. The dominant feature is covered seating with an information board and bike rack for 4 bicycles. There is a plain bench – seating with a rack for 2 bicycles and on the other side seating with a signpost and a rack for another 4 bicycles. The proposed objects are alike in their design and chosen material so that they meet the requirements for a rest area on the cycle path with the use of bike racks and simple assembly and maintenance (picture no. 3). The installation of the objects in the public realm comprises of removing soil to the required depth, construction of concrete foundations under the load-bearing walls (thickness 300 mm, minimum depth 870 mm), masonry of concrete load-bearing walls from boarding blocks and their stone cladding onto which the wooden mobiliary structures will be installed using lumber wood.

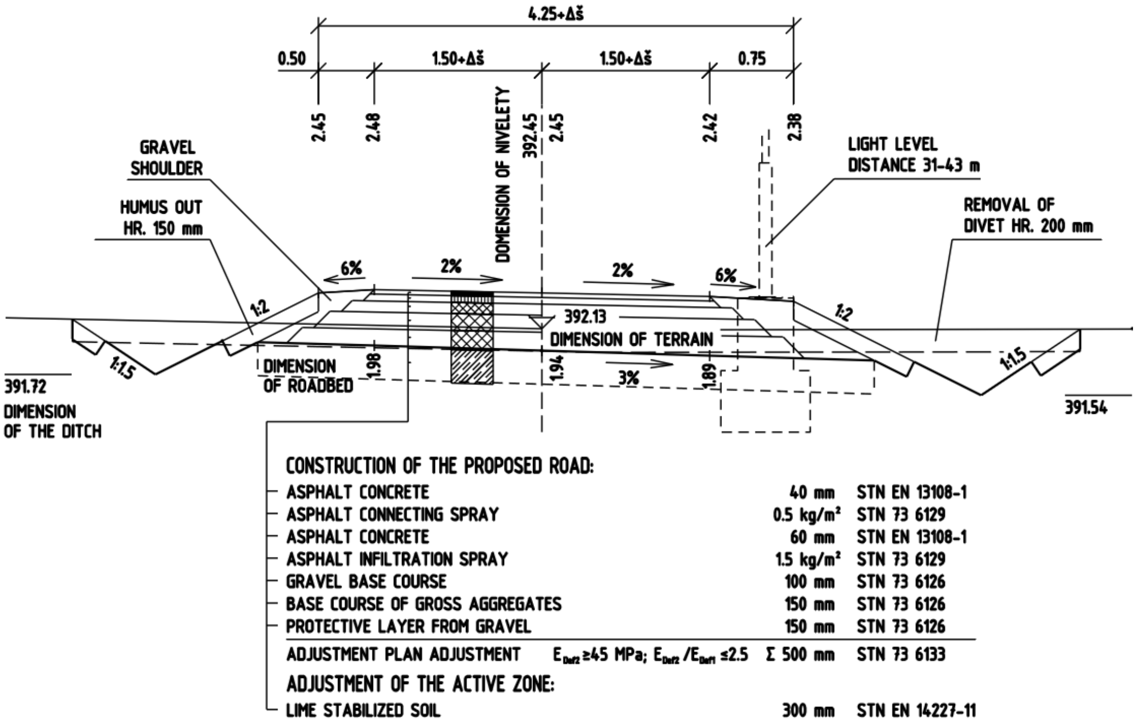

Fig. 2: Typical cross section of proposed cycle path

Fig. 3 Recreational mobiliary of the proposed cycle path

One element of the proposed cycle path between the villages of Pliešovce and Sása is also public street lighting, which will enable the use of the cycle path during the evening and night hours and also in poor visibility. The building of 33 steel masts mounted in concrete foundations and the construction of underground cable routing is proposed on the widened right-hand shoulder of the road.
The summary draft budget for the overall construction was calculated to be 502,346 EUR including VAT, the partial budgets for the individual building objects are summarized in table 1. The construction will be funded from the European Structural and Investment Funds from the operational programme

Integrated Infrastructure. The implementation is currently in the stage of legislative building approval (building permit).

Tab. 1: Construction costs by construction objects

stavebný objekt	cena
cycle path	332 916,50 EUR
street lighting	80 754,50 EUR
recreational mobiliári	4950,70 EUR
Summary without VAT	418 621,70 EUR
Value Added Tax (VAT)	83 724,34 EUR
Summary with s VAT	502 346,04 EUR

Discussion

The transport connection between the villages of Pliešovce and Sása is currently provided by the road II/527 and the road III/2467. As this is the only transport link between the two villages, it is used both by cyclists and pedestrians presenting a safety risk for both groups due to the risk of traffic collisions with motor vehicles. Some cyclists and pedestrians use, weather-permitting, a marked cycle route which leads along an unpaved grassy footpath which runs parallel to the proposed cycle path. The proposed cycle path will provide a new opportunity for the safe and hazard free transport for cyclists and pedestrians between Pliešovce and Sása villages when commuting to primary school, to work and for leisure and recreational activities by the river Neresnica, with appropriate links to local roads in both villages.

The proposed cycle path is a joint path for cyclists and pedestrians serving the residents´ and public needs, with car traffic being excluded, except in the event of emergency giving access to rescue services. The road safety will be ensured in accordance with the regulations and instructions of the administrator – the local council. In the winter season the administrator will keep the road clear by providing snow removal and road gritting in accordance with the requirements of the river Neresnica´s administrator.

By installing public street lighting the safety of cyclists and pedestrians will increase even in poor visibility conditions and allow the cycle path to be used duringl night hours.

The building of the rest area with its recreational equipment will enhance the stay in the pleasant natural environment next to the adjacent river. The recreational mobiliary objects due to the chosen material and colour will fit harmoniously with the local architecture and will compliment the surrounding natural environment.

Conclusion

The construction of the transport recreational infrastructure for tourists enhances not only the conditions for recreational activities, but it can also significantly improve the traffic situation and road safety on roads also used by tourists.

The specific proposal design for a cycle path making accessible two neighbouring villages in the Pliešovská basin micro region is a good example of that. It will ensure safe and hazard free transport for cyclists and pedestrians, whilst simultaneously providing them with an additional benefit in the form of a cycle ride or walk in a pleasant natural environment.

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Souhrn
V současné době obce vytvářejí koridory a infrastrukturu pro alternativní druhy dopravy, včetně cyklistické. Taková řešení dopravní a rekreační infrastruktury mohou významně přispět ke zlepšení dopravní situace, bezpečnosti silničního provozu, zlepšení životního prostředí, zlepšení podmínek pro rekreační aktivity obyvatel nebo zlepšení hospodářské situace regionů Slovenska. Projekt se zabývá návrhem cyklostezky, která poskytne novou možnost bezpečné a bezkonfliktní bezmotorové dopravy pro cyklisty a chodce mezi zájmovými obcemi mikroregionu Pliešovská kotlina a bude sloužit potřebám obyvatel obcí i veřejnosti. Součástí projektu je také návrh veřejného osvětlení, které umožní užívání veřejné komunikace i ve večerních a nočních hodinách a za snížené viditelnosti, čímž se zvýší bezpečnost cyklistické a pěší dopravy. Předmětem projektu je také úprava odpočinkového místa a jeho vybavení odpočinkovým mobiliářem s infotabulí, stojany na kola, posezením a dopravním značením, které svým designem a barevností harmonicky zapadají do místní architektury a svým materiálovým provedením doplňují okolní prostředí.

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DESIGN OF RETENTION GRASS STRIPS IN THE CULTURAL AGRICULTURAL LANDSCAPE

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Abstract
Reducing the size of soil blocks of agricultural land, especially in areas threatened by water erosion, leads to the need to implement anti-erosion measures in the landscape. One of them is anti-erosion grass strips. These strips act as protection against water erosion, increase the retention capacity of the landscape, are home to many animals, increase the aesthetic value of the landscape. The diverse cultural landscape will also increase the potential of tourism and recreation in the landscape. The costs of implementing these elements in the landscape are relatively low (compared to other technical anti-erosion measures). Anti-erosion grass strips (in combination with other landscape measures) positively transform the agricultural landscape into an ecologically more stable and aesthetically valuable area. For the correct function of grass strips in protection against water erosion, the design of retention strips is essential - a suitable shape respecting the morphology of the terrain, the width of the strip, the location in the area of the land (slope). A software application is currently being developed for this purpose. Through this simple application landscape engineers, farmers, can easily find out the appropriate technical solution of retention strips for the selected soil block.

Key words: Grass strips; water erosion; water retention; tourism; landscape

Introduction
In the Czech Republic (CR), more than 50% of farmland is threatened by soil erosion (Dostál et al. 2006; Podhrázská et al., 2015, Podhrázská et al., 2019). The main reasons of the high erosion threat in CR were insensitive human interventions into the landscape in the second half of the 20th century. Until this period, agricultural production exploited land blocks of a mean size of 0.5 ha. Appropriate anti-erosion measures must be implemented to reduce the risk of water erosion. One of these multifunctional measures is anti-erosion grass strip. Protective grass strip must be placed on the slope along the contour. Retention grass strips have an anti-erosion and retention function. They can be implemented as technical anti-erosion measures, which serve to interrupt the surface runoff and to infiltrate it. It recommends determining their width by calculation. The same possibility is mentioned by many authors of publications, eg Holý, M. 1994, Dýrová, E. 1988, Kasprzak, K. 1989, Doležal, et al. 2015, Dumbrovský, M. et al., 2021. For the purpose of dimensioning the width of anti - erosion grass strips, the method published in Holý, M., 1994 was chosen. The principle of this method is based on the assumption that the proposed anti-erosion grass strip captures and absorbs into the soil all the water that has flowed into it from the land above.

Methods and Results
The width of the anti-erosion strip is calculated according to the following equation (Holý, M. 1994):

$$D = \frac{\varphi_L * i_s * L}{(i_v - i_s)}$$

where:
i_s is the intensity of precipitation [m.s^{-1}],
L is the length of the unprotected slope [m],
D is the width of the anti-erosion grass strip [m],
i_v is the intensity of water infiltration into the grassland [m.s^{-1}],
φ_L is the volume runoff coefficient, calculated as the product of $n_3 * n_4$
n_3 is a factor expressing the slope of the study area
n_4 is the coefficient expressing soil permeability

Fig. 1: Example of anti-erosion grass strip in cadastral area Strarovice

Determination of values of input parameters for calculation of anti-erosion strip width

For the purposes of calculating the parameters of the anti-erosion strip, we recommend using the following procedure and verified data sources:

i_s is intensity of precipitation [m.s^{-1}]

We choose the intensity of the precipitation (with an average repetition time) at N = 10 years (H_S, N10) and the duration is 60 minutes. Precipitation parameters (total hourly precipitation with average repetition time) can be obtained from the CHMI station network for a specific area, or taken over from the ČVUT Praha application listed at https://rain1.fsv.cvut.cz/webapp/d-rain-point (Kavka, P., Muller, M. et al. 2018).

L is the length of the unprotected slope [m]

This is the longest slope length from the boundary of the catchment area in the direction of the slope to the anti-erosion strip. This length must be calculated based on a digital terrain model.

i_v is the intensity of water infiltration into the grassland [m.s^{-1}]

However, the intensity of permanent grassland depends on the hydrological properties of the soils, vegetation cover, the agrotechnics used and the method of management. The right choice of water infiltration into the soil is essential for the correct dimensioning of the width of the anti-erosion grass strip. Extensive literature searches by a number of domestic and foreign authors, who dealt with infiltration and experimentally measured it, were prepared to determine the recommended value of water infiltration into the soil of permanent grassland. Domestic authors include, for example, Holý, M. (1994), Dýrová, E. (1988), Kaprzak, K. (1989), Vičanová et al. (2008), Hejduk, S., Kasprzak, K. (2010), Hejduk, S. (2011), Sochorec, M., Hejduk, S. (2012), Sochorec, M. (2016), Kučera J. and kol. (2021). We also rely on a large number of measurements of infiltration properties of grasslands in the model areas Starovice - Hustopeče u Brna and Větřkovice u Vítkova. These are model areas of VÚMOP, v.v.i., where model anti-erosion grass strips are implemented, continuous monitoring of precipitation-runoff events as well as infiltration experiments are performed on them.

Tab. 1: Determined rates of water infiltration into the soil in permanent grasslands

Permanent grassland	Intensity of infiltration (mm.min^{-1})
farmed by heavy machinery (tractors), mowed 1-2 times a year	2.8
manually farmed without moving agricultural machinery	9.9
grazed by cattle	1.5

φ_L is volume runoff coefficient l

The volume runoff coefficient is calculated in the used equation (Holý, M., 1994) as the product n_3 * n_4.

where n_3 denotes the coefficient expressing the influence of the slope of the area and n_4 denotes the coefficient expressing the permeability of the soil. Values are given, for example, by Holý (1994).

Tab. 2: Coefficient n3 (Holý, 1994)

slope [%]	**coefficient n_3**	**slope [%]**	**coefficient n_3**	**slope [%]**	**coefficient n_3**	**slope [%]**
0	0,00	7	0,47	14	0,67	21
1	0,18	8	0,51	15	0,70	22
2	0,25	9	0,54	16	0,72	23
3	0,31	10	0,57	17	0,74	24
4	0,36	11	0,60	18	0,77	25
5	0,40	12	0,62	19	0,79	
6	0,44	13	0,65	20	0,81	

The coefficient n_4 expresses the permeability of the soil. It is defined by soil type and expresses the ability of soil to release water through its profile. Holý, M., 1994 defines 4 groups of soil types according to permeability and assigns them the value of the coefficient n_4. For simplification and universal applicability, these 4 soil groups can be assigned a hydrological soil group defined according to BPEJ.

Tab. 3: Values of the n4 factor and their assigned hydrological soil groups

Soil	***n_4***	**Hydrological soil groups**
Very permeable (sandstone of the outer flysch, brown soil, sanding sand and gravel, chernozem with sand).	0,45	A
Permeable (sands, sandy siltstones, calcareous chernozem, brown aluminous sandy soils).	0,65	B
Less permeable (sands, sandy ventilating rocks, loose sands, gray forest soils, gray loamy soils).	0,8	C
Impermeable (peat, bogs, mountain meadows, rocks, crystalline clays and loess, muddy soils and marshes.	0,95	D

D is the width of the anti-erosion grass strip [m]
This is the calculated width of the anti-erosion grass strip.

These findings were implemented in a new web application, which is used to design the location and dimensioning of anti-erosion grass strips in the landscape. The application is freely available at www.protieroznipasy.vumop.cz. As part of the application, a drain line can be drawn on the slope, for which the application will suggest a suitable place to break the slope and a suitable width of the anti-erosion grass strip.

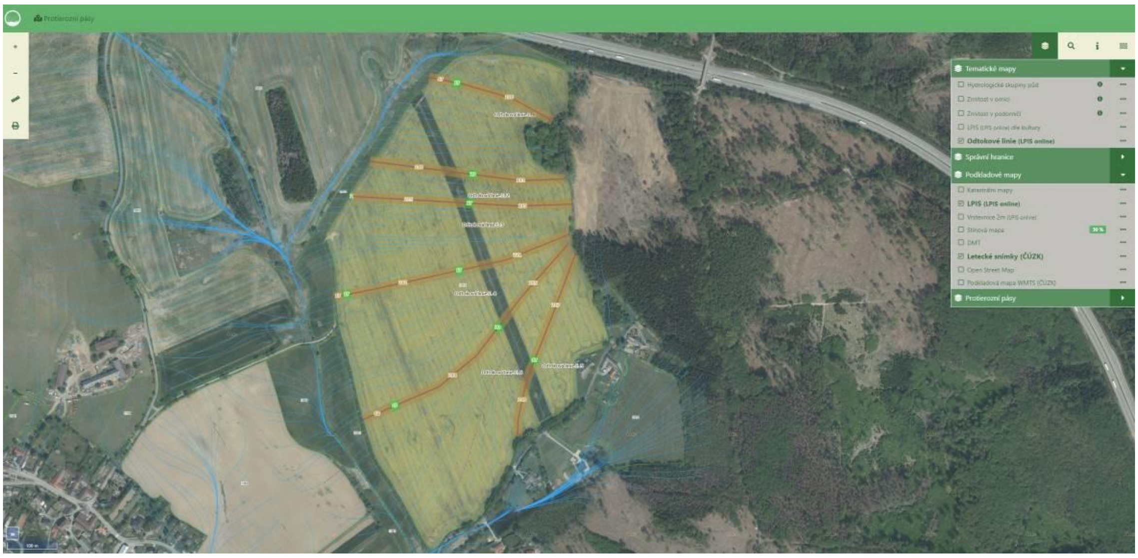

Fig. 2: Demonstration of a web application for designing anti-erosion grass strips (www.protieroznipasy.vumop.cz)

Conclusion

The anti-erosion grass strip is a technical anti-erosion measure with the correct dimensioning of the width and shape (including adaptation to local conditions). In the calculation of the long-term average soil loss by water erosion using the USLE method, the factor L (slope length factor) interrupts. Dimensioning of parameters of anti-erosion grass strips is based on the equation published in Holý, M., 1994. The principle of the method is based on the assumption that the designed strip captures and absorbs into the soil all water that flowed on it from the land, including water that fell on it. The input factors of this equation (values) were adapted to current conditions and long-term research findings of VÚMOP, v.v.i. Anti-erosion grass strips are suitable for the protection of agricultural land in the catchment area (not for the protection of urban areas from flash floods). A web application was developed for the design of anti-erosion grass strips, which is available at www.protieroznipasy.vumop.cz.

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Souhrn
Protierozní travní pás je při správném dimenzování šířky a tvaru (včetně přizpůsobení místním podmínkám) technické protierozní opatření. Ve výpočtu dlouhodobé průměrné ztráty půdy vodní erozí metodou USLE přerušuje faktor L (faktor délky svahu). Dimenzování parametrů protierozních travních pásů vychází z rovnice publikované v práci Holý, M., 1994. Princip metody vychází z předpokladu, že navržený pás zachytí a do půdy vsákne veškerou vodu, která na něj přitekla z výše položeného pozemku včetně vody, která na něj spadla. Vstupní faktory této rovnice (hodnoty) byly přizpůsobeny současným podmínkám a dlouhodobým výzkumným poznatkům VÚMOP, v.v.i. Protierozní travní pásy jsou vhodné k ochraně zemědělské půdy v ploše povodí (nikoliv ochraně intravilánu před bleskovými povodněmi). Pro navrhování protierozních travních pásů byla vyvinuta webová aplikace, která je dostupná na adrese www.protieroznipasy.vumop.cz.

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DO VISITORS TO THE JIZERA MOUNTAINS PLA BEHAVE SUSTAINABLY? COMPARISON OF THE SUMMER AND WINTER SEASONS

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Abstract
The paper presents results of research focused on sustainability of behaviour of tourists and visitors of the Jizera Mountains Protected Landscape Area. It builds on a sociological survey conducted on a representative sample of 733 tourists from Czechia and foreign visitors using CAPI in August 2021 and January 2022.
Our paper focuses on the analysis of mobility behaviour and selected activities in the protected area and potential for behaviour change in favour of more sustainable alternatives, including choice of means of transport to and around the territory, various services and activities in the area, and impacts of selected measures on the behaviour change; furthermore, differences between summer and winter seasons are compared. The paper also provides data on respondents' awareness regarding local specifics and possible activities and mobility services in the area.
The presented research results are a part of comprehensive research to develop guidelines for the so-called "Mobility plans for environmentally sensitive areas (ESAs)". Mobility plans should help authorities conceptually develop more sustainable forms of tourism and thus alleviate the pressure on the environment and its protection as such while respecting the specifics of the protected areas in Czechia.

Key words: Large-scale environmentally protected areas, sustainable tourism, sustainable mobility

Introduction
Large protected areas, in our view Protected Landscape areas (PLAs) and National Parks (NPs), have long faced growing numbers of visitors. The increasing numbers of visitors to protected areas bring pressure to provide basic infrastructure and services (transport, catering, accommodation, information services) and negative impacts on the environment and local communities (Drápela et al., 2021).
Transport is necessary to ensure the mobility of locals and visitors, but at the same time, it causes various external costs (Bůhová Foltýnová, 2008). Reducing external transport costs should therefore be a key objective in the further development of large protected areas. The present article finds out how visitors to the Jizera Mountains PLA come to this area, how they move around it and what they do in the area and the possibilities of developing more environmentally friendly modes of transport. The research aims to further describe the users of main transport modes (car, bus, train) and potential differences between the summer and winter seasons.

Materials and methods
The main source of data is a sociological survey, which took place in the Jizera Mountains in two waves in the form of CAPI: from 10 to 30 August 2021 and from 13 to 25 January 2022. The data collection was carried out by a professional sociological agency. The sample was created using quota selection, where quotas were set for age, gender, domestic vs. foreign visitors, one-day vs. multi-day stays, and weekdays vs. working days. These quotas were set on the basis of previous surveys of visitors to these areas. The obtained data were checked in terms of the requirement for completeness and logical consistency of the information obtained. A total of 733 correctly completed and logically consistent questionnaires were obtained, of which 355 came from the summer collection and 378 were from the winter wave. The structure of the sample is summarized in Table 1.

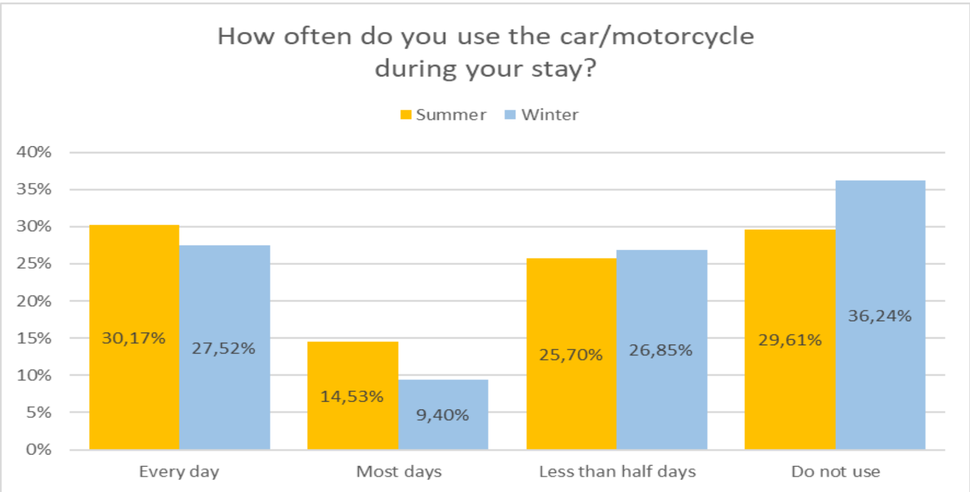
Results
The results of the analysis show that the dominant means of transport used by visitors is the passenger car. About 75% of the respondents come to the area by car, in both winter and summer. Most respondents park in paid or unpaid parking lots (87% in total), with more than 80% of them finding a free parking space in both winter and summer where they planned it without searching. The frequency of using one's own car during a multi-day stay is not very different in summer and winter, even though slightly more people use a different type of mobility in winter (see Graph 1). Overall, in both periods, 29% of the respondents who stay more days use their car to move within the stay on

average every day, 26% for most days, 26% for less than half of the days and 33% of the respondents move differently than by car or motorcycle during their stay.

Tab. 1: Sample description

	Summer		Winter		Total	
	N	%	N	%	N	%
Survey wave	355	48.43	378	51.57	733	100.00
Aged 15-29*	69	9.41	54	7.37	123	16.78
Aged 30-44*	132	18.01	127	17.33	259	35.33
Aged 45-59*	98	13.37	128	17.46	226	30.83
Aged 60 and over*	56	7.64	69	9.41	125	17.05
Tourists (overnighting)*	230	31.38	168	22.92	398	54.30
Day-trippers (not overnighting)*	125	17.05	210	28.65	335	45.70
Asked on weekdays*	193	26.33	211	28.79	404	55.12
Asked on Sat, Sun, public holidays*	162	22.10	167	22.78	329	44.88
Male*	173	23.60	194	26.47	367	50.07
Female*	182	24.83	184	25.10	366	49.93
Domestic visitors*	326	44.47	353	48.16	679	92.63
Foreign visitors*	29	3.96	25	3.41	54	7.37
Arrived alone	60	8.19	90	12.28	150	20.46
Arrived with spouse/partner	81	11.05	72	9.82	153	20.87
Arrived with friends	56	7.64	93	12.69	149	20.33
Arrived with family with children	152	20.73	108	14.73	260	35.47
Arrived with group (package tour)	6	0.82	15	2.05	21	2.86
Occupation:						
Employee	209	28.51	234	31.92	443	60.44
Self-employed	46	6.28	50	6.82	96	13.10
Pensioner (not working)	48	6.55	46	6.28	94	12.82
Homemaker/parental leave	24	3.27	14	1.91	38	5.18
Student/pupil/apprentice	21	2.86	28	3.82	49	6.68
Others	7	0.95	6	0.82	13	1.77
Household income: Below-average	10	1.36	7	0.95	17	2.32
Household income: Roughly average	238	32.47	241	32.88	479	65.35
Household income: Above-average	79	10.78	93	12.69	172	23.47
Household income: Not stated	28	3.82	37	5.05	65	8.87
Education: Primary, apprentice	78	12.01	62	8.45	150	20.46
Education: Secondary, leaving exam	131	17.87	119	16.23	250	34.11
Education: College, university	136	18.55	197	26.88	333	45.43

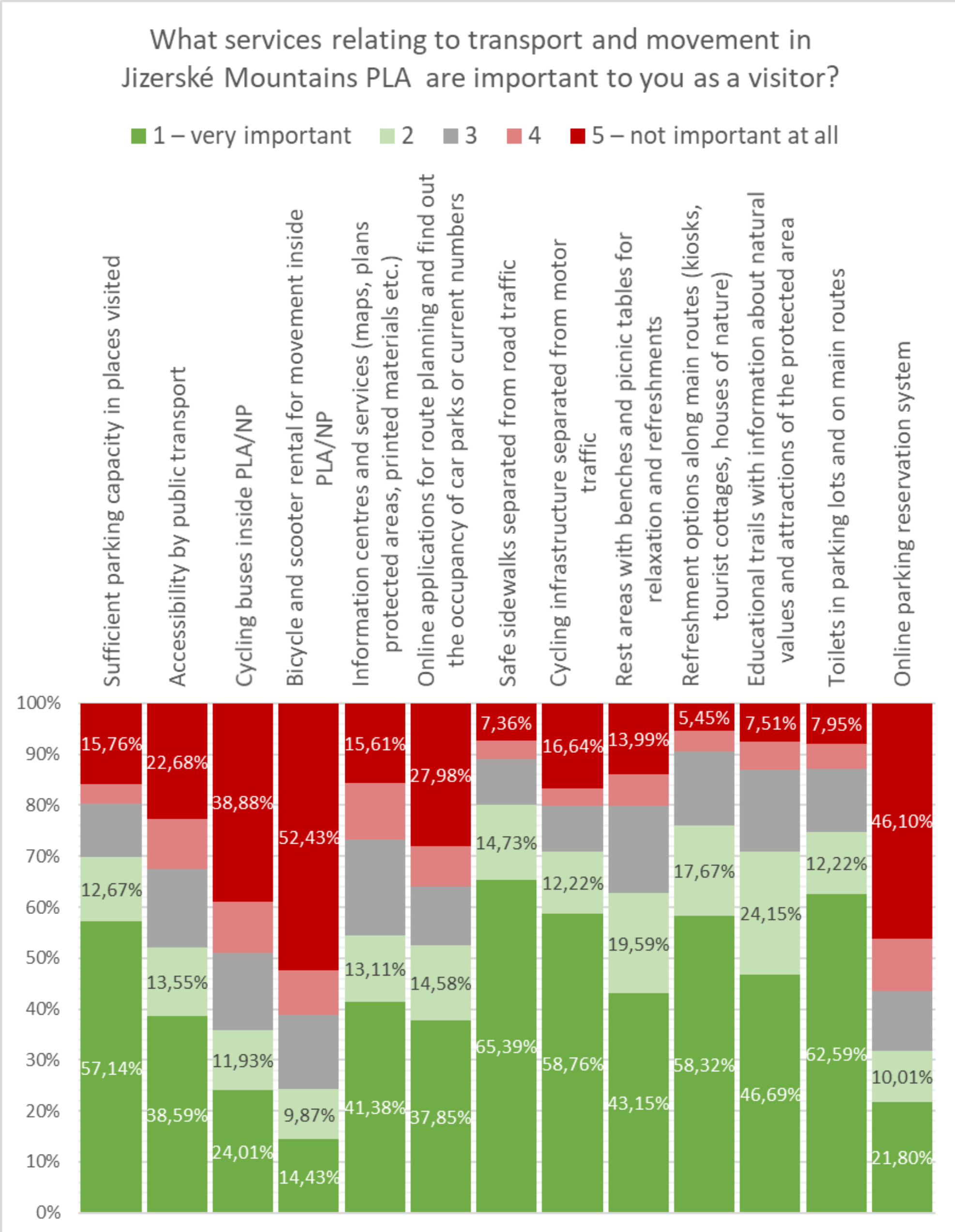
* set quotas for survey



Graph 1: Territorial mobility for multi-day stays

Services

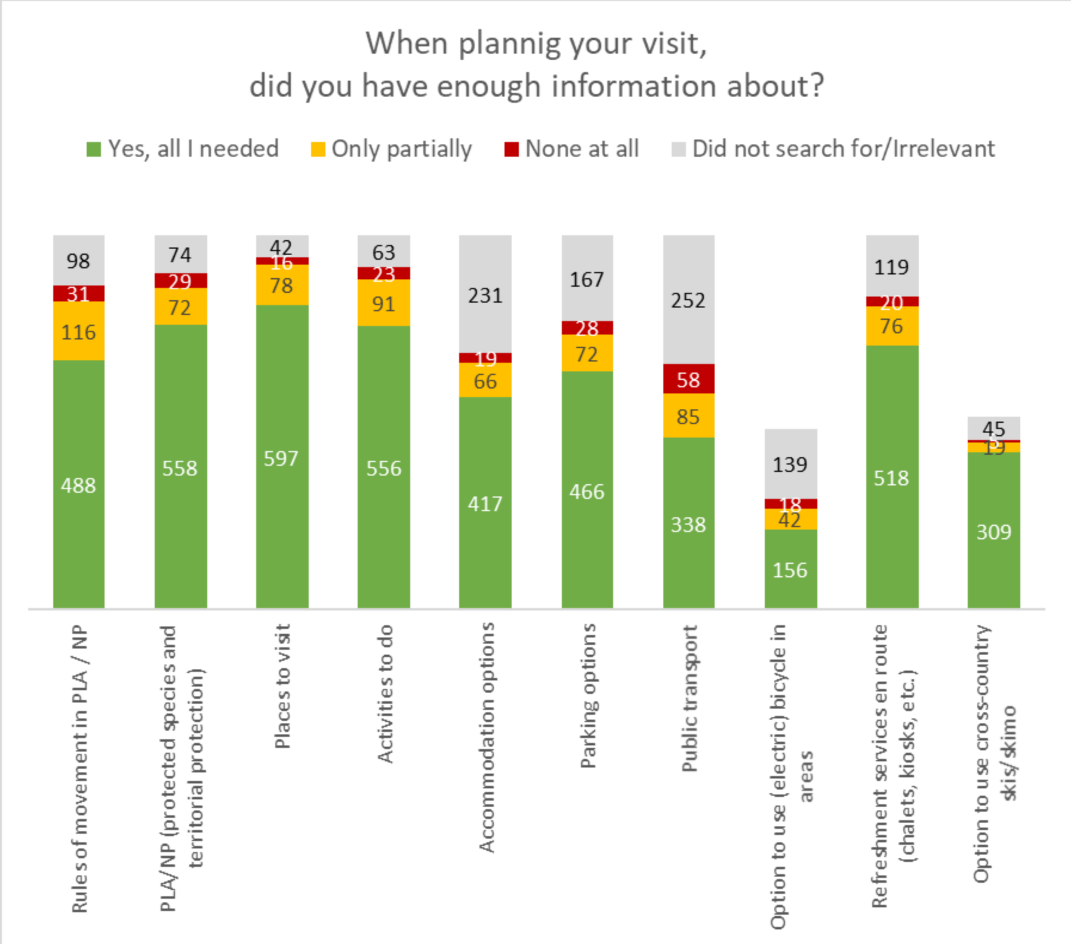
High-quality infrastructure appears to be important for tourists (especially safe sidewalks separated from road traffic – important for 80% of respondents, respectively cycling infrastructure separated from motor traffic – 71%), as well as the provision of toilets in car parks and along main routes (75%) and the possibility of refreshments on the main tourist paths (74%). Respondents also consider sufficient parking capacity in the places they visit (70%) to be important. On the other hand, respondents consider the possibility of renting bicycles or scooters to move within the territory (61% of the respondents) and an online parking reservation system (56%) to be unimportant; see Chart 2. The greater differences between summer and winter periods are caused by natural differences between these periods, which causes respondents to be more aware of the importance of sufficient parking capacity, toilets in car parks and on main routes or an online parking reservation system during winter.



Graph 2: Perception of transport-related services in terms of their importance

Visitors' awareness

Graph 3 shows that the respondents have most of the necessary information available when visiting the Jizera Mountains PLA. They search less for information about public transport and accommodation options, as some of them do not use these services. The satisfaction does not differ between winter and summer substantially.



Graph 3: Use of information by visitors

For further regulation and planning of transport, it is important to find out who uses different modes of transport to come to the PLA territory. To answer this question, a multidimensional linear regression is used, in which the dependent variables are currently used transport modes. Socio-demographic characteristics, as well as on with whom the respondent travels, the length of stay and interests in hiking or cycling enter the model as independent variables. Their list is given in Table 2.

Tab. 2: List of variables entering multidimensional linear regression

Car	**car = 1; otherwise = 0**
Train	train = 1; otherwise = 0
Bus (regular service)	bus = 1; otherwise = 0
Day asked	weekday = 1**,** weekend = 2
Domestic/foreign visitor	domestic = 1, foreign = 2
Length of stay	1 day = 1, 1-2 overnights = 2, 3-7 overnights = 3, longer = 4
Arrived with family	with family = 1; otherwise = 0
Arrived alone	alone = 1, otherwise = 0
Arrived with spouse	with spouse = 1, otherwise = 0
Age	15-29 = 1, 30-44 = 2, 45-59 = 3, 60 and over = 4
Gender	male = 1, female = 2
Education	primary = 1, apprentice = 2, secondary without exam = 3, secondary with exam = 4, university = 5
Economically active	active = 1, inactive = 0
Household income	below-average = 1, roughly average = 2, above-average = 3, way above average = 4
Interest in nature	yes = 1, no = 0
Interest in hiking	yes = 1, no = 0
Interest in cycling	yes = 1, no = 0

The results of the regression suggest that the car is used more in summer and winter by those who come for longer stays, as well as people travelling with family or with more people and with an above-average income. In summer, those who are less interested in nature belong here too. In winter, more foreigners, younger men and higher-income men drive a car (see Table 3).
The main factors that explain the choice of the train as a means of transport to visit the Jizera Mountains PLA include gender in the summer – men travel more in this way, as well as those with lower incomes (in addition, the lower the income in the respondent's household, the greater the chance that they come to the area by train), with more interest in nature and less interest in hiking. In winter, these are those who travel alone or without a family.
As Table 3 shows, women and people with lower incomes use the bus more in summer and winter. In addition, in winter, they are visitors from the Czech Republic, travellers without a family or alone and older people. In summer, on the other hand, it is more often those who are more interested in nature, hiking and, conversely, less interested in cycling.

Tab. 3: Regression analysis – factors influencing the choice of car

	SUMMER			WINTER		
N	324			339		
	Coefficient	P-value		Coefficient	P-value	
***By what transport mode did you arrive from home?* CAR / MOTORCYCLE**						
Day asked	-0.04	0.38		0.05	0.25	
Domestic/foreign visitor	0.02	0.86		0.18	0.04	**
Length of stay	0.08	0.00	***	0.06	0.01	**
Arrived with family	0.17	0.01	**	0.16	0.00	***
Arrived alone	-0.14	0.10	**	-0.24	0.00	***
Arrived with spouse	0.12	0.13		0.08	0.16	
Age	-0.01	0.58		-0.04	0.09	*
Gender	-0.07	0.16		-0.13	0.00	***
Education	0.02	0.32		0.03	0.08	**
Economically active	0.17	0.01	***	0.11	0.03	**
Household income	0.06	0.24		-0.01	0.85	
Interest in nature	-0.13	0.01	***	-0.15	0.08	**
Interest in hiking	0.02	0.70		-0.02	0.72	
Interest in cycling/cross-country skiing	-0.04	0.49		-0.05	0.33	
***By what transport mode did you arrive from home?* TRAIN**						
Day asked	0.01	0.79		0.03	0.14	
Domestic/foreign visitor	-0.03	0.60		-0.03	0.39	
Length of stay	0.01	0.66		0.01	0.43	
Arrived with family	-0.08	0.14		-0.04	0.06	*
Arrived alone	0.02	0.79		0.04	0.09	*
Arrived with spouse	-0.03	0.60		-0.03	0.16	
Age	0.01	0.64		0.00	0.62	
Gender	0.09	0.02	**	0.01	0.54	
Education	-0.02	0.25		0.00	0.60	
Economically active	-0.08	0.06	*	0.03	0.12	
Household income	-0.06	0.06	*	0.01	0.75	
Interest in nature	0.13	0.00	***	0.02	0.66	
Interest in hiking	-0.07	0.08	*	0.02	0.47	
Interest in cycling/cross-country skiing	-0.05	0.21		-0.01	0.68	
***By what transport mode did you arrive from home?* BUS (REGULAR SERVICE)**						
Day asked	0.04	0.21		-0.02	0.58	
Domestic/foreign visitor	-0.10	0.10		-0.14	0.08	*
Length of stay	-0.04	0.02	**	-0.09	0.00	***

Arrived with family	-0.06	0.18		-0.14	0.01	***
Arrived alone	-0.03	0.54		0.24	0.00	***
Arrived with spouse	-0.14	0.01	***	-0.09	0.13	
Age	0.01	0.72		0.04	0.05	**
Gender	0.06	0.08	*	0.14	0.00	***
Education	0.02	0.30		-0.03	0.09	*
Economically active	-0.07	0.08	*	-0.11	0.02	**
Household income	-0.04	0.22		-0.01	0.79	
Interest in nature	0.07	0.05	**	0.12	0.15	
Interest in hiking	0.10	0.01	**	0.05	0.33	
Interest in cycling/cross-country skiing	-0.10	0.01	**	0.07	0.12	

Note: * p<0.1; ** p<0.05; *** p<0.01

Discussion

Respondents expressed great interest in quality infrastructure in the area, especially a separate walking and cycling infrastructure with a sufficient supply of toilets, refreshments and rest areas. This interest was expressed by most respondents, regardless of the means of transport used. However, it was confirmed that visitors to the Jizera Mountains PLA use cars for transport to the area, in both winter and summer, while the use of alternatives to cars is more common among low-income people and single travellers. Public transport users also expressed greater interest in nature. Interestingly, the train is more often chosen by men, while the bus is chosen more by women. There are differences between the summer and winter seasons, especially in the provision of services. In winter, sufficient parking capacity, toilets in the car parks and on the main routes or an online parking reservation system proved to be even more important.

Conclusion

The results clearly show that visitors use dominantly cars to travel to and around the PLA, especially those travelling with families or other company, higher-income, men and coming for longer stays. Car is also used more by those who cycle in the area. One of the ways to reduce unsustainable travel and movement around the territory is to create products and conditions that will support alternative travel even for higher-income groups, travellers with children, etc.

It is necessary to create an offer of alternative types of transport with a sufficient system for informing visitors about the possibilities of alternatives, their benefits and possible (suitably set) advantages. Sustainable transport modes should be better integrated, cheaper, and should provide direct connection to boarding points with service infrastructure (refreshments, toilets, information panels).

In terms of sustainability and minimization of negative impacts of transport in the area caused by overtourism, multiple public transport boarding points, lines with regular intervals and interconnected with other urban transport (long-distance commuting) or to car parks at the edge or outside of the PLA must be established.

Among the actors who could address such an integrated system in environmentally sensitive areas are the PLA/NP administrations, destination agencies and communication administrations and wider integrated systems – region authorities. Other actors may be local governments, local government associations or other local action groups and organizations.

The presented results are a part of comprehensive research to develop a methodology for the so-called "Mobility Plans for Environmentally Sensitive Areas (ESA)". Mobility plans should help authorities conceptually develop more sustainable forms of tourism, and thus alleviate the pressure on the environment and its protection as such while respecting the specifics of protected areas in the Czech Republic.

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Souhrn
Příspěvek prezentuje výsledky výzkumu zaměřeného na udržitelné chování turistů a návštěvníků CHKO Jizerské hory. Vychází ze sociologického průzkumu provedeného na reprezentativním vzorku 733 návštěvníků z České republiky a zahraničí pomocí metody CAPI v srpnu 2021 a lednu 2022.
Náš příspěvek se zaměřuje na analýzu mobilitního chování a vybraných aktivit v chráněném území a potenciál pro změnu chování ve prospěch udržitelnějších alternativ, včetně volby dopravního prostředku při příjezdu a pohybu po území, různých služeb a aktivit v území, a dopady vybraných opatření na změnu chování; dále jsou porovnány rozdíly mezi letním a zimním obdobím. Příspěvek také poskytuje údaje o informovanosti respondentů o místních specifikách a možných aktivitách a službách mobility v dané oblasti.
Prezentované výsledky výzkumu jsou součástí komplexního výzkumu s cílem vypracovat metodiku pro tzv. „Plány mobility pro environmentálně citlivé oblasti (ESA)“. Plány mobility by měly úřadům pomoci koncepčně rozvíjet udržitelnější formy cestovního ruchu, a tím zmírnit tlak na životní prostředí a jeho ochranu jako takovou při respektování specifik chráněných území v ČR.

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DOBROGEA SOILS - AN ECOSYSTEM APPROACH

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Abstract
Soil resources, essential components of natural capital are necessary to analyze from the perspective of sustainable development, due to their role in relations with the components of the environment and with the socio-economic capital of a territory. In territorial planning, the study of soil resources is very important, from the perspective of ensuring ecological and social security. Being vulnerable to degradation processes, when used without observing the protective and conservative conditions, it can be degraded in a short time, and the subsequent recovery is long and expensive. Starting from these considerations, our analysis aims at evaluating the ecosystem services offered by the soils of the Dobrogea Plateau. Ecosystem services are one way to harness biodiversity by looking at what it does and how we value the function that soil performs. They generate a series of services that are essential for our health and well-being. Our study makes use of FAO (FAO and ITPS. 2015. Status of the World's Soil Resources – Main Report) assessments by correlating the soil reference groups according to the WRB with the soil units of the Dobrogea Plateau, a region characterized by the domination of the bio-climatically determined soils, to which various intrazonality situations are added. These include types of food security, climate regulation, water regulation, and socio-cultural services.

Key words: Dobrogea Plateau, soils, and ecosystem services

Introduction
Dobrogea Plateau is the largest part of the historical province of Dobrogea and it consists of three main subunits: the Southern Dobrogea Plateau, the Central Dobrogea Plateau and the Northern Dobrogea Plateau. It is a region with hill relief characterized by the domination of the steppe and forest-steppe soils bio-climate determined, which are added various situations of intrazonality, depending on the rock, excess moisture, salting.
With a total area of 10,350 km2 (4.35% of the country's surface), the Dobrogea Plateau has a varied edaphic coating that made possible a well-defined distribution of different types of crops and the appearance and development of the first human settlements since the Paleolithic.
This work highlights the corresponding links between the different types of soil in this region, the ecosystem services they can offer, and especially the analysis of the cultural and touristic services by identifying archaeological sites on these soils.

Material and methods
1. *Study area*

Dobrogea Plateau is morphologically characterized by low altitudes (89% of the territory is below 200 m), the relief energy is predominantly below 100 m, and the fragmentation density is 0.5-1 km/km^2.
Localities are focused on the coast, along the Danube and the principal valleys (Ielenicz, 2000). In concert, it is a region full of history, with traces of habitation from antiquity - a series of Greek and Daco-Roman fortresses, with continuity also in the Byzantine era.

2. *Data processing*

The methodology included a series of stages of data collection, database development, geospatial analysis, and identification of interdependent elements for determining some eco-systemic services in the study area. In addition, GIS and Remote Sensing techniques were used with the help of ArcGIS Pro2.8 and Google Earth Pro applications. The first stage consisted of the recognition and cartographic representation of the main types of soils in the study area. The information available on the Map of Romania's Soils was used, scale 1:200 000, 1963-1994 edition. This assembled vector data was later included in a complex geodatabase. To establish the type of eco-systemic services that each soil group in the Dobrogea Plateau can offer, in the second stage of work, the FAO Report 2015 was interrogated.

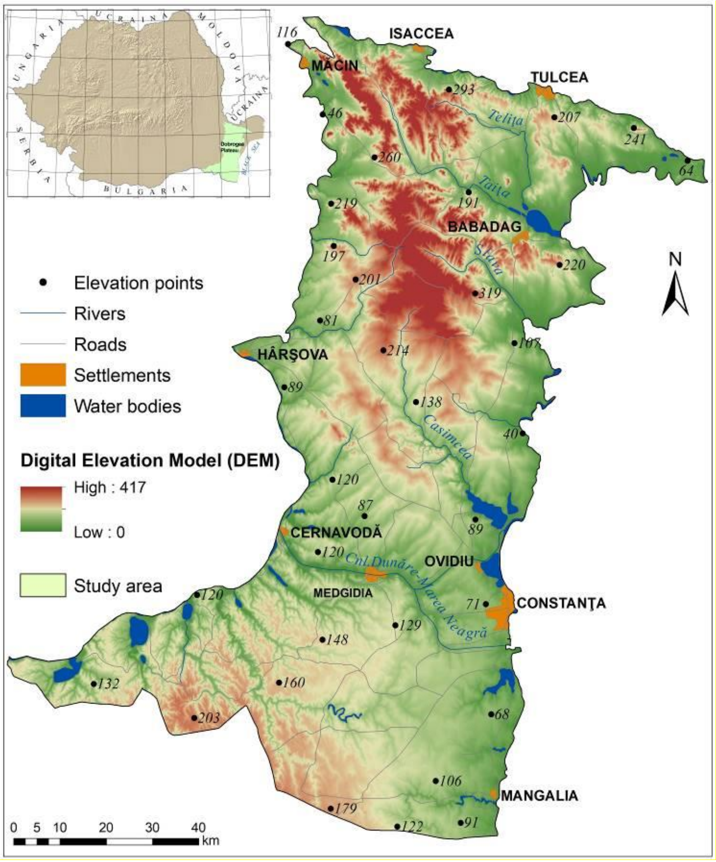

Fig. 1: Study Area. Dobrogea Plateau located in Eastern of Romania

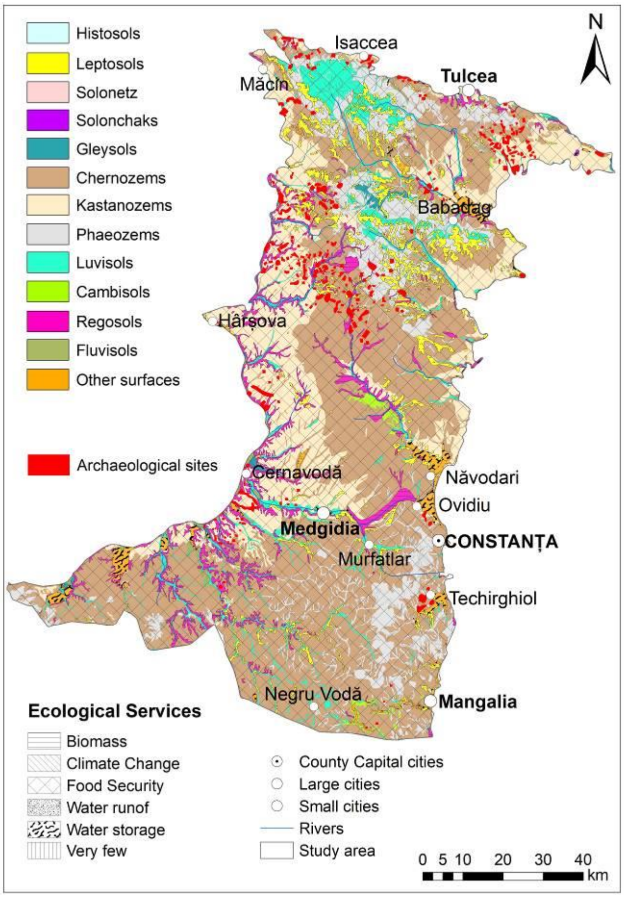

Fig. 2: Map of soil groups, major ecosystem services and archaeological sites

It suggests a generalization of the main soil groups globally and determines which type of soil can provide eco-systemic service.
Conform to this Report, a classification of the principal soil groups in the Dobrogea Plateau and the ecosystem services that can be performed was made. To bring some details about cultural services was an inventory of the archaeological sites and their correlation with the soil groups. Discovery of the archaeological sites was made on aerial images provided by the Google Earth Pro application, with a resolution of 50 m. These images were purchased on June 19, 2021. The result was a map of the ecosystem services offered by the soils.

Results

The first part of this study focused on identifying the ecosystem services offered by the soils of the Dobrogea Plateau In this respect, the soil types from the study area were mapped and correlated with the ecosystem services provided by each of them, according to the FAO Report 2015.

Tab. 1: Generalized ecosystem service rating of specific soil groups (WRB) (processing according to the FAO Report 2015). The share of land with archeological sites. F - Food, CL - Climate, W - Water, CU - Cultural, AS - Archaeological sites

SOILS	**%**	**F**	**CL**	**W**	**CU**	**SUM**	**MAJOR SERVICE**	**% AS**
Histosols	0.03	2	5	5	3	15	Climate Change	0.02
Leptosols	3.02	1	1	2	1	5	Water runof	3.27
Solonetz	0.04	1	1	1	1	4	Very few	0.00
Solonchaks	0.07	1	1	1	1	4	Very few	0.33
Gleysols	0.42	2	1	3	1	7	Food Security	0.60
Chernozems	47.56	5	4	4	1	14	Food Security	38.37
Kastanozems	19.37	3	4	2	1	10	Food Security	34.66
Phaeozems (Halic Phaeozems, Grey Luvic Phaeozems, Endoleptic Phaeozems)	14.85	4	4	3	1	12	Food Security	9.28
Luvisols (Haplic Luvisols, Albic Luvisols, Chromic Luvisols)	5.71	3	2	2	1	8	Food Security	3.45
Cambisols (Eutric Cambisols, Rhodi-eutric Cambisols)	0.51	3	2	3	1	9	Food Security	0.00
Regosols	5.66	2	1	1	1	5	Biomass	8.91
Fluvisols	0.42	4	2	4	2	12	Food Security	0.44
Other surfaces (Stony, Sands, Water bodies)	2,34							0.66

Assessment of soil contribution to types of ecosystem services - food security, climate change, water runoff, and socio-cultural services are estimated on a scale of zero to five for each category referred. Assessments shall be based on the characteristics and quality of the soil measured by: suitability for cultivation, organic carbon content, water retention capacity, and capacity to store archaeological remains.
This analysis resulted that the highest share is held by the Food Security ecosystem services (88.84%). Services are provided in a proportion of 81.78% by Chernozems (47,56%), Kastanozems (19.37%), and Phaeozems (14.85%). The primary ecosystem service is generally the one with the highest score. A particular situation is the case of Gleysols, who have been assigned the Food Security service because they. Those soils are part of the ecological group of chernozem soils (Florea, 2003) which by their fertility are widely used in agriculture, especially for cereal crops. However, with an excess of moisture, they frequently have a high nutrient content, having a high natural fertility potential for meadows. Through dewatering, they can also be harnessed by cultivation. In the same way, in the case of Kastanozems, the higher score attributed to climate services related to the carbon cycle has been overtaken by their role in ensuring food security.

At the same time, if we follow the scores given to the four categories of services, we can see that along with the involvement in food production, the different soils offer services that are well valued and related to water runoff and climate change. Thus, of the total score, about 30% go to services related to food production, but at the same time, services related to water runoff and climate change hold about 30% and 27%, respectively. Cultural services account for about 14%.

Foto 1,2- Left - Enisala Fortress (area with Regosols); Right - Halmyris Fortress (area with Kastanozems). Date: June 17-18, 2019

To bring some details regarding the cultural services, we considered that identifying archaeological sites and their correlation with the soil group represents a necessary stage in this study. More than 275 archaeological sites (23251.71 ha) have been identified on aerial images, most of them located in the central and northern part of the Dobrogea Plateau. After mapping, data were verified with the National Institute of Heritage database and subsequently punctually validated in the field through the campaigns organized in 2021.

The final data were included in the complex database and then correlated with the principal soil groups in the study area. Through the additional value they bring, cultural services can serve to secure the land as a whole in traditional ways of using it. They can foster the development of forms of cultural tourism combined with forms of ecotourism, with little impact on the environment.

Discussion

Ecosystem services are a way to enhance biodiversity by looking at what it does and how we value the function of soil. They produce a range of essential services for our health and well-being. To provide a framework for how ecosystems provide services to human lives, the terms "Ecosystem approach" and "Ecosystem services" are used. The 'ecosystem approach' is intended to help policymakers take complete account of ecological systems and their associated biodiversity. "Ecosystem services" describe the processes and functions provided by the natural world, which are used by humanity for its well-being. (FAO Report, 2015).

The solification was influenced mainly by temperate-continental climate conditions of the steppe and forest-steppe very good for agricultural use (Oprea, C.R. et. all, 2019). The primary ecosystem service is Food Security, which is connected with the decomposition and cycle of organic matter, nutrient regulation, and food production. It is added with scores close in value, equally valuable services related to the regulation of water and climate - clean air and water, gas exchange, and carbon sequestration.

Although the cultural services amount to about 14% of the total score, they have an essential role being able to offer alternatives for the sustainable development of the region so that the decisions regarding the use and management of the land and its resources must favor practical long-term solutions, to the detriment of those in the short term or which may lead to the degradation or destruction of soil resources. Therefore, under The World Soil Charter (FAO Report, 1981), land use for non-agricultural purposes must be organized in such a way as to avoid as much as possible the occupation or permanent degradation of good quality soils. The morphological characters described above to which optimal wind conditions are added were favorable elements for the installation and expansion of wind farms. In addition to the obvious advantages, there are also some problems, including removing fertile soils from the set-aside of some. These aspects are visible, especially at the locality level, among the most affected being Cogealac-Fantanele, Chirnogeni, Casimcea, etc. (Oprea, C.R. et. all, 2019).

Conclusion

The inventory of archaeological sites concerning soil groups opens up interesting discussions. The analysis of cultural services - cultural, spiritual values (for example, the traces of the Paleo-Christian basilicas of Halmyris and Niculițel - whose foundations are preserved in Kastanozems) and recreational - can be deepened. By capitalizing on them in ecotourism programs, and cultural tourism, to be organized in environmentally friendly ways, benefits can be brought to local communities, tourism activities spreading outside the area of maximum concentration, which is the Black Sea coast. In the region, especially in the northern half, where archaeological sites predominate, there are also soils with total scores for lower ecosystem services, ranging from 4 to 8, with scores for Food Security being mostly 1 or 2. Thus, through the cultural services, Leptosols, Solonchaks, Gleysols, Luvisols, and Regosols increase their value, the archaeological sites totaling within these groups 16,56%. In the situation of soil groups Chernozems, Kastanozems, Phaeozems with high scores, these tourism activities can contribute, as we have shown in the above lines, to securing land in flexible ways of use, optimized coexistence between alternative forms of valorization and traditional forms linked to the natural valence of soils.

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Souhrn

Ekosystémové služby představují způsob, jak zvýšit biologickou rozmanitost tím, že se podíváme na to, co dělá a jak oceňujeme funkci půdy. Produkují řadu služeb nezbytných pro naše zdraví a pohodu. Naše studie využívá hodnocení FAO (FAO and ITPS. 2015. Status of the World's Soil Resources - Main Report) tím, že korelovala referenční skupiny půd podle WRB s půdními jednotkami na Dobrudžské vrchovině. Jedná se o region nacházející se na jihovýchodě Rumunska, který je na severu a západě rámován Dunajem, na východě deltou Dunaje a Černým mořem a na jihu hranicí s Bulharskem. Jedná se o region s vynikajícím zemědělským potenciálem a větrnými zdroji a cenným turistickým potenciálem, který se však zužitkovává zejména pouze na pobřeží Černého moře. Jedná se o typy potravinové bezpečnosti, regulace klimatu, regulace vodních zdrojů a kulturních služeb.

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ECONOMIC EFFECTS OF WATER-RELATED TOURISM AROUND THE VLTAVA RIVER CASCADE

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Abstract
The Vltava River cascade with its series of dams and reservoirs has been traditionally an area of intense and diverse open-space recreation linked to water ecosystems. This study examines the effects of water-related tourism in this pilot area on the economy.
Using the Leontief input-output model based on the symmetric input-output table (SIOT) and data on yearly expenditure of recreationists, type I and II multipliers are derived for gross value added as indicator of economic effect. The results show that 1 CZK of tourists´ expenditure is associated with creation of about 0.41 to 0.53 CZK of regional gross value added (this also represents a proxy for the effect on regional gross domestic product). More than a half of the total effect of recreationists´ expenditure on the regional economy is realized through visitor purchases from economic sectors of accommodation and food service activities.

Key words: water-based recreation, tourism impacts, input-output analysis, gross value added, tourism expenditure

Introduction
Knowledge on the economic effects of nature-based tourism on the economy is vital, as the unpriced benefits of nature tend to have no voice in decision-making about the optimal use of natural resources. This is well acknowledged in research on environmental valuation and also newly emerging ecosystem accounting standards that relate environment to national accounts (UNSC, 2021). While some of the uses associated with natural resources, mostly extractive ones (lumbering, fishing etc.) are directly visible on the market and it is straightforward how they affect the economy, the effects of non-extractive uses such as providing recreation opportunities by nature remain largely hidden within the system of national accounts.
The total national impact of tourism on GDP is estimated annualy through the Satellite Tourism Account, but these numbers capture merely direct impacts of all types of tourism on the whole national economy. To link the economic impacts of recreation to a specific nature-based area and distinguish the share of the total effect driven by the nature-based area itself among all other recreational uses of the area (such as health and wellness tourism, historical tourism or congress tourism), a much more detailed economic analysis is needed, while more complex data necessary to accomplish such a task are often scarce or non-existing. Also, the impact of nature-based tourism in a particular area embraces a significantly larger portion of the total economic performance of the region than the direct impacts show (these encompass only the first round of supply-chain impacts of the goods and services demanded by visitors during their trips). The practice preferred for economic impact analyses is to focus on the total effect of visitors´ demand for the products of the economy which includes direct impacts and indirect effects of the demand (second- and further rounds of impacts on particular industries in the economy), and possibly also induced effects (realized through consumption of households employed in the stream of industries that is enabled by the visitor expenses).
This contribution investigates how such a task can be accomplished, using a Leontief input-output model for the regional economy following the best available practice (Spenceley et al., 2021). The approach is tested in a pilot area of the Vltava River cascade, an important recreation area in the Czech Republic characterized by a unique series of large water dams and reservoirs. Traditionally, the area has been very popular mainly with Czech visitors for diverse open-space recreation activities linked to water. The visitation pressure on this area has increased throughout last 20 years and is not expected to relent even in the future. This long-term trend is in sharp contrast with expected future risks related to climate change which might pose a challenge for maintaining the current level of qualities related to the water-based activities (such as maintaining recreation-supportive water levels and water quality) also in the following decades, considering the potentially shifting societal demand on other preferred uses of the water such as the flood protection function of the cascade.

Data

The work presented here builds on the methodology described in Kaprová (2020) and stems from a wide range of data:

- original on-site survey on visitor spending patterns in the pilot area (N=460), quota-sampled both for recreation areas around the Vltava river and recreation activities;
- data of visitation patterns based on mobile positioning data and other data sources;
- data describing the economy: both regional (NUTS3; Fischer et al., 2018; Sixta and Vltavská, 2016) and national symmetric input-output tables (SIOT produced by Czech Statistical Office);
- data describing the distribution of economic activities within the regions etc.

Only recreationists declaring that a water-based recreation activity was the motive for their actual trip (N=456) were further retained in the sample for the analysis of visitor expenditure. The main categories of spending include accommodation, board and transport (altogether, these form 77% of the expenditure of the average visitor). Further categories of expenditure included entrance and parking fees, costs of recreation equipment and retail purchases (including ingredients for cooking, souvenirs and gifts).

Results and Discussion

Using the Leontief input-output model (Miller and Blair, 2009; Mahajan et al., 2018), an open model and a model closed for households were built. This enables to address the full range of economic effects:

- direct - effects of first-round purchases in the supply-chain, in economic sectors that directly meet the visitors´ demand of goods and services (i.e. accommodation, meals at restaurants etc.);
- indirect – all subsequent supply-chain impacts, i.e. effects of all other rounds of additional purchases of economic inputs needed to meet the demand of the first-round supplier (suppliers to accommodation, restaurants, their suppliers etc.);
- induced – effects on economy through increased income of employees in sectors affected directly or indirectly by the visitor expenditure and subsequent changes of the consumption of employees through increased purchases of economic inputs;

and to derive type I and type II multipliers of economic effects.

We focus primarily on gross value added (GVA) as economic indicator, i.e. the value of gross output adjusted for intermediate consumption. Compared to gross output as another frequently used economic indicator, it does not overestimate the economic effect, as the value of all inputs to production are accounted for only once in the process of GVA calculation. In economic impact analyses, gross value added is also used as a proxy for gross domestic product (GDP), as GDP equals GVA plus (usually not very dominant) net taxes.

Figure 1 disentangles the storyline how the expenditure transforms into the effect on the regional economy. Out of 1 CZK of the gross (unadjusted) tourists´ expenditure at the pilot area, ca 20% is actually related to demand for products of the economy outside the region (produced in the rest of the Czech Republic or abroad) that were imported to the region, and thus the effects of these purchases leak out of the regional economy. Further 11% of the gross tourists´ expenditure are leakages related to direct taxes which also do not further translate into the regional GVA effect.

The gross expenditure adjusted for the leakages is used to calculate the economic impacts. The direct effect on GVA (25% of the gross expenditure) accounts for less than half of the total effect. The indirect effect adds another 17% to the total effect of visitors´ recreation-related expenditures. Induced effects account for further 11% of GVA formation. Following the usual practice (Miller and Blair 2009), we assume no leakages to savings. This type of leakage is relevant only for induced effects – i.e. by assumption, all income of households generated by visitor expenditure is used for consumption.

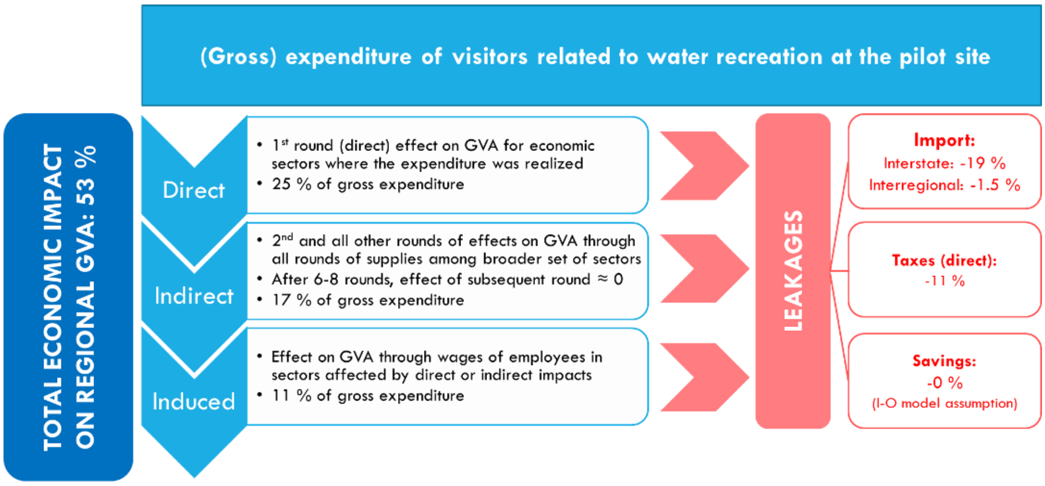

Fig. 1: Scheme of the economic impact of tourism expenditure related to water recreation at the pilot site of Vltava cascade on the regional gross value added (type II multiplier accounting for direct, indirect an induced effects)

Conclusion

The study enables to translate the effect of availability of the Vltava water ecosystems for recreation into economic terms, which is important in case the water-related recreation opportunities would be affected by climate change, droughts or floods and subsequent water management – and recreationists will have to substitute their trips with another recreational site outside the pilot area.

Using the type I and type II multipliers calculated respectively as the lower and upper bound of the true effect (Emonts-Holley et al., 2021), 1 CZK of tourists´ expenditure is assumed to be associated with creation of about 0.41 to 0.53 CZK of gross value added in the region (this also represents a rough proxy for the effect on regional gross domestic product) in the same year. These numbers represent weighted averages of multipliers across all expenditure categories and related economic sectors (weights=expenditure across categories and sectors). More than a half of the total effect of recreationists´ expenditure on the regional economy is realized through visitor purchases from economic sectors of accommodation and food service activities.

The I-O models are linear by definition, so the results are easily transferable to economic impact analysis. E.g. to accommodate a 100 CZK increase in tourists´ expenditure, creation of 41 to 53 CZK of gross added value is needed; also the loss of tourists and related expenditure is associated with a negative effect on regional GVA of the same magnitude. However, it has to be stressed out that the effects of large changes in recreation demand should be analyzed with extreme caution, and most preferably using a different modelling framework such as dynamic computable equilibrium models (CGE) if available, as the I-O model is rather restrictive in its assumptions (see e.g. Miller and Blair 2009; Emonts-Holey et al. 2021).

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Souhrn
Vltavská kaskáda s řadou přehrad a nádrží je tradičně oblastí intenzivní a rozmanité rekreace ve volné krajině spojené s vodními ekosystémy. Tato studie zkoumá dopady cestovního ruchu spojeného s vodou v této pilotní oblasti na regionální ekonomiku.
Pomocí Leontiefova input-output modelu založeného na nejpodrobnější symetrické input-output tabulce (SIOT) a na místě shromážděných údajů o ročních výdajích rekreantů jsou odvozeny multiplikátory typu I a II pro hrubou přidanou hodnotu jako ukazatel ekonomického efektu. Výsledky ukazují, že 1 Kč výdajů turistů je spojena s vytvořením přibližně 0,41 až 0,53 Kč regionální hrubé přidané hodnoty (to představuje také hrubý ukazatel efektu na regionální hrubý domácí produkt).
Modely vstupů a výstupů jsou z definice lineární, takže výsledky jsou snadno přenositelné do analýzy ekonomických dopadů. Dopady velkých změn v poptávce po rekreaci by však měly být analyzovány s maximální opatrností, pokud jde o předpoklady I-O modelu.

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EVALUATION OF NON-FOREST WOODY VEGETATION ALONG ROADS IN THE RURAL LANDSCAPE

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Abstract
Linear tree formations in settlements represent an important biological element in the built-up area system. Along roads they are often the only elimination element of negative factors. They can significantly affect the climate-regulatory features of public space, safety and fluidity of road traffic in case of traffic guidance and visual support of important rural elements, as well as the elimination of surrounding construction elements. At present, many settlements are marked by the significant influence of the past, when woody plants were planted primarily to create phytomass without a more detailed respect to authenticity, regional specifics, originality and composition in the streets. Roads were often perceived as linear transit components of urbanism. Demonstrations of the resulting diversity from the point of view of the woody plants age stage, originality, as well as proportional-spatial properties of the species, result in different fulfilment of the functions of the accompanying green roads. The visual and functional quality of the trees and its composition are reflected in the resulting roadside vegetation structure, which was the subject of the evaluation, as well as their fulfilment against the defined basic functions of roadside vegetation in the rural area. For comparison, model areas in the same landscape type with a similar urban structure were selected.

Key words: countryside, rural renewal, rural public spaces, road vegetation

Introduction
Linear green elements, accompanying greenery of roads, watercourses and areas in rural settlements have an important role and should also fulfil the functions of greenery in settlements. The high frequency of movement in a given type of functional zones serves not only for the movement of the population but is also important in terms of connecting important centres in the settlement, facilitating and increasing safety in the public space as well as improving and optimising sanitary conditions, climatic conditions and the length or quality of people's stay in these spaces (Mareček, 2005), (Rózová, Tóth, Pástorová, 2021). Currently, linear green space elements are little understood as places where people spend time and are seen as necessary routes that they have to pass to get to other functional zones (Bihuňová, Supuka, Tóth, Šinka, Kuczman, 2021). The street has only a kind of complementary meaning within the green network in the urbanised environment, which is also reflected in the different current state of the green space, as well as the actual landscaping, composition and overall character of the place. Differences are perceived at the level of quality but also quantity of green space (Rózová, Supuka, Klein, Jasenka, Tóth, Štefl, 2020), (Tóth,Kuczman, Feriancová, 2016). They are manifested in different ways in lowland, basin and mountain landscape types, where there are also different spatial parameters of public spaces (Rózová, 2001). Streets also differ based on their location within the plan-genetic structure of a given settlement, and a main street is perceived differently from a secondary street or a local road. The most important road within a settlement is the main street, which usually passes through the centre of the development, divides the settlement and also fulfils a certain axial continuity with the dominant feature of the settlement, usually a church, manor house or other significant building (Feriancová, Kuczman, Tóth, 2012). The continuity with significant buildings is also often historically supported and the street thus has a historical connection with the development of the settlement, the frequency of movement as well as the use itself (Mareček, 2005). This paper focuses on the assessment of the current state of just linear green space elements located in selected model areas of settlements of lowland landscape type of the Slovak Republic. The selected model territories are the main streets, which also define the character of the built-up area and the overall plan-genetic structure of the settlement, which is typical for the lowland landscape type of the Slovak Republic (Bechera and Kuczman, 2020).

Materials and methods
The model territories for the paper are rural settlements in the lowland landscape type of the Slovak Republic, located in the Trnava region, under the Little Carpathian Mountains in the Trnava Hills. The selected settlements are Smolenice and Dolná Krupá and their main roads.

Picture 1: Views of the researched areas. Author: Bechera, 2022
Location of settlements in western Slovakia. (mapka.gku.sk, 2022) Smolenice (A1) Dolná Krupá (A2)

The selection criteria were the same type of SR landscape, similar intensity in terms of traffic and use - the selected roads (Smolenice - class II. road No. 502, Dolná Krupá - class III. road No. 1299), visual and functional connectivity to the dominant feature of the settlement (in both cases the church in the centre of the settlement), the two-sided built-up area together with the two-sided linear greenery that was located on the studied area of the territory. In order to achieve objectivity and comparison of the current situation, the criterion was also the choice of the length of the surveyed area, which was 470 m in Smolenice (location: SNP Street from the intersection of Cintorínska and SNP Streets to the house No. 47/2) and 539 m in Dolná Krupá (location: Hlavná Street from the house No. 15/228 to the house No. 48/160).

The current state of greenery was analysed, assessed and evaluated on the basis of the methodology for the assessment of the composition of trees in public spaces of rural settlements of the Slovak Republic (Bechera, Kuczman, 2020). The methodology, which was used in the research of the selected spaces, tracks the current state of tree composition (trees and shrubs) in the space in relation to the functions of green space in rural settlements based on the influence and relationships of the characteristics of tree composition and the functions of public green space. The tree composition characteristics are divided into 14 categories and separate elements V1 - V14. The tree composition traits are abbreviated as follows: V1 - tree cover, V2 Tree height potential, V3 Shrub height potential, V4 Visual connectivity, V5/ Composition, V6 Species diversity, V7 Species authenticity, V8 Originality, V9 Shape, V10 Colour, V11 Utility, V12 Cultural-historical value, V13 Developmental stage, V14 Tree vigour. The methodology monitors the relationships and the effect of the current state of the characteristics of tree felling on the functions at the level of efficiency and utilization, specifically on 6 functions of public green spaces in rural settlements, namely: F1 Aesthetic-representative function, F2 Proportional-spatial function, F3 Climatic-regulatory function, F4 Eco-stabilizing function, F4 Cultural-social function, F5 Traffic-safety function. The final stage of the methodology is the determination of the fulfilment of functions on the basis of individual characteristics, thus objectifying the current state of tree felling from different perspectives and identifying three categories of functional efficiency, which are. The performance of each function is evaluated based on the percentage of each grade as well as a selective assessment of the individual characteristics within each function F1-F6 (Bechera and Kuczman, 2019).


Picture 2: Views of the researched areas - current state. Author: Bechera, 2022
Smolenice (A1) Dolná Krupá (A2)

Results

The methodology is based on the analysis of input data, which is crucial for the objectivity of the assessed area as well as the accuracy of the results. The input data follow the real state of the tree composition in terms of the characteristics of the tree stock V1-V14 as well as the areal-spatial parameters of the studied area or functional zone. The monitored parameters are the areal area of potentially or actually used area for planting or existence of green areas in various forms. Subsequently, by comparing the total area and the area used by greenery (areal tree cover), a percentage of the current state of cover and use is determined. By processing and completing the input data, the KQ quality category of the current condition is determined, from which the classification of the functional efficiency in the individual green space functions is also determined. The results for the model areas in the settlements of Smolenice (A1) and Dolná Krupá (A2) are summarised in the summary table. Explanatory notes to the table - fulfilment and degree of fulfilment of the effectiveness of the tree composition in the required characteristic in individual green space functions.

V/F	F1		F2		F3		F4		F5		F6	
	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
V1	◖	◖	◖	◖	◖	◖	◖	◖	/	/	◖	◖
V2	●	●	●	●	●	●	●	●	/	/	●	●
V3	●	●	●	●	●	●	●	●	/	/	●	●
V4	●	◖	●	◖	/	/	/	/	●	◖	●	◖
V5	◖	●	◖	●	◖	●	◖	●	◖	●	◖	●
V6	◖	◖	◖	◖	●	●	○	○	/	/	●	●
V7	○	○	/	/	◖	◖	○	○	○	○	◖	◖
V8	●	●	/	/	/	/	/	/	/	/	/	/
V9	●	○	●	○	●	◖	●	○	/	/	●	○
V10	●	○	●	○	/	/	/	/	●	○	●	○
V11	/	/	/	/	/	/	●	○	●	○	●	○
V12	◖	x	◖	x	/	x	/	x	◖	x	/	x
V13	◖	◖	◖	◖	◖	◖	◖	◖	○	◖	◖	◖
V14	○	○	○	○	○	○	○	○	○	○	○	○

● Full ◖ Partially full ○ Not enough full / Without a relationship x No rating

Picture 3: Public greenery fulfillment table. Author: Bechera, 2022

The results show that the prime results were obtained for the model area Smolenice (A1) in functions F6 (● - 58,34% ◖ - 33,3% ○ - 8,36%), F1 (● - 46,15% ◖ - 38,46% ○ - 15,38%), F2 (● - 45,45% ◖ - 45,45% ○ - 9,1%). The achieved results are mainly in terms of a relatively significant mass of green vegetation in the area, which is made up of suitable deciduous trees, a relatively high coverage of the area is achieved at the level of mainly trees and complementary shrubs. The street greenery is compositionally appropriately distributed and creates a street space also with a residential function, which is also supported by trees with historical context and a link to sacral monuments. The trees in the space are quite vigorous and age-appropriate, which is reflected in the relatively significant phyto-matter in the predominantly green shades of the tree leaves, which looks very natural. The prime results for the model area Dolná Krupá (A2) were achieved in functions F3 (● - 44.44% ◖ - 44.44% ○ - 11.12%), F1 (● - 33.34% ◖ - 33.33% ○ - 33.33%), F6 (● - 33.34% ◖ - 33.33% ○ - 33.33%). The results achieved are mainly in terms of regularly spaced green space in the street space and relatively effective dust capture by the trees. In terms of aesthetics, the street performs well especially in terms of understanding the integrity and guiding the observer. The safety fulfilment is at a high level as the trees form a separating mass, which can also be understood negatively in terms of visual connection (poor canopy height). However, the type of trees in the space is poorly chosen. The composition of the trees is particularly unsatisfactory in terms of tree species, canopy shape and colour. Overall, the A2 study area is non-compliant and the majority of the assessment is graded poorly meets and partially meets.

Conclusion

The results show that the different composition of woody plants in the monitored areas A1 and A2 differ not only from the visual point of view, but also from the functional point of view. The street space in Smolenice (A1) is significantly more efficient in terms of performing functions and at the same time it also performs an aesthetic-representative function better than the space in Dolná Krupa (A2). The significant predominance of deciduous tree species as well as the overall ratio between species in Smolenice (A1) results in better integration of public space into the green infrastructure system as well as better connection with the cultural-historical value of the central part of the village with the urban concept. Last but not least, the size of the public space and its proportionality, which is better in the model seat Smolenice (A1), also affects the overall perception of the user. The area of the rated street is wider in the central part, where the development deviates slightly and from the main axis and thus creates a slight lenticular formation, reminiscent of a hanging area or the so-called Village square. The plan-genetic structure has a significant influence on the amount of greenery, the quality of greenery and the fulfillment of functions from the point of view of greenery, from which the assortment of tree composition, used cultivars, forms and varieties also derives. Improperly chosen composition as in the case of Dolná Krupá (A2) even under relatively suitable conditions will achieve a bad aesthetic impression (hard conifers in alley planting with deformed crowns) but also reduced safety and connectivity (poor crown placement, poor growth form and species song with shading).

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Souhrn

Liniový typ zeleně v sídlech je jedním z důležitých prvků zelené infrastruktury, který propojuje krajinné a centrální zóny sídel s plošnými formacemi zeleně. Uliční prostranství spolu se zelenými plochami a liniovými prvky zeleně tvoří součást sítě zeleně a mají mnoho důležitých funkcí. Článek prezentuje výsledky hodnocení vybraných venkovských sídel a jejich částí funkčních zón na úrovni uliční zeleně z hlediska kvality dřevinné skladby a funkční účinnosti s ohledem na funkce zeleně.

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EVALUATION OF THE IMPLEMENTATION OF THE SMART CITIES CONCEPT FROM THE POINT OF VIEW OF THE BENEFIT FOR THE URBAN FORESTS OF THE CITY OF BRNO

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Abstract

The scope of Smart City issues is very wide and affects all areas of the city of Brno. When the term "city" appears in the concept, it is always taken as a whole, including municipal companies and established contributory organizations. Smart City is therefore significantly associated with the involvement of the urban ecosystem in the development of the city, where each of the actors has an irreplaceable role. This can take the form of participation in events, workshops and meetings, which serves to find the future direction of the city, gather ideas for its development, as well as to test the functionality or verification (proof of concept) of individual projects. There are many positive and interesting ideas, concepts and projects that incorporate digital technologies in urban forest management being supported by smart urban forest strategies and tree management policies. The contribution evaluates how these concepts affect the suburban forests of the city of Brno.

Key words: smart city, urban forests, development, smart urban forest

Introduction

In the last century, two important phenomena could be observed in the world, namely the increasing urbanization and the rise of information and communication technologies (ICT). Advances in technology have been most evident on the face of major cities. This has led to a slow movement of rural populations to the cities, and this has brought some positives for the cities, but it has also meant that new challenges have emerged that have had to be faced. For example, the increased concentration of people in cities led to road infrastructure becoming inadequate, increased concentrations of carbon dioxide and other greenhouse gases, and this pollution had negative impacts on citizens' health (Caragliu and Nijkamp, 2011). In conjunction with the Kyoto Protocol, the concept of 'smart cities' was born at global level. It combined smart innovative technologies and projects with sustainable development, i.e. development that is environmentally friendly and respectful of both current and future generations. A universal definition has never been established, but major world organizations (European Commission, UN, OECD) have all adopted the concept in more or less the same form (Caragliu, Nijkamp, 2011). The European Commission defines a smart city as "a place where traditional networks and services are streamlined using digital and telecommunications technologies for the benefit of citizens and businesses" (European Commision, 2019). Smart city is not limited to the information and communication technology (ICT) component. A smart city goes further and seeks to achieve more efficient use of resources and reduce emissions. It also lists the areas that such a smart city focuses on and tries to innovate. These include modernizing the transport network, water supply or waste management. In addition, more efficient ways of lighting and heating buildings, interactive city management that communicates with its citizens, safer public spaces and last but not least, the European Commission places emphasis on meeting the needs of an ageing population (European Commision, 2019). The Smart City concept was first discussed at European level in the Strategic European Technology Plan (SET Plan) in 2007. The aim of the plan is to achieve energy savings through a range of measures and to open up issues related to the future of energy (Ministry of the Environment, 2015). In 2011, the Smart Cities & Communities Industrial Initiative was launched to address in particular transport and energy issues. This initiative was followed up in 2012 by The European Innovation Partnership for Smart Cities and Communities, whose main objective is to find solutions to the various problems facing European cities (traffic congestion, greenhouse gas production, excessive energy consumption, etc.). According to the Ministry of Regional Development of the Czech Republic (2015), the comprehensive Europe 2020 Strategy (Europe 2020), which aims, among other things, to promote a low-carbon economy, can be considered as a starting document that also touches on the issue of Smart Cities.

Material and methods

The article was prepared by researching the available information on the smart city concept from the European and national perspectives and especially with a focus on the city of Brno. A literature search

was performed online in multiple databases using terms such as 'smart city concept' 'urban forest', 'urban forest planning', 'smart urban forest'. Information was obtained mainly by studying websites and strategic documents or individual concept documents. On the basis of available data, an assessment of the importance of this concept for suburban forests was prepared. The Czech Republic does not have a single strategic document directly addressing Smart Cities. Individual elements that are part of the Smart City concept are addressed in various sectoral documents (MMR CR, 2015):
▪ State Environmental Policy ▪ State Energy Concept
▪ Transport Sector Strategy
▪ Digital Czech Republic 2
▪ Action Plan for the Development of the Digital Market ▪ National Action Plan for Clean Mobility
Despite the absence of a single Smart Cities document, the Czech Republic is responding to this issue. Under the Government Council for Sustainable Development, a working group on Smart Cities has been created to try to create the necessary basis for documents of a strategic nature. In addition, it has the task of organizing seminars on Smart Cities, which are attended by various experts, academia or the private sector (Ministry of Regional Development of the Czech Republic, 2018). The smart city concept includes a smart environment. The challenge of recent years has been episodes of drought, which, as a result of climate change, are affecting the whole world, Europe and the Czech Republic included. Water is also an important element in the landscape, especially its successful retention in the landscape so that there is no rapid surface runoff and subsequent runoff from the landscape. Even in the city, there are countless rainwater retention measures. A smart city is therefore also a city that actively participates in water retention in the urban environment. Manville et al. (2014) conducted an analysis of cities at the European level. Only cities with more than 100,000 inhabitants from all EU Member States were included in the city assessment (the total number was 468). The evaluation method consisted first of creating a custom definition of a Smart City. To be considered "smart" a city had to fulfil at least one of the identified characteristics. The authors applied a classical approach and selected the individual subsystems of the Smart Cities concept as indicators - Smart Governance, Smart Economy, Smart Mobility, Smart Environment, Smart People and Smart Living. The cities were further subjected to a thorough investigation, e.g. whether the city has a Smart City strategy or whether a pilot testing and implementation of the strategy has already taken place. Manville et al. (2014) concluded that the frequency of occurrence of Smart Cities is directly proportional to population. Of the 52 cities with more than half a million citizens, only six could not be considered 'smart'. This phenomenon shows that the concept of Smart Cities is a growing phenomenon and is receiving the most attention, especially in large cities. Cities are particularly successful in the area of Smart Environment. This is, of course, because cities are increasingly committed to sustainable forms of development, recognising that environmental protection must be a priority. Albino et al (2015) provides more detail about the definitions, dimensions, and evaluation of the smart cities concept through time. Smart city definitions include six main components: smart "governance, economy, people, mobility, living and environment" (Lombardini et al., 2012) while assessing the performance of the smart cities (Yigitcanlar, 2015). Smart environment is mostly promoted in the field of water conservation and air quality improvement. Alternatively, increasing the amount of urban green space. The focus on suburban forests is still in the background.

Smart city and suburban forests

There are extensive research and documents on the importance of the urban forestry and greening area and its benefits to human wellbeing, and contribution to the economic value of the city (Anguluri and Narayanan 2017). The role of the urban forestry and urban green areas becomes crucial due to rapid population growth in the cities and slowly integrated into the smart city concept. There are several successful cities in the Czech Republic that can proudly consider themselves Smart Cities. Most of them are cities at the regional level, which can be characterised by a higher population, well-developed services, good transport infrastructure and, of course, easier access to financial resources. According to Pělucha (2012), the Czech Republic is characterised by a relatively specific settlement structure. Compared to other European countries, it is characterised by a relatively high number of smaller rural municipalities, which make up about 90%. At the same time, we also have a small number of large cities - after Prague, Brno and Ostrava, there are only a few cities with a population of around 100 thousand. Smaller towns have, of course, more difficult conditions for the implementation of Smart Cities activities. According to the research of the Czech-German Chamber of Commerce (2017), hereinafter referred to as CNOPK, which was devoted to the evaluation of the Smart Cities concept in municipalities and cities in the Czech Republic, cities and municipalities are most limited by budgets and finances in general, excessive bureaucracy, lack of professional or personnel capacities,

lack of concept, lack of information and know-how. Low citizen participation is also a problem. However, it is surprising that 64% of cities and municipalities have no Smart Cities agenda or strategy at all. The majority of cities over 10,000 inhabitants have their own coordinator dedicated to Smart City issues (CNOPK, 2017). Therefore, the starting point may be rather the promotion of Smart Regions, which are created at the level of regions. Regions, as higher self-government units, obviously have a greater opportunity to implement Smart Cities projects due to their larger budget. They are also able to concentrate more experts in key areas. In addition, it is very important to promote meetings with representatives of other cities where activities related to Smart Cities issues have already been implemented. The use of new technologies optimises public and social services and makes them more efficient and accessible. It helps to create a more open and skilled society and, above all, to improve quality of life. Local politicians and officials should aim to facilitate the interaction of the general public with the government and to improve and simplify administrative procedures. Promote and develop e-government services so that people can communicate and handle their affairs quickly, flexibly and efficiently. Digitalisation at the municipal and city level cannot make full progress without digitalisation at the state level, yet there are many opportunities for improvement in this area as well. As the mobility of the population increases, transport is also becoming a discussed aspect of smart cities. Ideally, transport should be simple, fast, and put as little strain as possible on visitors and residents, as well as on the environment. Smart cities are thus about building cycle paths, designing the safest possible transport systems, connecting even better with ICT and open data infrastructure, as well as promoting and improving public transport travel options and other alternatives. However, efforts to build urban smart elements are not always met with a favourable outcome. Growing consumption and urbanization put broader environmental pressure on ecosystems (on water, air, natural resources, land and biodiversity), while ecological stability requires that economic consumption of the products and services of nature be compatible with the rates of production and the assimilative capacity of the ecosphere (Rees, 1995). Furthermore, the environmental impacts of human activities come back to society in the form of negative health impacts and deteriorated living environments. Demand in urban areas tends to be more sophisticated and environmentally aware. Urban residents are more likely to download apps to avoid food waste or to think about their carbon footprint. This allows cities to experiment to find out what works, and then to scale up good ideas to rural areas and other cities and beyond. In 2017, the #brno2050 Strategy and its long-term vision for the development of the city were approved. The vision is based on 23 values important for the long-term development of the city. Each value has its own expert guarantor. These guarantors are independent, respected experts in a number of fields important for the comprehensive development of the city. The vision is further developed into more specific plans, which contain priorities for the next 10 years, and action plans with individual projects and activities for the coming years.
The City's development focuses on three areas:
1) resource efficiency
2) quality of life (environment, prosperity, services)
3) effective governance

Results

Environment and blue-green infrastructure

A healthy environment is the foundation of a sustainable and smart city. Reducing environmental burdens is at the forefront of environmental care. Without a sophisticated environmental policy, the rapid economic growth characterised by a linear buy-use-dispose economy would have much greater impacts on ecosystems and human health. Basic sustainability must be ensured by using as sparingly and efficiently as possible all the materials and energy resources we need to live our lives. The solution lies in innovation to provide the same or better services while reducing environmental burdens and improving quality of life. To monitor whether this has actually happened, innovative indicators are used to compare environmental performance for better decision making in city management (e.g. automated monitoring). It should be remembered that well-designed environmental policies also create economic opportunities. An important aspect is to regularly inform the public about the state of the environment in the city where they live. Environmental thinking should be a natural part of people's thinking.

Overview of the objectives of the area

- Strengthen the services provided by the landscape
- Ensure the protection of all components of the environment
- Implement and integrate climate and environmental policy
- Create and protect a coherent system of green and blue infrastructure in the city

PROCESS AND ORGANISATIONAL RECOMMENDATIONS FOR EVALUATING THE SMART CITY CONCEPT		
Environmental policy The City has an environmental policy or strategy and regularly updates its approaches so that they lead to: - Mitigating impacts on human health and ecosystems; - Adapting to anticipated climate change and increasing resilience; - Avoiding major risks (precautionary and preventive measures); - Restoring the resilience of societies and ecosystems by strengthening the care of natural resources; - Taking the carbon footprint into account when developing strategies and policies in other areas local government. The policy itself takes into account the national objectives of the Strategic Framework Czech Republic 2030, the State Environmental Policy 2012-2020, and possibly related strategies (biodiversity, air quality, etc.). Recommended frequency of updating the document: 3-5 years	YES	NO
Climate Change Adaptation - Strategy and Crisis Plan The city applies the main recommendations and measures for adaptation to climate change according to the Climate Change Adaptation Strategy for the Czech Republic (2015) and has developed its own locally specific adaptation strategy (especially with regard to maintaining water in the landscape and reducing the risk of all types of erosion, especially water and wind erosion). The city has developed a crisis management plan for critical situations ("disasters") in water supply, waste management, floods, drought. Methodological support can be found at www.adaptacesidel.cz. Recommended frequency of updating the document: 3-5 years	YES	NO
State of the environment report The City collects data, analyzes it, and regularly informs the residents of the City about the state of all components of the environment, preferably through the City's Environmental Yearbook. It informs not only about the current state, but also about the development over time, or compares the results of environmental indicators with monitoring in previous years. Recommended frequency of updating the document: 1 year	YES	NO
Information systems The city contributes to nature conservation by using the information systems of the Ministry of the Environment, such as the IS of the Convention on Biological Diversity, IS of Nature Conservation, IS of Flood, IS of Air Quality, Integrated Pollution System, IS of Waste Management, IS of Hydroecology, Register of CITES, etc. Recommended frequency of updating the document.	YES	NO
Department or expert responsible for collecting data on the state of the environment The City has an expert or group of staff tasked with collecting environmental data, updating strategies, and monitoring changes in the state of the environment. The same or a separate staff member may be assigned the task of climate protection and adaptation of the city to climate change. The regular evaluation of this data is used by the staff to plan environmental protection. They use the means of new technologies and ICT to carry out their work.	YES	NO

Stable and diverse ecosystems are central to maintaining a healthy environment. The development and management of the City is careful to maintain and enhance the ecosystem services provided by the landscape. Agriculture, forestry and water management take account of natural limits by improving soil conditions, slowing water run-off from the landscape and helping to maintain biodiversity. The development of settlements and technical infrastructure shall be carried out with the utmost regard to maintaining and enhancing the services.

Conclusion

What it all means for suburban forests. Increasing demands for digitalisation may place greater demands on suburban forest owners. There is also the likelihood of increased demand for bike paths and bike lanes, which if built would again lead to further constraints on forest owners' management. For a useful and successful solution to the SMART Czech Republic issue, it is necessary to meet some basic assumptions, or good cooperation in solving the challenges facing society in the Czech Republic. In the context of the Czech Republic, SMART solutions are those that meet the objectives and commitments of the Czech Republic in a timely manner, so that as the date of the required fulfilment approaches, there is no pressure for ineffective solutions due to lack of time. The critical ones include both those objectives and commitments that the Czech Republic has made within the European Union, and those that are beyond the commitments made by significant problems in the national context and require urgent solutions. At the same time, as stated throughout the document, SMART is a solution that brings significant positive effects in several areas.

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Souhrn

Digitální služby mohou městům pomoci oživit a zlepšit služby pro jejich obyvatele, a také řešit některé problémy, se kterými se dlouhodobě potýkají. Tyto problémy souvisejí s probíhajícími demografickými změnami, škrty ve veřejných financích a omezováním veřejných služeb nebo s velmi aktuálním přechodem na oběhové a nízkouhlíkové hospodářství. Digitální služby zde však nevystupují jako samospasitelné řešení, ale spíše jako nástroj pro efektivnější uplatnění tradičních způsobů řešení

problémů. Existuje již mnoho příkladů úspěšné praxe. Například se podařilo vyřešit problémy se zásobováním venkova I měst pomocí online tržišť, do kterých se zapojili místní výrobci a obchodníci. Efektivní komunikaci mezi obyvateli o otázkách obecního významu mohou významně podpořit integrované aplikace sociálních médií. Takové řešení umožňuje obcím velmi efektivně a transparentně komunikovat a diskutovat s obyvateli, stejně tak jako mohou pomoci k lepší realizaci a aplikaci konceptu smart city.

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EVALUATION OF WOODY PLANTS LOCATED IN RURAL PUBLIC PARK AREAS

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Abstract
The composition of woody plants as well as their species composition in rural public settlements is diverse and depends on many factors; from the layout of the settlement structure, through cultural and historical ties, up to the landscape in which the settlement is located. The change of approach in the green public spaces creation during the past years has brought woody plants to solid position in case of rural environment shape; not only in the form of composition, but also in the valued fulfilment of many other important functions of rural public spaces. The current climate change, which trees must face also plays a crucial role. Visual value and their prosperity are a reference to the functioning and use of space in these areas. The aim of the paper is to evaluate woody plants species in selected model areas, which represent park groupings located within Slovak lowlands. The premises represent highly frequented places in the central spaces of the countryside with various connections to the surrounding functional areas. The evaluation of woody plants was carried out at the level of the fourteen analysed aspects and values against the selected monitored functions. Their performance was reflected in the three qualitative categories of performance in which they were evaluated. The paper outlines the quality of woody plants in the evaluated areas and contributes to their objectification in the assessment.

Key words: countryside, rural renewal, rural public spaces, visual value

Introduction
The green areas are located in the central parts of the settlements but also in the wider centre and fulfil various functions as they are places where the population movement is concentrated. Places in the centres had in the past and still have a great cultural and social importance and the appropriate composition of trees is very important for achieving the desired functions of public green space and at the same time it is also important to meet the safety of operation as well as the overall connection of green areas with important buildings in the settlement (Frolec, Vařeka, 1983), (Rózová, Supuka, Klein, Jasenka, Tóth, Štefl, 2020). The creation of central areas and plan formations of greenery should take into account not only the proportional-spatial possibilities but also the overall architecture and character of the surrounding buildings (Supuka, Tóth, Bihuňová, Verešová, Šinka, 2020), (Tóth, Bihuňová, Kuczman, Halajová, 2018). Especially important is the selection of appropriate tree forms with suitable visual qualities as well as the overall composition that will support the long-term stay of people in the space (Kuczman, Feriancová, 2013), (Tóth, Feriancová, 2013). Typical for central zones are more massive tree canopies, larger volumes and masses of greenery as well as more concentrated arrays of groups of trees and undergrowth shrubs (Rózová, 2001), (Kuczman, 2018). Central zones have varied over periods in the past and have always served the function of promoting social interactions between the local population, traders as well as those passing through the sites. The central zones, together with the flat formations of greenery, created an environment where people spent a lot of time. The places fulfilled a meeting and recreational function, where people spent time not only passively but also actively, when they were used for important cultural events such as weddings, fairs, feasts and other seasonal activities (Mareček, 2005). The importance of these places also lies in the location itself, which was always close to important buildings, amenities, on important streets as well as near sacral buildings (Kuczman, Feriancová, 2019). The central zones together with the greenery were certain representative areas that reflected the abilities of the population, the degree of intelligence as a degree of belonging and cohesion of the population (Mareček, 2005), (Frolec, Vařeka, 1983). The paper focuses on the assessment and analysis of the current state of the area elements of green spaces located in selected model areas of settlements of lowland landscape type of the Slovak Republic. The selected model territories are central zones - village squares, which also define the character of the built-up area and the overall plan-genetic structure of the settlement, which is typical for the lowland landscape type of the Slovak Republic (Bechera, Kuczman, 2020).

Materials and methods

The model territories for the paper are rural settlements in the lowland type of the Slovak landscape located in the Trnava region, near the Považský Inovec mountain range and the Váh river. The selected settlements are Drahovce and Madunice and their central zones near the amenities of the settlements.

Picture 1: Views of the researched areas. Author: Bechera, 2022
Location of settlements in western Slovakia. (mapka.gku.sk, 2022) Drahovce (B1) Madunice (B2)

For objective comparison of the results, the following criteria were selected: location within the settlement near the buildings of amenities in the centre of the settlement, the same or similar year of reconstruction and implementation of modifications of the central zone - the studied area, location on the main road in the settlement, similar spatial parameters and size of the area, location in the lowland type of the landscape of western Slovakia.

The current state of the greenery was analyzed, assessed and evaluated on the basis of the methodology for the assessment of tree composition in public spaces of rural settlements of the Slovak Republic (Bechera, Kuczman, 2019). The methodology, which was used in the research of selected spaces, tracks the current state of tree composition (trees and shrubs) in the space in relation to the functions of green space in rural settlements based on the influence and relationships of the characteristics of tree composition and the functions of public green space. The tree composition characteristics are divided into 14 categories and separate elements V1 - V14. The tree composition characteristics are briefly listed as follows: V1 - tree area cover, V2 Tree height potential, V3 Shrub height potential, V4 Visual connectivity of trees, V5 Tree composition, V6 Tree species diversity, V7 Species authenticity of trees, V8 Tree originality, V9 Tree shape, V10 Tree colour , V11 Tree utility, V12 Cultural and historical value of trees, V13 Tree developmental stage, V14 Tree vigour. The methodology monitors the relationships and the effect of the current state of the characteristics of the trees on the functions at the level of efficiency and utilization, specifically on 6 functions of public green spaces in rural settlements, namely: F1 Aesthetic - representative function, F2 Proportional - spatial function, F3 Climate - regulating function, F4 Ecostabilizing function, F4 Cultural - social function, F5 Traffic - safety function (Bechera, Kuczman, 2019), (Bechera, Kuczman, 2020)

Picture 2: Views of the researched areas - current state. Author: Bechera, 2022
Drahovce (B1) Madunice (B2)

Results

The methodology works on the basis of the application of input data, which are based on the current state of the art from different observed perspectives - the characteristics of tree felling. The numbers of tree and shrub species, areas and height limits in the area are monitored. By entering the data into the input data table, the QC - quality category in each characteristic is determined. Subsequently, according to the table in the methodology, the performance of the functional efficiency in each feature is determined and the result is the functional efficiency - the sum of the functional efficiency values converted into a percentage value. The results for the model study areas in Drahovce (B1) and Madunice (B2) are presented in the summary table (Picture 3).

V/F	F1		F2		F3		F4		F5		F6	
	B1	B2	B1	B2	B1	B2	B1	B2	B1	B2	B1	B2
V1	◖	◖	◖	◖	◖	◖	◖	◖	/	/	◖	◖
V2	●	●	●	●	●	●	●	●	/	●	●	●
V3	●	●	●	●	●	●	●	●	/	/	●	●
V4	●	●	●	●	/	/	/	/	●	●	●	●
V5	●	●	●	●	●	●	●	●	●	●	●	●
V6	●	◖	●	○	●	◖	◖	○	/	/	◖	●
V7	○	○	/	/	◖	◖	○	○	○	○	◖	◖
V8	●	◖	/	/	/	/	/	/	/	/	/	/
V9	◖	●	◖	●	●	●	◖	●	/	/	◖	●
V10	●	●	●	●	/	/	/	/	●	●	●	●
V11	/	/	/	/	/	/	○	◖	○	◖	○	◖
V12	x	○	x	○	x	/	x	/	x	○	x	/
V13	◖	◖	◖	◖	◖	◖	◖	◖	◖	◖	◖	◖
V14	●	◖	●	◖	●	◖	●	◖	●	◖	●	◖

● Full ◖ Partially full ○ Not enough full / Without a relationship x No rating

Picture 3: Public greenery fulfillment table. Author: Bechera, 2022

The model area Drahovce (B1) in the central part of the settlement achieved the most significant functional efficiency for the functions F1 (● - 66,7% ◖ - 25,0% ○ - 8,3%), F2 (● - 70,0% ◖ - 30,0% ○ - 0,00%), F6 (● - 50,0% ◖ - 41,6% ○ - 8,4%).

The results are also evident for evenly spaced greenery with optimal density and composition, and the creation of safety near bus stops and sidewalk intersections. The performance of the functions is also for appropriate composition and proportionality of trees in relation to buildings. However, shrub cover is low and ineffective. The Madunice area (B2) as a model example achieved the best and most significant functional efficiency in the F6 (● - 58,4% ◖ - 41,6% ○ - 0,00%), F1 (● - 46,1% ◖ - 38,5% ○ - 15,4%), F2 (● - 54,6% ◖ - 27,3% ○ - 18,1%). Compositionally, the area is well designed in terms of green space and the amount of green space is slightly lower, which is reflected in the coverage. The composition of trees is very good in terms of vitality but slightly inadequate in terms of age stage. Visual and functional connectivity and security of the space by separating traffic levels through shrub planting is highly appropriate.

Conclusion

The studied spaces are similar in functional efficiency results. The space in Madunice (B2) has a smaller area coverage in relation to the surface area. This has little effect on the performance of the functions, given that it is a landscaped and compositionally suitable public space in terms of tree composition. The space in Drahovce (B1) is functionally efficient overall and the tree composition is relatively satisfactory. However, there is a distinct lack of shrubs in the undergrowth, appearing only close to the road as a positive example of separation of the road from the central zone. Overall, this is a visually and compositionally appropriate space in terms of tree composition.

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Souhrn
Zelené plochy v centrálních zónách venkovských sídel a v parkových oblastech venkovských sídel patří k nejnavštěvovanějším místům v rámci sídelné struktury. Kompozice stromů i celková architektura centrálních zón často souvisí s historickými stavbami a budovami v oblasti. Kompozice stromů v centrálních zónách a parcích má také historickou kontinuitu a silnou symboliku. V neposlední řadě také významně ovlivňují kvalitu a délku pobytu návštěvníka v prostoru. Příspěvek se zaměřuje na zkoumání a hodnocení dřevinné skladby ve vybraných venkovských sídlech a jejich funkčních zónách z hlediska kvality, kvantity a plnění funkcí veřejné zeleně z hlediska charakteristik dřevinné skladby.

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EXAMPLE OF THE USE OF PUBLIC RECREATIONAL ACTIVITIES TO MAKE VISIBLE THE CONTRIBUTION OF FORESTERS IN SOLVING OF FLOOD CONTROL

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Abstract
The article deals with an example of the use of the public recreational activities to make visible the contribution of foresters in solving of flood and erosion control of the landscape. On the example of historical stone dam on Račková torrent in Račková valley in the Western Tatras (Tatra National Park), is explained the importance of significant foresters activity - torrent control. Torrent control Račková, which also includes a stone dam, was designed by foresters in the years 1930-1940, has been fulfilling its flood and erosion control function for 80 years. Based on historical data and field measurements, we designed an information panel in the immediate vicinity of the often visited tourist and recreational sidewalk in Račková dolina. The panel emphasizes the important contribution of foresters in flood and erosion protection of the landscape. It also explains the history, significance and function of the existing historic stone dam, its technical and hydraulic parameters, ecological and environmental aspects etc.

Key words: tourism, leisure education, torrent control

Introduction
Foresters have a long tradition and rich practical experience in torrent control activities. The torrent control has its own specifics, which distinguish it from the regulations of rivers and brooks. The basic principle of torrent control is a comprehensive tending of the entire watershed including forest ecosystems. We are thinking in particular of the conversion of surface runoff into subsurface through the hydric function of forest ecosystems, integrated erosion control, proper drainage of forest roads etc. These ideas have already been expressed by the founders and the first designers of torrent control in the former Czechoslovakia - foresters prof. Dr. h. c. Ing. Vojtěch Kaisler (*1870 - †1943), prof. Dr. Ing. Leo Skatula (*1889 - †1974) and prof. Ing. Róbert Binder (*1897 - †1980). Watercourses in the Slovak Republic have a total length of 61,147 km. Of this length, the torrents form 24,000 kilometers (39.25 %). State forestry organizations manage 7,501.8 km of small watercourses (12.27% of the total length of watercourses in the Slovak Republic). These watercourses have the character of torrents. Other torrents (approx. 16,498 km) belong to the administration of the Slovak Water Management Company. The torrents are characterized by extreme changes in discharges even in relatively short periods of time and significant creation, transport and deposition of sediments (erosive activity). Torrents are located in the highest situated-alpine and mountain regions of Slovakia. In the Slovak Republic are all of the rorrents situated in large – scale protected areas (national parks and protected landscape areas); therefore, torrents and torrent wadersheds management is demanding, requiring experienced experts who are able to integrate landscape protection requirements for floods and erosion and valid legislation in the protection of landscape and nature. The area of 9 national parks in Slovakia is 317,540 ha (6.48% of the area of the SR), the area of their protective zones is 262,591 ha (5.36% of the area of the SR) and the area of 14 protected landscape areas in the SR is 522,581ha 10.66 % of the SR). This means that the total area of large – scale protected areas 1 102,713 ha (22.49% area of the SR).

Materials and methods
Račková torrent in the Western Tatras (Tatra National Park) can be dangerous for man and the landscape for risk of flash floods and extreme erosion.Torrent control Račková is one of the important historical works of foresters with anti-flood and anti-erosion function in Slovakia (Fig. 1).

Fig. 1: Interest area: Račkova torrent in the Western Tatras

The first more detailed documented flash flood in this area occurred in the watersheds of torrents Račková (35,8 km^2), Tichý potok (54,6 km^2), Kôprovský potok (30,5 km^2) and river Belá (85,1 km^2) on the southern slopes of the Western Tatras on August 11, 1929. During torential rain fell in 3 hours 83 mm of precipitation (SKATULA 1973). The floodplains were affected by a catastrophic flash flood that devastated the area along the sides of the watercourse Belá and caused major flood damages in the municipalities of Pribylina, Liptovská Kokava, Vavrišovo, Dovalovo, Liptovský Peter and town Liptovský Hrádok. In the territory under the confluence of the Račková, Tichý potok and Kôprový potok (Belá river), the width of the channel reached more than 40-50 m (normally it is about 8-10 m). This flood was an incentive to build a significant torrent control Račková in 1938-1940. The dominant building of this torrent control is a stone dam with a consolidation and retention function which serves its purpose until now (Fig. 2). The originally planned retention volume of the dam was 42.000 m^3, currently it is 27.300 m^3. Torrent control Račková was designed and built by foresters. The characteristics of the Račková watershed and torrent are given in Tab. 1 and Tab. 2.

Tab. 1: Characteristics of watersheds and trorrent Račková (part 1)

A_w (km^2)	H_{minw} (m a.s.l.)	H_{maxw} (m a.s.l.)	$H_{øw}$ (m a.s.l.)	L_{tr} (km)	L_t (km)	L (km)	D_w (km.km^2)	L_v (km)
35.76	890	2248.4	1572	31.41	39.86	8.45	0.897	9.00

Explanatory notes to Tab. 1: A_w – watershed area; H_{minw} - minimal altitude of the watershed; H_{maxw} – maximal altitude of the watershed; $H_{øw}$ – mean altitude of the watershed; L_{tr} – total length of tributaries; L_t – total length of watercourses in the watershed; L – length of main stream; Density of watercourses in the watershed; L_v – length of thalweg.

Tab. 2: Characteristics of watersheds and torrent Račková (part 2)

H_{mint} (m a.s.l.)	H_{maxt} (m a.s.l.)	ΔH_t (m)	A_f (km^2)	$f_{\%}$	L_d (km)	$S_{øt}$ (%)	$S_{øw}$ (%)	B_w (km)	$w_w:\ell_w$ (-)
890	1717	827	20.49	57.3	34.28	9.79	33.70	3.97	1:2.26

Explanatory notes to Tab. 2: H_{mint} - minimal altitude of the torrent; H_{maxt} - maximal altitude of the torrent – source; ΔH_t - absolute torrent height difference; A_f – forested watershed area; $f_{\%}$- percent of forest area of the watershed; L_d – legth of the divide; $S_{øt}$ – mean gradient of the torrent; $S_{øw}$ – mean slopes gradient of the watershed; B_w – mean width; $w_w:\ell_w$ – width/lenght ratio of the watershed.

Fig. 2: Stone dam in Račková torrent after reconstruction in 2018–2019

On the one hand, it is necessary to prevent the damage that can be caused by flash floods and extreme erosion, on the other hand, it is necessary to take ecological aspects into account when using torrent control activities in protected areas. For these reasons, it is necessary to look for solutions that would minimize the negative impact of similar constructions on the environment and nature protection. Therefore, torrent control and mountain basin management in these areas is a very challenging and extremely responsible task. It is in this direction that foresters have an irreplaceable and responsible role.

To obtain the necessary data for information boards, we analyzed the discharge capacity of the stone dam in the Račková torrent. We calculated this capacity using the simplified of Pocelet´s weir equation for different water levels (1):

$$Q = m \,.\, b \,.\, \sqrt{2g} \,.\, h^{3/2} \quad (m^3.s^{-1}) \qquad (1)$$

In equation (1):
g – acceleration of gravity (9,81 m.s^{-2}),
m – weir coefficient:

$$m = \left[0{,}405 + \frac{0{,}003}{h} - 0{,}030\,.\left(1 - \frac{b}{B}\right)\right].\left[1 + 0{,}55\,.\left(\frac{b}{B}\right)^2.\ \left(\frac{h}{h+a}\right)^2\right] \qquad (2)$$

The other symbols are explained in Fig. 3.

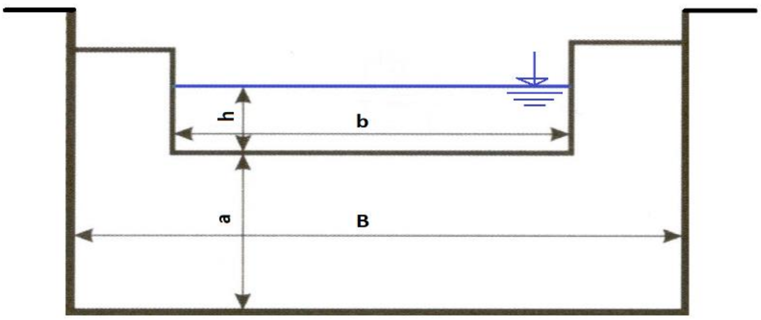

Fig. 3: Scheme for simplified calculation of discharge through Poncelet´s weir

Results

The characteristics for the construction of the consumption curve (discharge rating curve) for the weir in the dam of the Račková torrent are given in Tab. 3.

Tab. 3 Characteristics for the construction of the consumption curve (discharge-rating curve) for the weir in the dam of the Račková torrent

h (m)	b (m)	B (m)	a (m)	m (-)	Q ($m^3.s^{-1}$)
0.5				0.397	6.84
1.0				0.395	19.24
1.5	11	21	9	0.394	35.26
2.0				0.394	54.28
2.5				0.394	75.88

Explanatory notes to Tab. 3: Symbols h, b, B, a (m) are explained in Fig. 3; Q ($m^3.s^{-1}$) - equation (1); m (-) - equation (2)

The consumption curve is shown in Fig. 4. T – year discharges are ghiven in Tab. 4.

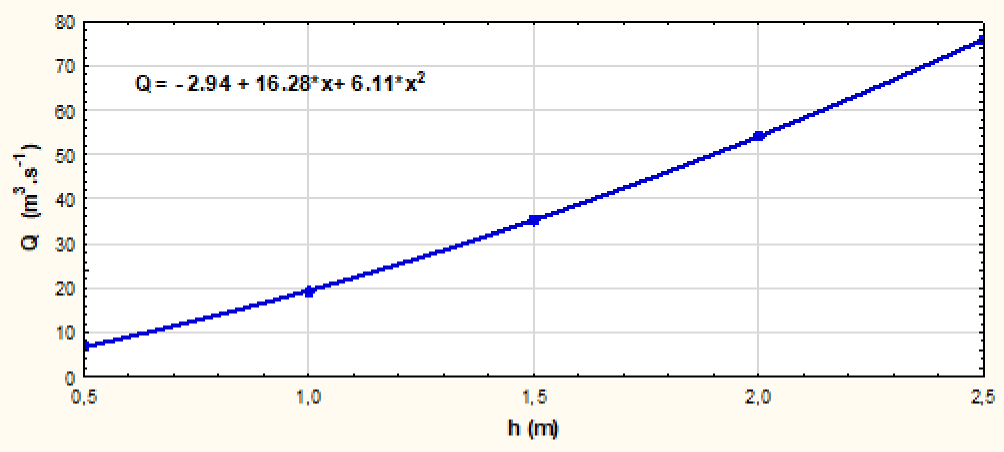

Fig. 4: Consumption curve (discharge-rating curve) for the weir in the dam of the Račková torrent

Tab. 4 T – year discharges in torrent Račková

Q_1	Q_2	Q_5	Q_{10}	Q_{20}	Q_{50}	Q_{100}
10.50	16.80	27.30	35.70	44.81	59.51	70.01

The obtained results show that the 100 - year discharge can safely flow through the weir in the stone dam on the Račková torrent. At level h = 2.5 m it can flow 75.88 ($m^3.s^{-1}$); the calculated 100 - year discharge is 70.01 ($m^3.s^{-1}$). In addition, water can flow through the body of the dam through six vaulted drain holes, which create a certain reserve.

Conclusion

One of the aims of the presented work was to create a professional basis for the creation of information boards aimed at emphasizing the contribution of foresters in the solution of integrated flood and erosion protection of the landscape. Information boards can be used for informal education of the public in various recreational activities in one of the most visited locations in the Western Tatras.

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Souhrn
Článek se zabývá příkladem využití rekreačních aktivit veřejnosti ke zviditelnění přínosu lesníků při řešení protipovodňové a protierozní ochrany krajiny. Na příkladu historického hrazení bystřiny Račková v Račkové dolině v Západních Tatrách (Tatranský národní park), je vysvětlen význam důležité lesnické činnosti, kterou je hrazení bystřin. Hrazení bystřiny Račková, jehož součástí je i kamenná přehrážka, projektovali a stavěli lesníci v letech 1930-1940. Toto dílo plní svou protipovodňovou a protierozní funkci již 80 let. Na základě historických dat a terénních měření jsme navrhli informační panel v těsné blízkosti často navštěvovaného turisticko-rekreačního chodníku v Račkové dolině. Panel zdůrazňuje významný přínos lesníků v protipovodňové a protierozní ochraně krajiny, vysvětluje historii, význam a funkci hrazení bystřin, jakož i stávající historické kamenné přehrážky, její technické a hydraulické parametry, ekologické a ekologické aspekty atd. Pro získání odborných podkladů pro informační tabuli jsme použili zjednodušený postup výpočtu pro posouzení průtokové kapacity v tělese kamenné přehrážky pomocí Ponceletova přepadu. Při výšce hladiny h = 2.5 m přepadem může protéct 75.88 $m^3.s^{-1}$. Vypočtený 100 - letý průtok představuje 70.01 $m^3.s^{-1}$. To znamená, že přes přehrážku přepadem bezpečně proteče i 100 - letý průtok. Kromě toho může voda protékat přes těleso přehrážky i šesti klenbovými odvodňovacími otvory, které vytvářejí další rezervu. Bystřina Račková může být nebezpečná pro člověka i krajinu z několika důvodů, zejména rizika přívalových povodní a extrémních erozních procesů. Na jedné straně je třeba předcházet škodám, které mohou způsobit přívalové povodně a extrémní erozi, na druhé straně je nutné při využívání podobných staveb v chráněných územích zohledňovat ekologické aspekty. Z těchto důvodů musíme hledat řešení, která by minimalizovala negativní dopad podobných staveb na životní prostředí a ochranu přírody. Lesníci mají v činnostech zahrazení bystřin dlouhou tradici a bohaté praktické zkušenosti. Hrazení bystřin má svá specifika, kterými se odlišuje od úprav řek a potoků. Základním principem hrazení bystřin je komplexní péče o celá povodí. Máme na mysli především přeměnu povrchového odtoku na podpovrchový prostřednictvím využití hydrické funkce lesních ekosystémů, integrovanou protierozní ochranu, správné odvodnění lesních cest atd. Tyto myšlenky vyslovili již zakladatelé a první projektanti děl hrazení bystřin v bývalém Československu, lesníci - prof. Dr. h. c. Ing. Vojtěch Kaisler (*1870 - †1943), prof. Dr. Ing. Leo Skatula (*1889 - †1974) a prof. Ing. Robert Binder (*1897 - †1980). Jedním z cílů předkládané práce bylo vytvoření odborného podkladu pro tvorbu informačních tabulí zaměřených na zdůraznění přínosu lesníků v řešení integrované protipovodňové a protierozní ochrany krajiny. Informační tabule mohou sloužit k neformálnímu vzdělávání veřejnosti v rámci různých rekreačních aktivit v jedné z nejnavštěvovanějších lokalit Západních Tater.

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EXPLORATION OF THE RECREATIONAL POTENTIAL OF THE NATURAL MONUMENT SIXOVA STRÁŇ ON THE SURROUNDING EPIGEON

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Abstract
During seven months in 2020, we studied the epigeic component of arthropods in the Sixova stráň Nature Monument, Krupina District (Slovakia). The aim of this work was to determine the influence of recreational and tourist potential of the Sixova stráň Nature Monument on the epigeon. We used baited ground traps to collect epigeic material, and the study area consisted of three sites (andesite (A), marsh (M) and forest (L)); we distributed 15 change traps with 24-h exposure. We obtained 1,233 epigeon representatives. Site A showed the highest variability in the number of species. Plot L had the highest number of individuals (483) followed by plot A (347) and plot M (303) contained the fewest individuals. We found a statistically significant difference in the abundance of beetle species detected, between sites A and L ($p \leq 0.01$) and between sites A and M ($p \leq 0.05$). There was no statistically significant difference between sites M and L. Species identity of beetles according to Jaccard was 30% between sites A and M, 23.8% between sites A and L, and 25.9% between sites M and L. We did not confirm an effect of recreational and tourist potential on epigeon in that site.

Key words: Coleoptera, tourism, swamp, ground traps

Introduction
Forest landscapes, in addition to being a biodiversity heritage, are a typical part of Mediterranean mountain landscapes (Cillis et al., 2019). These landscape types have been shaped by human activities over the centuries. The Six hillside is characterized by a forested montane habitat and an oval-shaped marsh, formed from the extraction of high-quality andesite and the subsequent partial flooding of this abandoned pit quarry. From a forestry point of view, the site is classified as a loess beech woodland and has significant tourist and recreational value, due to its ecological and standing characteristics that make the hiking trails very suggestive and accessible (Bily et al., 2014). If at the beginning of the century, the ecosystems of mountain forests were threatened by excessive economic exploitation, nowadays the problem concerns the recreational use by people (Picuno, 2016). Tourism is associated with excessive human movement, noise, waste production, soil erosion, etc. (Bhat et al., 2014; Braunović & Perović, 2017; Gössling & Hickler, 2006). Soil arthropods are just one of the multifaceted dominant indicators found in all habitats. Soil arthropods respond very rapidly to individual changes in the environment. As a result, information obtained from arthropod studies can be used to accurately characterize almost all aspects of the ecosystem (Shakir & Ahmed, 2015). Many authors use them to monitor the status of an area as well as to determine the factors that influence it (Palacios-Vargas & Mejía-Recamier, 2007; Peterkova et al., 2021; Tuf, 2013; etc.). In the small-scale site of the Sixova stráň Natural Monument in the cadastre of the town of Krupina, no research work has yet been carried out to detect the component of the epigeon in its species distribution. In this paper, we investigated the influence of the recreational and tourist potential of the Sixova stráň Natural Monument on epigeon. Each recreational area is specifically burdened by tourism; in this context, it is necessary to monitor these forest landscapes, both to assess their evolution for detailed analysis and restoration, and to assess their current status and future development. This analysis is essential for assessing the forest landscape in the light of ongoing recreational and tourist use.

Materials and methods
The Sixova stráň natural monument (fig. 1) is located in the southeastern part of the Štiavnické vrchy protected landscape area in central Slovakia and falls within the cadastral territory of the town of Krupina (48°22'41'' N, 19°00'59'' E). The site lies approximately 500 m above sea level with an area of 0.83 ha and an altitude of 549 m above sea level. It was designated as a Protected Natural Feature in 1985 to protect an outstanding example of columnar detachment of andesites, and Level 4 protection is in place at the site (Bily et al., 2014). These habitats are crossed by major hiking trails, so they are also the most attractive for tourists. The long-term average monthly air temperature is 7.83 °C, the

monthly atmospheric precipitation averages 59.46 mm and the average annual wind speed is 1.74 m.s-1 (Diviaková, 2011).

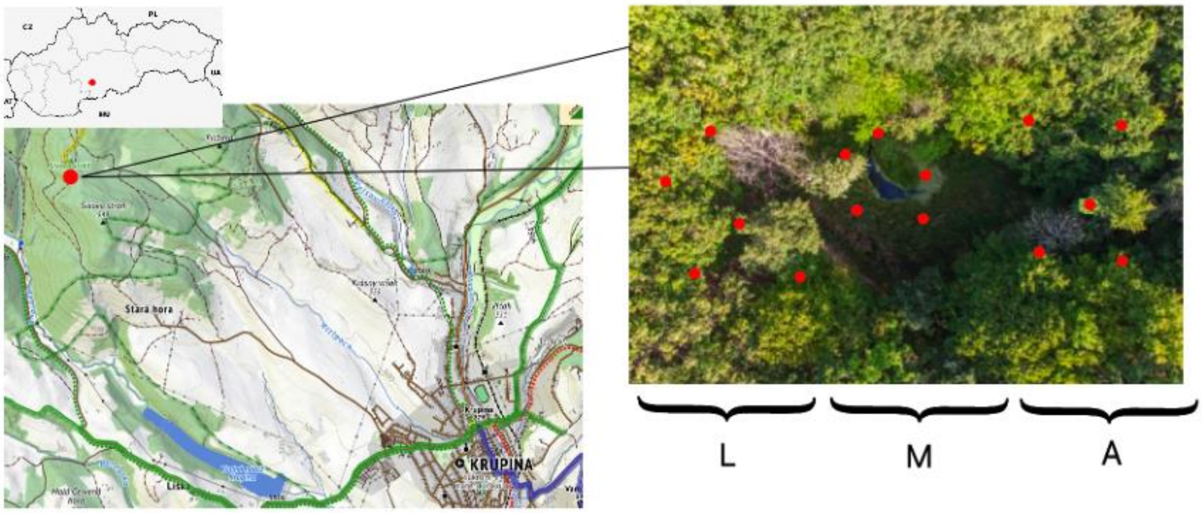

Fig. 1: Location of study area in Slovakia (L- forest, A- andesite, M- swamp)

The analysis of epigeic species in the area of the Sixova stráň was carried out on the basis of collections of epigeic material. For the collection of epigeic material, we used ground traps with meat bait (fine ham), thus focusing mainly on predatory individuals, which is a well-established method in this type of research (Bani et al., 2016; Gajdoš et al., 2019; Peterkova et al., 2021; Porhajašová & Šustek, 2011). The collection was carried out in the months of March to September, during one year 2020. The ground traps consisted of glass 7dcl jars, with a 75 mm diameter opening. The traps were buried in the soil, with the rims of the jars reaching the same height as the relief height. Fifteen traps were deployed at three sites (L- forest, A- andesite, M- swamp) and distributed once a month with a 24 h exposure (Fig. 1). We divided habitats into recreational (A and M) and non-recreational (L). Determination of epigeic species was done in situ using identification keys and atlases (Brtek, 2001; Záhradník & Severa, 2007). The statistical set obtained by the analyses had a normal distribution. To determine normality, we used the Shapiro-Wilks test. We further subjected the obtained data to statistical processing, using the paired Wilcoxon test to compare recreationally used areas and non-recreationally used areas in terms of the abundance of individuals.

Results

During seven months in 2020, we collected material consisting of 1233 specimens, of which 17 groups were arthropods, 3 groups were other invertebrates and one group was vertebrates. Further, we dealt only with the phylum Arthropoda. Eudominant groups of arthropods in the study areas were Formicoidea (42.89%) and Coleoptera (10.22%). The dominant groups were represented by Araneae (6.89%) and Collembola (6.65%). The subdominant groups were Opiliones (4.30%), Isopoda (2.35%) and Diplopoda (2.19%). We found a statistically significant difference in the abundance of beetle species detected, between sites A and L ($p \leq 0.01$) and between sites A and M ($p \leq 0.05$). There was no statistically significant difference between sites M and L. Species identity of beetles according to Jaccard was 30% between sites A and M, 23.8% between sites A and L, and 25.9% between sites M and L. We did not confirm an effect of recreational and tourist potential on epigeon in that site. The number of representatives of each group at the site in the recreation area was (andesite- 347 individuals, swamp- 303 individuals), while the representation of individuals in the non-recreation area was (forest- 483 individuals). Figure 1 is based on the mean values of recreation and non-recreation areas. The mean value of the recreation area (andesite and swamp) consisted of 10 ground traps and the non-recreation area forest consisted of 5 ground traps.

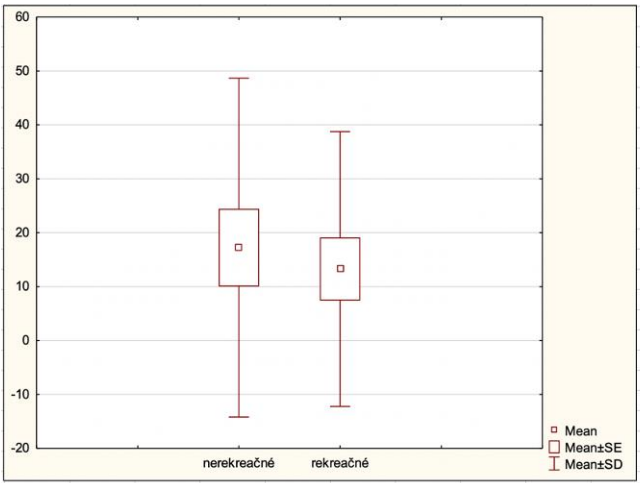

Chart 1: Average number of individuals in recreational and non-recreational areas

We did not observe a statistically significant difference between the recreational and non-recreational area (p= 0.08).

Discussion

Although many papers report the impact of humans during tourism and recreation on biodiversity, the data we collected are not consistent with these findings (Bhat et al., 2014; Braunović & Perović, 2017; Gössling & Hickler, 2006). The Sixa Strana Nature Monument shows no signs of waste pollution and is also subject to a high level of nature protection. On the other hand, the area is sought after for its interesting nature and recreation, which is likely to appeal especially to visitors who are interested in respecting the rules of nature conservation. Okello and Kiringe (2004) state that tourism is not the primary threat to biodiversity. Fanini et al. (2014) investigated the impact of small-scale non-commercial beach parties, which are commonly held in Greece, by analysing the impact of trampling stress, through captures obtained using traps placed at research and control sites. The results indicate the sustainability of small, time-limited parties. Based on the present work and other works mentioned, we conclude that there is a certain sustainable level of recreation and tourism, without disturbing the epigeon of the landscape. To more accurately track the sustainability of recreation and tourism, it is necessary to expand the monitoring to include more plant and animal species with regular repetition.

Conclusion

The Six Slopes Natural Monument represents a recreation and tourism area that has been impacted by human activities over a long period of time. As the area contains an andesite deposit, a marsh and a forest, all of which are differentially impacted by tourism, it represents a suitable site for investigating changes in the epigeon. Our research showed a statistically insignificant difference between the area visited by people and the area not used recreationally. Epigeic representation as well as abundance of individuals were not significantly different. Since the research was carried out for only one year, it is advisable to repeat the investigation. The present work can inform sustainable recreation in the studied Sixa Strana Nature Monument.

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Souhrn
Přírodní památka Sixova stráň představuje rekreační a turistickou oblast, která je dlouhodobě ovlivněna lidskou činností. Vzhledem k tomu, že se v oblasti nachází andezitové ložisko, mokřad a les, které jsou různě zatíženy turistickým ruchem, představuje tato oblast vhodnou lokalitu pro studium změn u epigeonu. Během sedmi měsíců v roce 2020 jsme pomocí zemních pastí nasbírali materiál čítající 1233 jedinců. V následujícím textu jsme se zabývali pouze fylogenezí Arthropoda. Počet zástupců jednotlivých skupin na lokalitě v rekreační oblasti (andezit, bažina) byl 650 jedinců, zatímco zastoupení jedinců v nerekreační oblasti (les) bylo 483 jedinců. Zjistili jsme statisticky významný rozdíl v početnosti zjištěných druhů brouků mezi lokalitami A a L a mezi lokalitami A a M. Mezi lokalitami M a L nebyl zjištěn statisticky významný rozdíl. Nebyl zjištěn statisticky významný rozdíl mezi rekreačními (lokality A, M) a nerekreačními oblastmi (lokalita L). Náš výzkum ukázal statisticky nevýznamný rozdíl mezi oblastí navštěvovanou lidmi a oblastí, která není určena k rekreaci. Předkládaná práce může sloužit jako podklad pro současnou udržitelnou rekreaci a cestovní ruch v přírodní památce Šest svahů. Předpokládáme také, že rozšíření cestovního ruchu a rekreace do dalších podobných lokalit nebude mít vliv na místní entomofaunu.

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FACTORS AFFECTING GEOSITE VISITS BY STUDENTS OF PRIMARY AND SECONDARY SCHOOLS: AN EXAMPLE OF THE CITY VRANOV NAD TOPĽOU (SLOVAKIA)

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Abstract
This research investigates the factors affecting students of primary and secondary schools in a geotourism context. Information for research has been identified by questionnaire. Visiting the geosites is most frequently related to nature-based tourism which may be considered one of the most widespread interest activities of outdoor recreation. This study provides an initial investigation into the motivation factors of students and the relationship between these motivations, factors and the behavioral intention of the students to visit a geosite. Knowledge of these factors can significantly affect effective management and planning within the development of geotourism and related tourism forms at various locations as well as geoeducation at schools.

Key words: geosite, analysis, visit, geotourism, Slovakia

Introduction
In recent decades, the tourism of young people and students who try to travel as cheaply as possible, use public transport, spend the night outdoors, under a tent, or use cheap accommodation, has expanded significantly. In addition, the situation with the COVID pandemic has significantly affected the travel behavior of many tourists. Domestic destinations have become more significant, and people have spent more time in natural environment. Many natural beauties have been "rediscovered". In this context, natural forms of tourism, such as geotourism or ecotourism, play an irreplaceable role.
This article aims to find out, on the example of a selected group of primary and secondary school students in the town of Vranov nad Topľou, what are the factors that influence students when visiting geosites.
Geosite is a part of the geosphere that is important to us for understanding the history of planet Earth. Geosites are defined mainly as geological or geomorphological objects that have the following values: scientific (sedimentary excavations, glacier remains); cultural-historical (religious or ceremonial values); aesthetic (some mountainous or coastal areas); socio-economic (aesthetic landscape areas as tourist destinations) (Reynard 2004).
Geosites, especially from the perspective of classical geology, include various abiotic nature features, such as: structural, petrological, geochemical, mineralogical, paleontological, hydrogeological, sedimentary, pedological, geomorphological.
Geosites can be individual-specific objects (springs, lava flows) or larger systems (river systems, glacial objects, coastal landscapes). Active geosites allow the visualization of geo(morpho)logical processes in action (active volcanoes, river systems) while passive geosites indicate past processes. In this case, they have a special historical value as the Earth’s chronicle (documenting landscape development, life history, and climate change).
The main threats to geosites are construction work, but also erosion or changes on Earth, often due to human influence. According to Icelandic Institute of Natural History (2018), the main reasons of geosites damage include: (1) destruction - can be caused using certain minerals, (2) reduction - caused by roads, construction works, and (3) overlap - caused by reservoirs, inhabited areas, landfills, land reclamation, afforestation, etc.
The priority of protection from a scientific point of view could be, e.g., places where: geosite is well preserved and of scientific importance, the history of geological periods or events is preserved, a lot of research has been done and there is a long history of research, it is possible to repeat research and study (including teaching), a lot of geological (geoscience) knowledge has been acquired, a certain geological period has been examined and described (reference point), and/or there are world-unique elements of geoheritage.
However, from the geotourism perspective, in addition to the above-mentioned cases, attention should be paid to localities where the interest of (geo)tourists exceeds the scientific character of the place, because such geosites are of undeniable economic importance and can contribute to increasing the level of (geo)education. It is therefore very important that such places are given due attention in the context of managing their protection and development.

Material and methods

Information concerning the factors that affect primary and secondary school students when visiting geosite were obtained through a questionnaire. The questionnaire is one of many research methods that use mainly mass and rapid collection of information. In this way, we learn about the knowledge, opinions, and attitudes of the interviewees to various facts (current or potential). As a research tool, the questionnaire is a research, diagnostic, and development tool. The questionnaire method is subjective, not costly, and allows a detailed and accurate statistical analysis of the results. Questionnaires often provide information on various aspect of respondents' lives (Georgia Institute of Technology 2007).

For this study, a questionnaire in paper form was created to find out the factors that influence primary and secondary school students to visit geosite. The questionnaire was completed by 250 respondents and consisted of 12 items. The following were used in creating the questionnaire:

- 10 closed items - alternative answers to the questions were predetermined. Two of these questions were in the form of an assessment question using the Likert scale (Likert 1932) with 5 levels (1 - absolutely irrelevant/absolutely disagree; 2 - rather irrelevant/rather disagree, 3 - neutral/don't know, 4 rather essential/rather agree, 5 - completely important/I totally agree.
- 2 semi-closed items - the questions were prepared in advance - the correspondent could choose several answers.

The questionnaire consisted of the following items:

1. Gender.
2. Age.
3. Which year do you attend?
4. What type of school do you attend?
5. How often do you visit geosites? (e.g., caves, gorges, mountains, waterfalls).
6. Do you look for any information about the geosites before the visit?
7. Where do you get information about geosites?
8. If a quantitative assessment of geosites were available, would it influence your choice and decision-making when visiting geosites?
9. Do you visit sites/natural geosites within the school? (outdoor school, hiking club, military exercises)
10. If yes, what geosites do you visit?
11. What is important for you when choosing specific geosite?

Results and discussion

Out of the total number of 250 processed questionnaires, 120 male respondents and 130 female respondents took part in the research. The group of respondents aged 14-17 was the most numerous, consisting of 1620 respondents (64.8%). Basic demographic data are summarized in Table 1. 155 respondents stated that they visit geosites at least once a year. 15 students stated that they do not visit geosites at all. The answers show that more than half of the respondents (142 respondents) search information about geosite before the visit. The most frequent information source is internet (191), followed by family and friends (60), and school (58). Magazines (8) and radio (10) have been identified as the least used sources of information on geosites. Within the school (teaching), the majority of respondents visited geosites (233), stating that they most often visit (1) castles, chateaux, manors (178), (2) nature trails (154), museums, and open-air museums (147) and caves (99).

The analysis of the survey results (Table 2) shows that the most important criteria influencing the attendance of geosites by primary and secondary school students are: security, visual attractiveness and uniqueness. These three criteria indicate that when a student decides to visit a geosite (whether with family, at school, or alone), safety at the site is the most important factor. This is natural, as many of the geosites are not properly secured and are often abandoned (e.g., quarries, abysses, overhangs but also some caves or mines). The visual attractiveness of geosite is also important because if a student decides to visit given geosites, he/she must have been interested in something. If student sees photographs and videos in various forms of mass media communication, it can significantly influence his/her visit to given geosites. The uniqueness is self-evident only because every geosite, whether within Slovakia or in any part of the world, is in some way unique for its future visitor.

The criteria "sale of souvenirs", "registration in UNESCO" and "number of visitors" reached the lowest value. These criteria reached a value of 2.26; 2.49 and 2.72. This means that it is rather irrelevant for the students whether they can bring a souvenir from the geosites. Also, students consider rather irrelevant to them whether the geosites is included in the list of important sites, i.e., in the United

Nations Educational, Scientific, and Cultural Organization (UNESCO). This may be because students are not so interested in this category of sites, which can be a huge mistake. Such geosites are usually the most important, most beautiful, and most visited. They are often excellently promoted, so students should learn about them more, whether at school or in another form, such as mass media communication. Students also consider rather irrelevant how many visitors have visited or are visiting these geosites.

Tab. 1: Demographic data of respondents

Demographic item	Value	Number	Percentage
Gender	Male	120	48%
	Female	130	52%
Age	11-13 years	34	14%
	14-17 years	162	65%
	18-20 years	54	22%
Type of school	primary school	81	32%
	secondary school	169	68%
Class	8th class (primary school)	41	16%
	9th class (primary school)	40	16%
	1st class (secondary school)	38	15%
	2nd class (secondary school)	42	17%
	3rd class (secondary school)	50	20%
	4th class (secondary school)	39	16%

Tab. 2: Analysis of criteria influencing geosite selection by primary and secondary school students

Criteria	Diameter	Deviation
uniqueness	3,67	1,02
entrance fee	3,26	1,05
availability of information	3,28	1,04
opportunity to gain new knowledge	3,06	1,13
attendance	3,26	1,06
length of visit	3,43	1,10
presence of a guide	3,01	1,14
sale of souvenirs	2,26	1,09
security conditions during the visit	3,84	1,18
visual attractiveness	3,72	0,96
possibility to eat	3,55	1,08
possibility of accommodation	3,14	1,14
distance from place of residence	3,17	1,17
number of visitors	2,72	1,10
access	3,54	1,07
geosite is on the UNESCO World Heritage List	2,49	1,15

The obtained results show slight deviations in comparison with previous studies (e.g., Allan 2011; Allan et al. 2015; Csorvási 2016; Štrba 2019), which can be related mainly to the specific structure of the respondents who participated in this survey. However, the results of the survey can be considered very useful in terms of the development of geotourism, the promotion of geoheritage, geosciences, and education in this area.

Conclusion

The article used a questionnaire to find out the factors that influence the visit of geosites by primary and secondary school students on the example of students in the town of Vranov nad Topľou (Slovakia). These factors can significantly contribute to visitor loyalty and the sustainability of tourism in the region. The results of the study show that the factors "safety conditions during the visit", "visual attractiveness" and "uniqueness" can be considered important for the successful development of geotourism, which can affect the overall satisfaction of visitors in a particular place. However, the most important motivating factors include "traveling with family/friends", "exploring new places/geosites" and "for fun". It should be noted that further research is required in this field as presented results of this case study may differ from other regions in Slovakia or other countries.

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Souhrn

V posledních letech nabývají na významu domácí destinace a lidé tráví více času v přírodním prostředí. Mnoho přírodních krás bylo „znovu objeveno“. Nezastupitelnou roli v této souvislosti hrají přírodní formy cestovního ruchu, jako je geoturismus nebo ekoturismus. Tento článek si klade za cíl prostřednictvím dotazníku na příkladu vybrané skupiny žáků základních a středních škol ve městě Vranov nad Topľou na Slovensku zjistit, jaké faktory ovlivňují žáky při návštěvě geolokalit. Z celkového počtu 250 zpracovaných dotazníků se výzkumu zúčastnilo 120 chlapců a 130 dívek. Výsledky studie ukazují, že faktory „bezpečnostní podmínky při návštěvě“, „vizuální atraktivita“ a „jedinečnost“ lze považovat za důležité pro úspěšný rozvoj geoturismu, který může ovlivnit celkovou spokojenost návštěvníků konkrétního místa. Mezi nejdůležitější motivační faktory však patří „cestování s rodinou/přáteli“, „poznávání nových míst/geolokalit “ a „pro zábavu“. Výsledky průzkumu lze považovat za velmi užitečné z hlediska rozvoje geoturismu, propagace geologického dědičství, geověd a vzdělávání v této oblasti.

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FACTORS OF THE URBAN SPACE SUPPORTING RECREATION AND THEIR INFLUENCE ON THE ENVIRONMENT

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Abstract

The paper focuses on the investigation of the dependence of specific elements of urban space, which also support recreation, on selected environmental influences. The basic functions of urban space include not only the satisfaction of physiological needs, but also psychological needs. Urban space is usually closely related to urban planning, which includes parts of the landscape to which the settlement pattern is related. For the purpose of this research, public green spaces and water areas were chosen as the monitored elements in urban space. The database included 518 points in which the above dependency was investigated. The points represented physical locations on the map, which were located in the city centre of Brno and the adjacent urban districts. The dependence under consideration is detected using a non-parametric test that allows comparing two groups or conditions without assuming that the data are normally distributed. The results of the research defining the examined dependencies can help those involved in urban planning to understand more about the importance of public green spaces and water areas so that their recreational potential can be exploited at the same time.

Key words: Environment, dependence, nonparametric test, green spaces, water areas.

Introduction

Cities occupy 2% of the Earth's surface, but consume 60-80% of energy and produce about 75% of emissions. (Yang et al. 2021, Bibri et al. 2020) Modern urban planning is now seeking to take environmental factors more seriously into account in urban planning. Environmental and ecological urbanism is an urban architectural landscape style that focuses on the ecological aspects of the city. These considerations include the amount and type of green space as well as the amount, size and type of water bodies. (Ostarek 2021)

Heat waves are getting longer, more intense and also more frequent, which has a negative effect on the physical and mental health of urban dwellers. At the same time, these adverse effects can be mitigated. (Yang et al. 2021) One indicator of urban climate is the higher nighttime temperature in cities compared to rural areas. This phenomenon is known as the urban heat island. (Vescovi et al. 2005) Increased evaporation can reduce air temperature, thereby mitigating the heat island and increasing the thermal comfort of residents. Published studies show that shaded areas of a city can reach up to half the temperature of unshaded areas. The problem of overheating in urban areas is generally where there is not enough green space. In addition, publications also point out that green spaces play an important role in overall climate regulation and protection from noise, dust and exhaust fumes. (Yang et al. 2021) For this reason, the integration of green spaces into a compact functional urban environment is suggested. These include urban parks, street greenery, green corridors, community gardens, greening of waterways, courtyards, roof gardens and vertical gardens. Urban greenery can shade buildings, regulate the urban microclimate, mitigate the heat island effect and promote biodiversity. It also reduces energy consumption to air condition buildings. The ability of greenery to reduce carbon dioxide through photosynthesis contributes to reducing the carbon footprint. (Fok et al. 2018)

The rise and renovation of green spaces in cities has also increased the availability and use of these places for recreational activities. Physical exercise can be observed in parks of widely varying sizes. The same is true for recreational activities such as reading, sunbathing or playing chess. The development of biodiversity then extends these activities to the experience of birdsong, butterfly watching, etc. In addition, urban greenery acts as a pull factor for tourism. Tourism can be supported by its ecological and cultural benefits, as together with its cultural or historical function, it can attract more tourists and ecotourism environments. (Fok et al. 2018) In terms of psychology and medicine, the presence of greenery in the city helps in regenerating human fatigue, promoting eyesight, digestion, and maintaining body temperature. (Trstenjak 1984) Professor Franek from the University of Hradec Kralove states that the sight of natural scenery leads to improved memory and concentration. Patients in hospitals recovered faster when they had a view of trees from their beds. Children with

attention deficit disorders had fewer symptoms when in nature. Other sociological research indicated that women living in apartment buildings surrounded by greenery concentrated better than women who lived in apartments without green surroundings. (Franek et al. 2002)
Some authors include water areas (blue space) in green spaces. In fact, most water bodies contain vegetation and thus function as green spaces within the ecosystem, even though they are hidden under water. (Gaston 2010) Water is also commonly used in urban planning as a decorative element of public places. (Kleerekoper et al. 2012) Its cooling effects have been studied for a long time. For example, in 2009, Chinese scientist Xu studied the effect of a body of water on thermal comfort for tropical days with air temperatures above 35 °C, and his results suggest that bodies of water with a surface area greater than 2 104 m2 significantly cool coastal zones. (Mei et al. 2009) A Polish model study in 2004 pointed out that small ponds (4 m2) also cool their surroundings. (Robitu 2003) Other scientific work highlights the cooling effect of a lake with a temperature of 15 °C, where it can achieve a reduction of 1.5 °C to 2 °C in areas close to the lake. At the same time, this study concludes that the size of the water surface has a non-linear effect on air temperature. This means that several smaller lakes have an impact on a larger area of a city than one large lake. Water bodies can also affect temperature in more distant areas, with cooler air originating from the lake being driven by the wind to create an airflow over a range of several kilometers. The cooling effect is closely related to the water temperature and the time of day. While in spring, when the water surface is cold, it has a cooling effect on the air temperature, in autumn, when the water is heated and the water temperature is higher than the air temperature at night, it has a warming effect. Here it can be seen that lakes within a city can be a cooling feature during the day, but can also be responsible for warming the air during the night hours. In this way, the lake acts as a buffer to the diurnal temperature cycle. (Theeuwes et al. 2013)

Materials and methods

The subject of this paper is to investigate and find the dependence of specific elements of urban space, which also support recreation, on selected environmental influences. Public green spaces and water areas are selected as elements of urban space. Day noise, night noise, immission and temperature were chosen as the environmental factors for which the influence was investigated. The schematic of the investigated relationship and the links between the investigated elements and influences are shown in Figure 1.

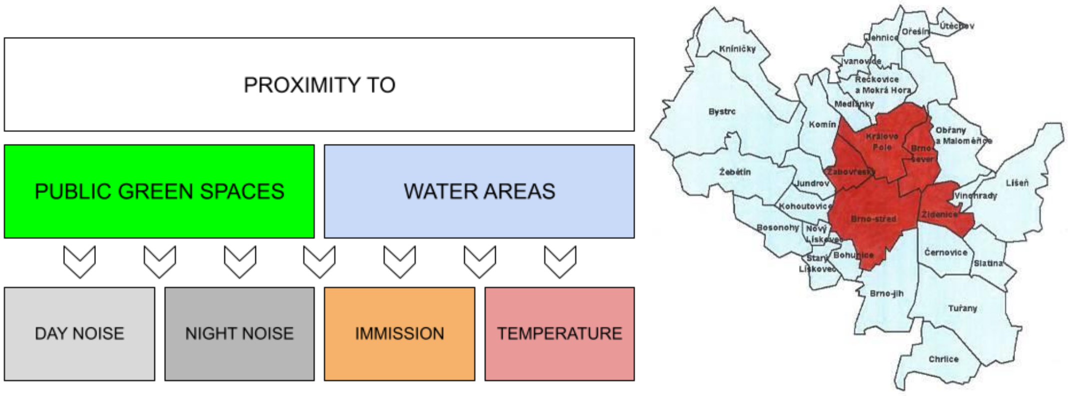

Fig. 1: The schematic of the investigated elements and influences with showing the locations of the study area Brno city

First, a process of searching, selecting and evaluating selected sites in the area was carried out. In these sites, 518 points were identified and data and information were collected with respect to the subject of investigation. The points represented physical locations on the map, which were located in the city centre of Brno and adjacent urban districts, as shown in Figure 1.
Subsequently, data on the selected environmental factors for which the effect was investigated were compiled. Noise was determined from a noise load model at a height of 4 m above ground level, for daytime hours between 6 and 22 hours, and for nighttime hours between 22 and 6 hours available from the noise map produced by ENVING. The data on immissions reflect the total immission load of NO2 in the average annual concentration, obtained from the available feasibility study on the territory of the city of Brno. Temperature data were obtained from hyperspectral imaging of the Brno city area on the last day of August 2019 from the UrbanAdapt project application.
Testing and statistical analysis was performed using the nonparametric Mann-Whitney test, which allows comparison of two groups or conditions without assumptions that the values are normally distributed, corresponding to a Gaussian normal distribution. The Mann-Whitney test determines

whether there is a statistically significant difference between two unrelated, independent groups on a dependent variable. This test was chosen on the basis of verifying and then rejecting the normality of the collected data.

Results

Non-parametric Mann-Whitney test was performed at 0.05 level of significance, 95% confidence interval. Separately for the urban space element of public green space and water areas. The chosen limit value for the distance between public green spaces and water areas is based on experience from previous research.

Tab. 3: Descriptive statistics of results from the Mann-Whitney test for public green spaces.

VARIABLE	POINT ESTIMATE	95% CI	W	P-VALUE	ADJUSTED P-VALUE
DAY NOISE	5,000	0,001;5,001	67539,5	0,0041	0,0037
NIGHT NOISE	0,000	0,000;5,000	67042,5	0,0100	0,0086
IMMISSION	0,600	0,000;1,130	66469,0	0,0253	0,0243
TEMPERATURE	2,000	1,000;3,000	79133,0	<0,0001	<0,0001

Table 1 provides useful descriptive statistics for the two independent groups of public green spaces being compared. The first group includes public green spaces in close proximity (being within 300 m of the selected point). The second group does not include public green space in close proximity (being further than 300 m from the selected point). Based on the statistical test, a significant median difference was found for all environmental effects examined due to public green space in close proximity to the selected physical point examined.

Tab. 4: Descriptive statistics of results from the Mann-Whitney test for water areas.

VARIABLE	POINT ESTIMATE	95% CI	W	P-VALUE	ADJUSTED P-VALUE
DAY NOISE	5,000	0,000;5,000	68137,5	<0,0001	<0,0001
NIGHT NOISE	5,000	5,000;4,999	69338,5	0,0100	0,0086
IMMISSION	0,990	0,710;2,120	66833,0	0,0002	0,0002
TEMPERATURE	2,000	1,000;3,000	67795,0	<0,0001	<0,0001

Table 2 provides useful descriptive statistics for the two independent groups of water areas being compared. The first group includes water areas in close proximity (being within 1 km of the selected point). The second group does not include water areas in close proximity (being further than 1 km from the selected point). Based on the statistical test, a significant median difference was also found identically for all environmental effects examined due to water bodies in close proximity to the selected physical point examined.

The adjusted p-value is more accurate. The unadjusted p-value is higher than the adjusted p-value, so it is considered a more conservative estimate.

Discussion

It is verified from the research and publications focusing on the issue of examining environmental impacts in the urban environment that green and water areas that help regulate the climate will need to be taken into account when planning cities or new construction in cities. The authors of this paper have taken inspiration from these researches and publications and in their case study they have investigated the relationship between green and water areas respectively and the selected environmental factors obtained from available public sources. It has been shown that the creation and restoration of public green spaces and water areas in cities has the potential to improve the overall climate while harnessing their recreational potential.

Conclusion

The aim of this research was to investigate selected elements of urban space that also support recreation in relation to selected environmental dependence. These were public green spaces and water areas. The dependence was demonstrated on specific factors - day noise, night noise, immissions and temperature. Data on specific values were obtained from publicly available sources. For this purpose, the authors compiled a database in which the above dependence was examined. A statistically significant effect on environmental factors was demonstrated in the case of public green spaces within 300 m of the investigated site and in the case of water areas within 1,000 m of the investigated site.

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Souhrn

Článek se zaměřuje na zkoumání závislosti konkrétních prvků městského prostoru, které současně podporují rekreaci, na vybrané vlivy životního prostředí. Sledovanými prvky v tomto výzkumu jsou zvoleny veřejná zeleň a vodní plochy. Faktory životního prostředí tvoří hluk ve dne, hluk v noci, imise a teplota. Do databáze je zařazeno celkem 518 bodů, ve kterých je výše uvedená závislost zkoumána. Body přestavují fyzická místa na mapě, která se nacházejí v centru města Brna a navazujících městských částech. Uvažovaná závislost je zjišťována pomocí neparametrického Mannova-Whitneyho testu. Tento test byl zvolen na základě ověření a následného zamítnutí normality shromážděných dat. Na základě výsledku statistického testu byl zjištěn významný mediánový rozdíl, tedy statisticky významný vliv na faktory životního prostředí v případě veřejné zeleně do 300 m od zkoumaného místa a v případě vodních ploch do 1 000 m od zkoumaného místa. Bylo prokázáno, že vznik a obnova veřejné zeleně a vodních ploch ve městech má potenciál zlepšit celkové klima a zároveň využít jejich rekreační potenciál. Výsledky výzkumu tak mohou napomoci osobám zabývajícím se plánováním v městském prostoru více porozumět významu veřejné zeleně a vodních ploch.

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FOREST ENGINEERING VERSUS HERITAGE CONSERVATION

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Abstract
The paper deals with the following and often ignored topic: the conservation of evidence of human settlements in the forests, which is threatened by the rising of forest engineering activities. In our paper, we analyse contemporary legislative means of heritage conservation, and we try to apply these means in a case of an archaeological locality in a forest environment. Our model case is an abandoned medieval village in the area of Drahanská Highlans (Czech Republic). We intend to present how the object is registered in an information system of heritage conservation institutions, and we try to suggest some instructions on how to proceed in potential industrial activities to this object's owner. Finally, we mention the classification issue of non-archaeological forest objects' heritage values (i.e., a coppice's).

Key words: archeology, cultural heritage, legislative process, coppice, Drahanská Highland

Introduction
This paper was inspired by the lack of information about heritage conservation in the field of forest engineering. The values held by contemporary heritage conservation specialists are spreading rapidly. Heritage conservation is not just about castles, monuments or statues, but also about old factories or workers` colonies. Nowadays, cultural landscape is considered to be one of the most crucial areas of interest. By cultural landscape we mean an area that appeared in a specific period of time by cooperation of human actions and those of nature. We can classify a landscape in many ways (Kuča) and we are all familiar with medieval landscape, composed baroque landscape or an industrial landscape (Landscape and Power). Drahanská Highlands, which was thoroughly inspected by our team of researchers, is one of these. In Czech Republic, this area is unique because of its many cultural aspects. Since prehistoric until modern times, it has been influenced by mining, metallurgy and charcoal burning. At the same time, it`s a landscape that went through an intensive agricultural colonization in the 13th century which was followed by a steep downfall in the 15th century. Since the 17th century this area has been popularized as a touristic and recreational region as one of the first regions in the Middle Europe (Tartaro Mastix Moravie). Important migration and communication trajectories went through this area since prehistoric times. We can also see it as a "magical land" with a lot of prehistorical (Býčí skála, Kateřinská jeskyně) and modern (St. Mary`s church in Křtiny) pilgrimage sites. We cannot deny heritage protection of most of the places, that we can identify as historically, culturally or aesthetically valuable. However, there still exist a lot of objects (mostly of archaeological nature), which are not obviously identifiable, though they serve as an important proves of historical development of human settlements since the prehistoric times until nowadays, such as the Heritage Act defines them. These were the kind of objects we focused on in our MaHoLe project. We aim to focus on some aspects of these object`s heritage protection in the Czech legislative environment and we`ll try to discuss some possibilities for an owner of such an object.

Material and methodology
Current legislative in relation to forest environment analysis
The main legislative regulation of heritage conservation is the Act 20/1987 Coll. About heritage conservation (hereinafter the Heritage Act). It`s one of the oldest valid laws in Czech Republic and together with the implementing regulations it comprehensively regulates heritage conservation.
In its first part, the Heritage Act defines the concept of Cultural Monument and the process of declaring something as a Cultural Monument. In its second part, it deals with rights and obligations which follow from being an owner of a Cultural Monument. Other definitions, such as National Cultural Monument or Protected Heritage Areas, are rarely applicable in forest environment, so we won`t be focusing on them. Well, what does the concept of Cultural Monument really mean? According to the law it`s a significant evidence of historical development, ways of life or society`s environment from the earliest until present times. This evidence represents creative abilities and works of man in various fields of expertise and is valued for its revolutionary, historical, artistic and technological features or because it`s related to famous people or historical events. The process of declaring something as a

Cultural Monument is relatively complicated. The Department of Culture (MK ČR) requests an opinion from the relevant regional authority and municipality with extended powers. In practice it also requests an expert opinion form the National Heritage Institute (NPÚ). Then they inform the owner of the object and ask him to comment on the suggestion. After getting all the relevant opinions MK ČR decides about the declaration. We should mention that an object can become a Cultural Monument even if his owner doesn`t agree. If an object of archaeological nature is concerned, MK ČR requests an opinion of Institute of Archaeology of the Czech Academy of Sciences (Institute of Archaeology).
If an object becomes Cultural Monument, it`s recorded in the Central List of Cultural Monuments of the Czech Republic which is held by the NHI and which is linked to one of the basic registers of public administration RUIAN (Register of Territorial Identification, Addresses and Real Estate), so the information, that this particular plot of land is under the protection as a Cultural Monument, appears in the Real Estate Cadastre.
There is a common problem with Cultural Monuments of archaeological nature, because the area of such a monument is usually defined by geographical coordinates which are not compatible with the plots in the Real Estate Cadastre, so the information about their protection doesn`t appear in the register. However, after the approval of the new civil code, only the whole plot can become a Cultural Monument of archaeological nature. On one hand, the problem with recording them in the Real Estate Cadastre is solved, but on the other, the question of archaeological findings on large forest plots remains. Declaring the whole plot might “disqualify” large forest area. The only solution seems to be to divide the given area with the archaeological locality as a separate plot. That, however, requires cooperation of its owner.
Specific obligations follow from an ownership of a Cultural Monument. First, the owner has to maintain the Cultural Monument in good shape. In the case of archaeological monuments in forest environment, influences that might damage or destroy the monument should be avoided. If a Cultural Monument is seriously neglected, the state can even expropriate it, which is hardly used in practice. On the other hand, the ownership of a Cultural Monument brings some compensations. Besides expert help of NHI for free, one can receive a contribution to renovate the Cultural Monument and is exempt from property tax. This fact should be seriously considered when we talk about forest engineering. Classification of the territory where the Cultural Monument is located among the “special purpose forests” seems to be an ideal solution because these are also exempted from the tax.
The third part of the Heritage Act, which deals with archaeological researches and localities, is crucial in the context of applying heritage conservation in forest environment. This part regulates the authorization to conduct archaeological research and defines the role of the Archaeological Institute, which is the only institution legally authorized to conduct such a research. There exist two of them: one in Prague and one in Brno. Other institutions or individuals (hereafter authorized institution) have to meet some conditions and receive the authorization to conduct such a research from MK ČR. If an archaeological research is started, the authorized organization has to inform the Archaeological Institute and provide them with research report. If a Cultural Monument or a Protected Heritage Area is considered, NPÚ has informational obligations too.
If an archaeological research is conducted in a forest area, the authorized institution (including the Archaeological Institute) has to make an agreement about the conditions of archaeological research with the owner. The law, however, doesn`t state the requisites of this agreement. It might as well be an oral agreement, but it`s recommended to sign a written contract, where both sides oblige to fulfill some deadlines, conditions or compensations of damages. If the owner doesn`t accept the agreement, the authorized institution can ask the Regional Office to force the owner to tolerate the archaeological research.
Another important concept in the Heritage Act is rescue archaeological research. Basically, it is an obligation to carry out archaeological research in the event of disturbance of an area with archaeological findings. This is considered to be the entire territory of the Czech Republic. So before preparing any construction or other activity, the owner of the land has to carry out an archaeological research. At the same time, the builder is obliged to inform the Archaeological Institute about the construction plan.
For the owner of forest land, the last sentence of Section 22(2) of the Heritage Act is important, as it applies a similar procedure as for construction activity also in the case of other activities. This means such activity that may endanger or damage archaeological situations. For example, afforestation of land or logging. Thus, the forest owner should discuss his procedure with the Archaeological Institute before any such activity and, if he is a legal entity or an individual entrepreneur, he must pay for any rescue archaeological research.
The presence of archaeological findings in the forest environment must also be taken into account. Especially in connection with the development of amateur detector research. An archaeological finding

is defined as an evidence or a remnant of human activity. It can be both movable (e.g., tiles, coins, or jewellery) and immovable (most often the remains of human settlements). However, human remains are not considered to be an archaeological finding under the Heritage Act. The law does not define the temporal classification of a finding. It can only be said that it is an object, the study of which can trace the development of human history, and which is located underground. Therefore, if an archaeological finding is made during normal forest management activities, the finder is obliged to report the find to the relevant Regional Authority within the next day. If he fails to do so, he appropriates the find and its value exceeds CZK 5,000, he commits a criminal offence. The finder is entitled to a reward, which in this case is up to 10% of its value. This will be determined by an expert opinion of the Archaeological Institute or the National Museum.

Another legal norm for the field of archaeological heritage conservation is the Convention for the Protection of the Archaeological Heritage of Europe (hereinafter referred to as the Malta Convention).The Convention became valid in the Czech Republic in 2000. It was essentially a response to unregulated construction and development activities that directly threatened archaeological heritage. The most important part of the Convention is the chapter dealing with Heritage Identification and Protection Measures. In the second article of this chapter, the Contracting Parties undertake, in accordance with their legal systems, to maintain an inventory of archaeological heritage and to establish archaeological reserves even in places where there are no visible remains.

The Czech legal system reacted to this part of the Malta Convention by creating the so-called archaeological findings sites (hereinafter referred to as AFS). These are areas with elements of archaeological heritage, which are divided into four categories. AFS I – territories with unequivocal archaeological findings, AFS II – territories with reasonably expected archaeological findings, AS III – territories where archaeological findings are currently not expected but cannot be unequivocally excluded, AFS IV – territories without archaeological findings. The first two categories are not in dispute. It is a valuable area that is spatially clearly defined. Very often AFS II forms a buffer zone for AFS I. For example, the core of a vanished medieval village is AFS I and the surrounding plains are AFS II. The category AFS IV includes quarries or opencast mines, i.e. mined out areas. However, what about evidence of historic mining. On the one hand, these are fully established as historic industrial heritage. For example, the Erzgebirge/Krušnohoří mining region has become a UNESCO World Heritage Site. According to the AFS categorisation they do not carry archaeological value, which is not true. Therefore, the whole AFS classification will have to be adjusted. The AFS III category includes areas that are not in other categories, i.e. the rest of the country.

The AFS are recorded in the Significant Archaeological Sites (SAS), which is divided into a map and database section. This system is technically and content-wise outdated. Currently, the NPÚ, as the administrator of SAR, is creating a new version of the system, which should be deployed in 2023.

For the forest owner, the information in Article 3 of the Malta Convention concerning archaeological excavations is relevant. According to the convention, non-destructive survey methods are preferred. In the context of the significant development of these methods in the last decade (airborne laser scanning, geophysical measurements, remote sensing, geobotanical indications), this concept takes on a whole new dimension. Therefore, the forest owner should primarily require the application of non-destructive methods in any archaeological activity on his land.

After almost 40 years of the existence of the Heritage Act and more than 20 years of the Czech Republic's accession to the Malta Convention, it appears that Czech legislation in the field of archaeology is outdated and therefore insufficient. This fact is particularly evident in the protection of archaeological heritage in the forest environment. The Heritage Act deals primarily with archaeology in the relationship of the builder to the protection of archaeological heritage and is very complicated to apply to other environments. The more modern Malta Convention is unfortunately insufficiently anchored in our legal system and therefore more difficult to enforce.

Results

From March 2020 to the present, several dozen archaeological remains of human economic activity in forests have been documented within the MaHoLe project. Three sites with different natural and geographical conditions have been selected within Drahanská Highlands. In addition, each of the sites was located in a different historical area, so the source base also differed. The southern area is located near the village of Pozořice. The centre of the area is the ruins of Vildenberk Castle, in the vicinity of which a number of relics related to the castle's economic background have been preserved (pond system, water cisterns, stone quarries). The central area is situated southeast of Blansko near the village of Klepačov. It is a plateau above the Punkva valley. This area is rich in mires that surround the extinct medieval village of Polom with a pond and an interesting water channel. The northern area

is close to the important medieval centre of Holštejn Castle. Within this area, the research focused on the extinct medieval village of Bohdalůvka. It serves as a model example of an archaeological site.
The site of the extinct medieval village from the 13th and 15th centuries is located on the border of the cadastral areas of Holštejn and Housko. The village was in the place where there is a small forest meadow, known as Bohdalevská meadow. Remains of the original buildings have been preserved on the sides of the watercourse that springs in the northern part of the meadow. A small dam of a pond in the southern part of the intravillan has been preserved. The village was a short, double-rowed, wooded lane settlement typical of most colonial settlements in Drahanská Higlands. The two rows were 50 to 60 metres apart. The length of the whole village was 155 metres. Two rounded elevations in the form of piled stones were preserved around the perimeter of the village. These elevations are now only slightly visible.
The first written record of the village dates back to 1463, but archaeological findings date the beginnings of the settlement to the second half of the 13th century. In 1492 it is mentioned as deserted. It is evidence of the remains of an extinct medieval village preserved in a forest environment. It is a valuable archaeological and cultural and historical monument that bears witness to the medieval landscape.
If we want to carry out archaeological research on the site, it is necessary to inform the Archaeological Institute. The digital form in the Information System on Archaeological Data is used to notify the archaeological research. The information is then stored in the Archaeological Information System of the Czech Republic (AIS). The information can be viewed within the Digital Archive of the AMCR database and visualised within the Archaeological Map application. The entire information system has been newly built since 2016. It contains a number of databases with professional and educational content. The map and databases are clear and the full-text search works well. It is evident that the system is intended for the general public.
The creation of an AFS is somewhat more complicated. The Information System on Archaeological Data (ISAD), based on the above-mentioned SAS database, is designed for this purpose. A new polygon can be created within the mapping application, to which additional information must be added in a multi-component form. The saved information then goes to the NHI for approval. It is an outdated system. The database is no longer populated. The polygon can only be drawn in a very schematic way and many unnecessary predefined fields have to be filled in the database.
The highest form of protection for an archaeological site is the declaration of a Cultural Monument. This is a complicated process, as discussed in the previous chapter. Anyone can submit a proposal for Cultural Monument designation, but the registration of the proposal is entirely in the hands of the National Heritage Institute. A specialist in the inventory part of the Heritage Catalogue, which is a registration system including objects of conservation interest, fills in the information for the site and links the entry to other components of the Integrated Information System for the Protection of Monuments (IISPP). In particular, localisation using the NPÚ geoportal is essential. After the Ministry of Culture actually initiates the administrative procedure of declaring an object a Cultural Monument, a record of the legal status is created in the Central List of Cultural Monuments, which is a database recording the life of the Monument within the legislative process. That is, when the Cultural Monument was declared, when the Cultural Monument protection was extended, or when it ceased to exist. This information is combined with the information in the inventory part of the Heritage Catalogue to create a full-fledged record of the Cultural Monument, which is spatially defined and contains links to other documents (photographs, planning documentation). IISPP is a robust system that captures all components of the Czech cultural heritage. It records information i.e. on defunct factories, but also on i.e. medieval bells, so the data is very coherent. Archaeological cultural heritage is a relatively significant part (approximately 10%), so the Heritage Catalogue is set up for this type of information, but lacks a better link to ISAD. The link to the Archaeological Information System is completely missing.

Discussion and conclusion

Identification of new values – What to do with the relics of human economic activity that are not archaeological in nature

In the previous chapter, we demonstrated the process of recording an archaeological site in the various archaeological conservation systems using a case study. We showed the advantages and weaknesses of the existing systems, especially their lack of continuity. However, during the project research we came across objects of a non-archaeological nature. These are mainly stumps, i.e. the remains of coppice forest, which are evidence of pre-industrial forest management. The stumps fulfil the definition of a Cultural Monument as evidence of a society's way of life and environment. So, from the point of view of heritage conservation, there should be no problem in declaring a stump as a cultural monument. However, in practice this has not yet happened. One of the reasons may be the difficult spatial definition of the object from the point of view of the Civil Code, where the tree is considered a thing connected with the land, i.e. the stump in the forest area would have to be declared a Cultural Monument with the plot on which it grows. This, as with archaeological objects, complicates the situation considerably. Another way to apply heritage protection to a stump is to declare a larger area of ancient coppice forest as a Heritage Area. According to the international classification of cultural landscapes, the forest is considered a “relict landscape”. It is a category of landscape where evolutionary development has stopped at a certain period and the characteristic features are still visible. It is therefore possible to fulfil the definition of a Heritage Area as part of a landscape unit. The advantage of a Heritage Area is the possible absence of cultural monuments within its territory. In practice, the declaration of this type of cultural landscape has not yet been implemented. The closest approach to this type is the Mining Cultural Landscape Háj - Kovářská - Měděník, where, among other things, the object of protection is defined as “sparse mountain spruce forests and peat bogs, extensive meadows around smaller settlements”, i.e. certain types of relict landscape. The protection of stumps is much more effective from the point of view of nature conservation. The Nature Conservation Act defines the terms “commemorative tree” or “group of commemorative trees”, which can be declared by the municipality with extended jurisdiction.

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Souhrn

Příspěvek podává informaci o ochraně pozůstatků lidské hospodářské činnosti v prostředí lesa z pohledu památkové péče. Cílem příspěvku bylo prezentovat možnosti památkové péče v této v současné době okrajové části spektra kulturního dědictví. Příspěvek vycházel z údajů získaných výzkumem tří geograficky a historicky odlišných lokalit v oblasti Drahanské vrchoviny. Byla provedena analýza dvou zásadních právních úprav pro tuto oblast kulturního dědictví – Památkového zákona a Maltské konvence. Jednotlivé články a pojmy výše uvedených norem byly aplikovány na archeologickou složku kulturního dědictví, případně byly uvedeny postupy pro majitele dotčeného lesního pozemku. Na konkrétním příkladu archeologické lokality, zaniklé středověké vesnice Bohdalůvka, byly prezentovány možnosti evidence lokality v systémech archeologické památkové péče. V rámci diskuze byly komentovány výhody a nevýhody jednotlivých systémů. Především bylo poukázáno na jejich malou vzájemnou provázanost. Rovněž byla řešena problematika ochrany pařezin z pohledu památkové péče. Bylo konstatováno, že nejvhodnější ochranou pro oblast Drahanské vrchoviny by byla památková zóna.

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FOREST VISITORS DATA BEFORE AND DURING COVID-19 LOCKDOWN CRISIS: FOREST RECREATIONAL SERVICES IN THE FACE OF COVID-19 PANDEMIC STRESS

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Abstract
COVID-19 has overtaken human freedom of movement and association. Moreover, the infection has claimed numerous lives of more than a million people by the middle of 2021. Given the numerous forest ecosystems services and benefits to humans and biodiversity, urban forests and parks provide a significant part by offering urban dwellers recreational and leisure space, mental health relief, and meditation. Consequently, this data aims to give a clear state of forest visits to a forest near Brno City before and during the COVID-19 pandemic. Medical experts, leaders, and policymakers could use this data to make better decisions regarding lockdown rules, recreational services during the lockdown, and epidemiological situations. Moreover, this data will help other researchers on health and welfare issues concerning forest and urban nature visits and other recreation services. Using TRAFx Infrared Trail Counter, we counted visitors in the Training Forest Enterprise Masaryk Forest Křtiny in the outskirts of Brno City in the Czech Republic. Data (https://doi.org/10.17605/OSF.IO/8NAKW) has been prepared and presented herein for further use.

Key words: Brno city, Mental health, recreational and leisure space, urban forest services

Introduction
By 2020, the COVID-19 pandemic had claimed over 1 million dead and over 30 million infections worldwide. This situation was also compounded by long periods of lockdowns and government restrictions, which worsened many people's mental health, including school children (Galea et al. 2020, Soga et al. 2020, Bamwesigye 2021a. Geng et al. 2021). These occurrences have left many people worldwide with mental health and psychological welfare issues. The constant lockdowns that are practically necessary have also compounded the already bad situation and increased mental health rates (Sainz-Santamaria and Martinez-Cruz 2021, Lieberoth et al. 2021, Yamada et al. 2021].
Amidst this situation, the recreational forest services are sought to have played a vital role in minimizing stress if used or accessed by the people in need. Forests, urban parks, and green spaces provide leisure services necessary for visiting individuals and families (Bamwesigye et al. 2020. Wells 2000, Doli et al. 2021, Venter et al. 2021). In Oslo, for example, nature and recreation services were said to have increased by 291% of the usual outside activities before the COVID-19 (Venter et al. 2021, Wacker and Holick 2-013, Bamwesigye et al. 2021, Slater et al. 2020)
Understanding the benefits of forest ecosystems and recreational services on individual welfare is more necessary than ever (Bamwesigye et al. 2020, Doli et al. 2021, Bamwesigye et al. 2021, Derks et al. 2021) presented increasing numbers of forest visitors ranging from children to families in the studied period between January and June 2020. Their study analyzed the trends in forest park visitors in selected countries. Their results reveal interesting trends whereby there were increases in infections, whereas the number of visitors had reduced and the number of infections increased (Geng et al. 2021).
This study data provides policymakers and decision-makers a basis for future planning in epidemiological situations. More so, a ground for forest management with information for improving forest services and planning for epidemiological situations given the services and benefits of the forest and urban nature. Therefore, this data aims to provide scientific material (Data) before and during the COVID-19 pandemic for further studies. Medical experts, leaders, and policymakers in the Czech Republic and the globe could use this data to make better decisions regarding lockdown rules, recreational services during the lockdown and in epidemiological situations. Moreover, this data will help other researchers study the relationships between infections, forest and urban nature visits, and other recreation services.

Material and methods

Location of study and its characteristics

The study was conducted in the Training Forest Enterprise Masaryk Forest Křtiny (TFE) and organizational part of Mendel University in Brno and a special-purpose facility of its Faculty of Forestry and Wood Technology. Forestland property has an area of 10,265 ha. The forest forms a continuous complex immediately linking with the northern limits of the Moravian metropolis of Brno City and reaching as far as the town of Blansko[18]. The forest is situated at altitudes ranging from 210 to 575 m above sea level.

TFE enjoys an entirely exceptional position in the fulfillment of the aesthetic and educational functions of the forest. There are whole forest stands with the natural species composition left without intervention in the past. The natural beauties of local forests are intentionally maintained and improved. Forest glades established in the complex of continuous forests are kept with care. Exotic tree species have been planted around the meadows to make their surroundings more colorful and attractive. Forest springs are sought and looked after, and new fountains.

The tradition of Training Forest Enterprise Masaryk Forest in Křtiny in the development of aesthetic and educational functions of the forest is a long one. The natural beauties of the region are deliberately complemented and emphasized. Forest glades are intentionally established in the unbroken area of the forest stands, around which exotic tree species are planted to enhance the aesthetic impression. Existing forest springs are carefully looked after, and new fountains are built. Memorials and memorial tablets are being placed at selected places.

Data collection

The main goal of monitoring forest visitors, and traffic is to provide basic information about the number of visitors and data on the temporal variability of traffic and distribution of visitors within the target area. The monitoring of forest visits in recent times over protected areas and urban nature facilitates planning administration activities and sustainable management while considering the social and cultural needs of the people.

We installed the counter in July 2014 and collected hourly data until June 2018. We put the counter again in March 2021 during the COVID-19 lockdown, given the importance of monitoring forest visits. The trail visitor monitoring used automatic reader Pyro Box Compact from Eco-counter. This device counts all forest road users on the trail without distinguishing among them. Counting is based on the temperature difference between a human body and its surroundings (TRAFx Infrared Trail Counter). The readers can distinguish the direction of the movement and are installed in the narrowest places of the trails to prevent counting two persons walking side by side as one. The data are stored in one-hour intervals.

About TRAFx Infrared Trail Counter installed, It counts people on trails, paths, and sidewalks. It has an advanced microelectronic design and high-quality infrared scope. The counter has a very long battery life of up to 10 years, and its significant advantage is its large storage capacity. This counter is built for outside conditions, i.e., -40C to +55C. Unlike other trail counters, it does not require a receiving unit or reflector to operate[19]. This results in a very compact, unobtrusive design that reduces the risk of vandalism. It also works well in winter conditions. Herein, primary data in excel file for download and reuse (https://osf.io/8nakw/) (Bamwesigye 2021b).

Results and Discussion

We present data collected over the years using an installed counter in the form of a metal box (July 2014–May 2018) and the form of a wooden nest (2021) on the forest road "Červená" (Red Trail) in the Training Forest Enterprise Masaryk Forest Křtiny near Brno City. The data collected is from July 2014 to 11 June 2018, when the counter was removed. Given the COVID-19 situation, we put the counter back to the same spot from 1 March 2021 during Lockdown (Figures 1). Our results showed a spike during March, April, and May compared to June and July in 2021. The strict and heavy COVID-19 lockdown had run from November 2020 to the end of May 2021. Compared to other years, the results showed a frequency spike during March, April, and May again for 2015, 2016, 2017, 2018, and 2021 (Figures 1).

The COVID-19 lockdown had run from November 2020 to the end of May 2021. Compared to the same period of other years, the data of March, April, and May 2021 shows a higher trend, apart from a few days in April and May, on which values of 1088 and 1312 forest visitors, respectively were recorded on given days. During the lockdown, we observed significant values of 624, 595, and 873 on given days in March and 553,640, 427, 559 in April and towards the end of May.

During the warm period of the summer, the collected data show a declining trend of numbers of visitors in the forest, in each category. Due to the periods of good weather during the summer, our data illustrate more visits in the forest, but on a more stable level than very high spikes of the visiting frequency in the spring period. In addition, it is very interesting that there were more forest visitors in the summers of 2016 and 2017 than in 2021 (Figures 1).

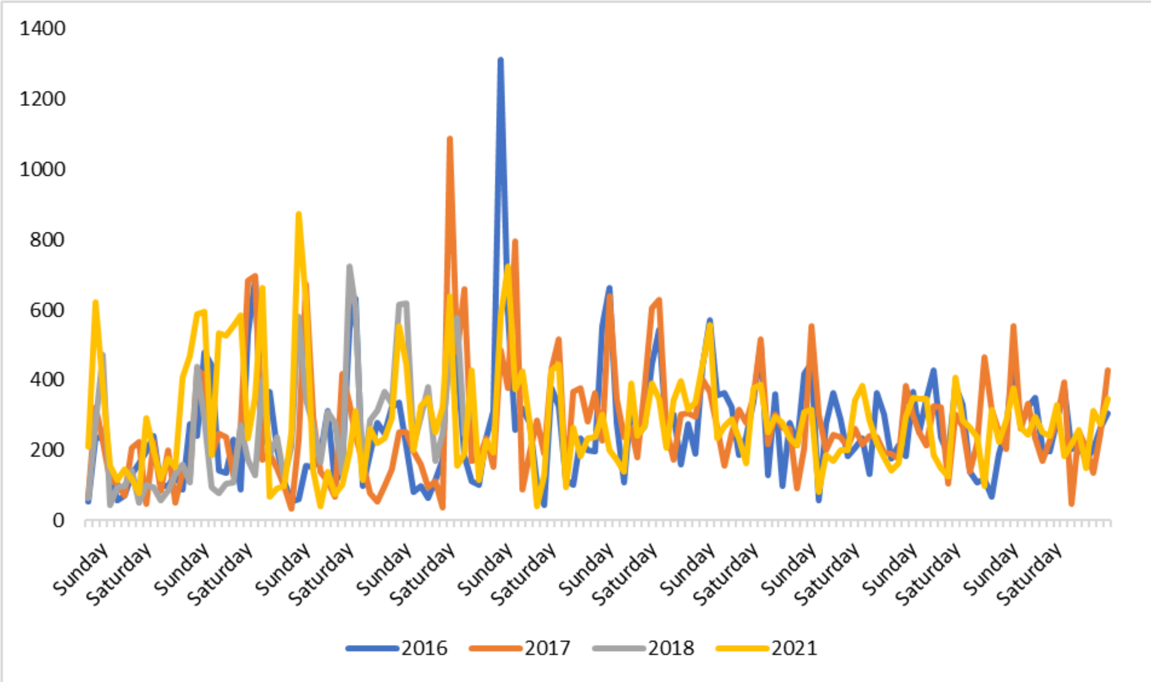

Fig. 1: Forest visitors on the weekends from 2016 to 2018, and 2021 in March to July. (X-axis is months March to July in selected years, Y-axis is the number of forest visitors at of Training Forest Enterprise Masaryk Forest Křtiny).

The studied months and years showed that 2021 had more total forest visitors at 40,616 people, 2017 at 38,502, 2015 at 37,820, 2016 at 37,491, and 2018 at 12,696 people. However, 2018 cannot be substantively counted regarding the total since June and July data are missing. The lower number of forest visitors in 2016 could be associated with other factors, such as socioeconomic characteristics and or climate. These factors could be studied in-depth to get to the gist of the discussion.

We conclude that ceteris paribus, the studied data showed a notable trend in the COVID-19 lockdown period with special attention in March, April, and May 2021. Even though previous years also recorded high visitors in the forest, the COVID-19 period showed exceptional results (Figure 1). Moreover, the year with COVID-19 presented the highest observed visitors, with more than 800 visitors than the second highest year. This trend is also reflected in the summary statistics of the selected data from March to July through the subsequent years. The mean and median scores showed high scores for 2021, 286, and 250 people, respectively. Understanding the ranges in this data can further be observed in the quartile ranges, which illustrated an almost equal distribution.

Conclusion

The COVID-19 pandemic has completely changed many people's ways of life regarding freedom of movement and work. Various studies have illustrated the immense stress associated with the pandemic, regardless of age or geographical region, due to lockdown and change in routine. Our investigation on visitors' movement at Training Forest Enterprise Masaryk Forest Křtiny allowed us to observe that more people enjoyed the forest recreation services in March, April, and May 2021 than in previous years, with minor variations on some days. We recommend follow-up research to use visitor recorders to thoroughly investigate the trend of forest visitors and big data on opinions on the role of forest ecosystem services, especially in the urban and suburban areas. Moreover, this data could help decide on future research and policy decisions regarding epidemiological situations.

Based on data analysis in previous stages of the work, the following conclusions can be formulated:

It was found that the peak visits are at the turn of April and May (after winter)-regardless of external factors. In other words, the city forest is always needed for relaxation, and its proximity to the city makes it an attractive place, especially for short-term rest. Regardless of the COVID-19 pandemic, the peak of visits to the city forest falls in the following years at the turn of April and May (after winter) and remains within similar quantitative limits. In other words, the city forest is now always needed for the

recreation of city people-people want to be among the greenery regardless of the pan-demic. The above basic statements allow us to formulate some general conclusions:
Urban society always needs contact with nature in the first spring days after winter. At the turn of April and May, the forest has the highest share of users. Hence, the organization of tourism and mass events is advisable in the spring. It is the best time to organize outdoor events: excursions, walks, picnics, festivals, etc. Thus, it is valuable information for the managers of the area and organizers of tourism and collective events.

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Souhrn

COVID-19 předběhl svobodu pohybu a sdružování lidí. Kromě toho si infekce do poloviny roku 2021 vyžádala mnoho obětí na životech, a to více než milion lidí. Vzhledem k četným službám lesních ekosystémů a přínosům pro člověka a biologickou rozmanitost mají městské lesy a parky významnou úlohu, protože nabízejí obyvatelům měst prostor pro rekreaci a trávení volného času, úlevu pro duševní zdraví a meditaci. Následně si tato data kladou za cíl podat přehledný stav návštěvnosti lesa v blízkosti města Brna před pandemií COVID-19 a v jejím průběhu. Zdravotničtí odborníci, vedoucí pracovníci a politici by mohli tato data využít k lepšímu rozhodování o pravidlech výluky, rekreačních službách během výluky a epidemiologických situacích. Kromě toho tato data pomohou dalším výzkumníkům v otázkách zdraví a sociální péče týkajících se návštěv lesů a městské přírody a dalších rekreačních služeb. Pomocí infračerveného počítadla tras TRAFx jsme počítali návštěvníky ve Výcvikovém lesním podniku Masarykův les Křtiny na okraji města Brna v České republice.

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GREENERY AS A MATTER OF SECURITY FOR CITIZENS INVOLVED IN DIGITAL CRIME MAPPING BY THE USE OF GIS-BASED TOOL IN POLAND

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Abstract
National Map of Security Threats (NMST), implemented in Poland in 2016, is a GIS-based tool for digital crime and threat mapping involving citizens in shaping local security by reporting neighborhood hazards. Among 26 categories of threats possible to report, 5 are directly related to greenery. The study aimed to identify the advantages and disadvantages of this tool related to data collection and its practical use as a source supporting security in the category of greenery. The advantages of the NMST include modern (online) and an anonymous way of reporting dangers by respondents as part of joint involvement in shaping local safety, etc. The disadvantages include limited data and restricted access, resulting in difficulty in analyzing the detailed information and no possibility of comparative analysis due to limited data storage time. Due to the predominance of limitations, this tool should be developed in the direction of tracking long-term trends by access to older data, the possibility of assessing the effectiveness of actions taken against threats, the opportunity of reporting threats also out of the current list to increase the social usefulness of the NMST related to access and usage of urban green areas.

Key words: urban green spaces, public safety, digital crime mapping, social participation, placemaking, Poland

Introduction
Advanced crime mapping methods have been used for a dozen years to analyze, prevent, and combat crime. Initially served only specialized formations dealing with fighting crimes, they became sources of public information on the level of security in particular locations. Developing these methods in the 21st century is related to interacting with citizens, who turn from data recipients to their co-creators. Modern crime mapping is used to visualize crime, analyze already collected records, and make the data available to the public. Its crucial goal is to involve city residents in reporting dangerous places and events (which do not require immediate intervention) in the neighborhood, thus shaping local security (Szyszka and Polko 2020).
National Map of Security Threats (NMST) (Krajowa Mapa Zagrożeń Bezpieczeństwa, 2022) is a tool implemented in 2016 by the Police in Poland. The map lists specific, most common threats to the safety of human life and health, property, and public order, taking into account their spatial distribution. Their occurrence is essential from the point of view of society, the Police, and other bodies and institutions and affects the feeling and enforcement of security (Stawnicka and Klonowska 2018). Reports made by citizens are visible down to the exact street and number (if this can be indicated). The map allows for statements to be made in 26 hazard examples. Reports in a given location are marked with different colors indicating their status: new, verification, confirmed, approved and transferred to other institutions, authorized and eliminated, unconfirmed.
After five years of operating the NMST in Poland, 2.122.772 reports were recorded at the end of 2021. On average, over a thousand threats are placed every day, and according to police statistics, about half of them are confirmed.
The data available for an external website user allows seeing only threats placed within the last 30 days. Threats from the publicly accessible part of the map are removed depending on status: threats considered a joke or a mistake are removed when this status is granted, threats considered unconfirmed - after seven days from granting such status, while the eliminated threats are visible for 30 days. At the same time, selected categories (the use of drugs, animal abuse) are not available for external users of the map.
Selected threats recorded through the NMST are related to popularly visited urban green areas. Identifying hazards, including the scope and access to the collected data, is crucial to eliminating undesirable behaviors from those places. It may also be helpful for both supporting the revitalization and rehabilitation of existing green areas, as well as planning and designing new ones. Therefore, in

the first stage, the study aimed to recognize the diversity of possible threats assigned to the category of greenery through the NMST. In the second stage, it was crucial to identify the advantages and disadvantages of this tool related to the scope of data collection and accessibility and its practical use as a source supporting safety in this particular category.

Material and methods

For the pilot study, the data obtained from the NMST on 27/03/2022 were used. The available 26 types of threats were assigned to 7 categories: 1) demoralization/vandalism, 2) threats related to water, 3) threats related to the greenery devastation, 4) threats related to road traffic, 5) threats related to poverty, 6) threats related to using alcohol or drugs, and 7) threats related to animals (Table 1). Detailed identification of threats allowed assigning 5 of their types in the greenery category. Then, the NMST tool was characterized in terms of available information and the scope of its processing. It included data on reports, such as: general number, new and under verification, confirmed, confirmed and transferred to other services, confirmed and eliminated, unconfirmed. The percentage amounts of total confirmed and eliminated reports compared to all reports in each category were also presented.
Data obtained from the NMST in the category of greenery include 5 types of threats: 'the burning of grass', 'wild waste dumps', 'illegal logging', 'destruction of greenery', 'driving quads in forest areas' (Table 2).

Results

According to the analysis of the collected data, greenery is the second category, after traffic, in which the most cases of threats were reported. It also has a high rate of confirmed submissions (82.09% = third place overall), which shows that applicants take the NMST and the subject matter they report seriously.
Regarding individual threats assigned to the greenery category (its devastation), it should be noted that there are only 5 of them, which is a small share about the available 26. At the same time, among those listed (Table 2), the most notifications (3638) were recorded in the case of 'wild waste dumps'. This threat is higher than others in this category. The following threats reported by map users were: 'destruction of greenery', 'burning of grass' and 'driving quads in forest areas', which obtained much fewer reports – between 158 and 283. The least numerous group is represented by 'illegal logging' with only 82 reports.

Tab. 1: List of notifications regarding possible categories of threats placed on the NMST (Source: own study, data from: Krajowa Mapa Zagrożeń Bezpieczeństwa, 2022, https://mapy.geoportal.gov.pl/iMapLite/KMZBPublic.html, accessed on 27.03.2022)

CATEGORY	**Number of reports (general)**	**New and under verification reports**	**Reports confirmed**	**Confirmed, transferred to other services**	**Reports confirmed and eliminated**	**Unconfirmed**	**Confirmed total**	**Confirmed % of all reports in the category**	**Eliminated % of confirmed reports in the category**
DEMORALISATION/ VANDALISM	2158	394	961	239	336	239	1507	69,83%	15,57%
WATER	20	2	2	6	9	1	17	85%	45%
GREENERY	**4322**	486	992	1973	583	286	3548	82,09%	13,48%
TRAFFIC	**39634**	3514	16434	7245	10283	2132	33962	85,68%	25,94%
POVERTY	379	51	208	17	70	33	295	77,83%	18,46%
ALCOHOL/DRUGS	**4178**	629	1862	26	1330	331	3218	77,02%	31,83%

Tab. 2: Main characteristics of threats in the category of greenery (Source: own study, data from Krajowa Mapa Zagrożeń Bezpieczeństwa, 2022, https://mapy.geoportal.gov.pl/iMapLite/KMZBPublic.html, accessed on 27.03.2022)

CATEGORY / HAZARD		Number of reports (general)	New and under verification reports	Reports confirmed	Confirmed, transferred to other services	Reports confirmed and eliminated	Unconfirmed	Confirmed total	Confirmed % of all reports	Eliminated % of confirmed reports
GREENERY	The burning of grass	161	61	30	4	9	57	43	26,71%	5,59%
	Wild waste dumps	**3638**	294	822	1902	482	138	3206	88,12%	13,25%
	Illegal logging	82	25	10	15	13	17	38	46,34%	15,85%
	Destruction of greenery	283	49	95	21	76	42	192	67,84%	26,85%
	Driving quads in forest areas	158	57	35	31	3	32	69	43,67%	1,89%
GREENERY TOTAL:		4322	386	992	1973	583	286	3548	82,09%	13,48%

Discussion

The positioning of the greenery category as the second among the 7 in the ranking in terms of the number of applications indicates that there are many threats in green areas, which may significantly reduce the sense of security of their users. The impact of undesirable behaviors on the sense of security in urban greenery is confirmed by many studies from European countries (Maruthaveraan and Kronijndendijk 2014; Mak and Jim 2021), including those concerning the use of Polish green areas (Lis et al. 2019; Polko and Kimic 2022).

The evaluation of the MNST tool shows that the main advantages include: modern (online) and an anonymous way of reporting dangers by respondents as part of joint involvement in shaping local safety, showing trends in increasing and reducing risks in locations' greenery. However, the map has some limitations regarding the scope and use of collected data. First, it only gives the current stage of threats and makes it impossible to track changes in time (annual and multi-year) or seasonal terms. Data should be collected regularly and submitted for comparative analysis to provide a long-term perspective. Also, there is no information about re-reports in the place of already eliminated threats - only the Police have access to this data.

Secondly, the tool's design that allows reporting threats only from a closed list prevents citizens from submitting other real hazards. Only 5 of 26 types of threats are directly related to the category of greenery and its devastation. However, they do not exhaust many other potential hazards, such as acts of vandalism resulting in the devastation of equipment and architectural objects, littering the space (Hilborn 2009; Polko and Kimic 2021), contamination with dog feces (Corti et al. 1996; Bedimo-Rung et al. 2005), maintenance and condition of greenery in general, not only in the context of its devastation (Bixler 1997; Suchocka and Kimic 2019; Kimic and Polko 2021), and many others. Although the Police declare that new types of threats can be added to the menu in MNST during the evaluation process of this tool.

Conclusions

The results of the pilot study presented in this paper show that the greenery category, as one of very important for identifying threats through the National Map of Security Threats, requires extending the list of available options (types of threats). This is key to popularizing this tool by encouraging applicants to use it more often as more compatible with the actual situation and to increase the social usefulness of the NMST related to access and usage of urban green areas. At the same time, it is crucial to expand the scope of the collected information about potential threats and their location to accelerate, in practical terms, rehabilitation and revitalization of green areas through more effective prevention and taking actions to transform them into more safe spaces. Due to the predominance of limitations, the MNST tool should also be developed to increase access to collected information to allow tracking of long-term trends by access to older data and assessing the effectiveness of actions taken against threats.

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Souhrn

Národní mapa bezpečnostních hrozeb (NMST), zavedená v Polsku v roce 2016, je nástroj založený na GIS pro digitální mapování kriminality a hrozeb, který zapojuje občany do utváření místní bezpečnosti tím, že hlásí nebezpečí v okolí. Mapa - otevřená pro externí uživatele - je zdrojem informací o běžných hrozbách pro bezpečnost lidského života a zdraví, majetku a veřejného pořádku s přihlédnutím k jejich prostorovému rozložení podle názoru uživatelů. Z 26 kategorií hrozeb, které je možné nahlásit jako místní nebezpečí, se pouze 5 přímo týká zeleně. Cílem studie bylo zjistit výhody a nevýhody tohoto nástroje související se sběrem dat a jeho praktickým využitím jako zdroje podporujícího bezpečnost v kategorii zeleně. Mezi identifikované výhody patří moderní (online) a anonymní způsob hlášení nebezpečí respondenty v rámci společného zapojení do utváření místní bezpečnosti, který ukazuje konkrétní trendy zvyšování a snižování rizik v lokalitách zeleně. Mezi nevýhody patří omezený počet dat, omezené kategorie hrozeb, omezený přístup, a tedy obtížná analýza podrobných dat, nemožnost srovnávací analýzy vzhledem k omezené době uložení dat apod.

Vzhledem k převažujícím omezením by měl být tento nástroj rozvíjen směrem ke sledování dlouhodobých trendů přístupem ke starším datům, možností vyhodnocování účinnosti přijatých opatření proti hrozbám, možností hlášení hrozeb i mimo aktuální seznam, aby se zvýšila společenská využitelnost NMST související s přístupem a využíváním ploch zeleně.

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HANDS ON THE LOCAL GREEN: COMMUNITY-BASED PROJECTS OF GREEN SPACE CO-DESIGN IN SLOVAKIA

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Abstract

In recent years, we have experienced an increase in volunteering actions in Slovakia, accompanied by investments into climate change mitigation measures. Green spaces provide the public with the opportunity to take on an active role in the climate action as one of the UN sustainable development goals. However, unprofessional interventions often have negative consequences, for instance we can observe how trees that were planted in good will by enthusiastic residents during Socialism, need to be felled these days, because they were planted too close to the building facades. Therefore, it is very important that enthusiastic activism has professional support and/or leadership. Recently, there have been several voluntary actions coordinated by landscape architects or other professionals. In this paper we will present these good practices by the example of three selected initiatives - 1) Park rodín Tvrdošovce (Park of Families, ViZia civic assoc.); 2) Zelený plán Galanta (Green Plan, civic association), and 3) Strom darom Nové Zámky (Tree as a Gift, ETC, civic assoc.). The study will provide a comparative analysis and evaluation of these three voluntary actions, with a particular focus on their commonalities and differences, in the context of citizen engagement, co-design and shared residential active recreation experience.

Key words: green infrastructure, landscape architecture, nature protection, residential recreation, volunteering

Introduction

A sustainable development of recreation considering the aspect of nature and landscape protection is strongly related to raising the environmental awareness of the public. Many people want to engage in nature or ecotourism, they wish to take part in activities that may have a benefit for their local environment. There is also a rise in communal consciousness and participation in community activities (Bell et al., 2009; Tóth et al.,2014).

The low interest in protection and development of public spaces and greenery in Slovakia has been the impuls for volunteer initiatives. The low involvement of people in public realm is often exploited by certain "politics" in an attempt to buy public space, which changes its public essence. This is an extremely sensitive phenomenon which demands transparency in its negotiation and public input in relation to its formation and reformation. The execution and manner of usage of the public area is a significant factor of development policies, whether in an urban, municipal or rural context (Falťan,2010).

Strategic, conceptual and sustainable spatial planning of settlements is important. However, big changes in the territory require major investments by the local government and it takes a decade for expected change to come. Those processes cannot respond quickly enough to the needs of urban population as climate change progresses (Pfeifer,2013). Intervention of volunteers in public space is important, since they are improving the quality of life of urban and rural residents today.

Material and methods

The subject of the study is an insight into 3 civic associations that act in transformation of public space. All of them are located in the south-western part of Slovakia. Collected information were obtained from the websites, FB pages, statutes of civic associations and by interviewing initiatives. The study offers an overview of the mission, objectives, main activities of the civic associations (CA), non government organization (NGO) and the source of funding.

Results

Park of Families Tvrdošovce / VIZia civic assoc. (CA)

The project **started in 2019** by an initiation of parents of children attending the local kindergarten. The idea was **to transform** the spacious (1ha) unused area into a park. They brought in local **landscape architect** Attila Tóth for expert guidance.Park of Families is the **main activity** of the VIZia (CA) in the rural setting of the settlement **Tvrdošovce** founded in **2020.** Today the association coordinates the

establishment and maintenance of the area. **The mission** of the (CA) is the **protection, restoration, creation and improvement** of landscape, nature, environment and green infrastructure **in the countryside**.
One of the objectives of the (CA) is to raise environmental awareness and civic engagement. **The community** of volunteers consists of members of (CA) but also those who only want to participate on work in the park. Volunteers meet regularely and the community has naturally expanded. The activities of the (CA) are accepted by the municipality and annually supported financially too.
Outcomes in 2 years are **30 planted trees** in the park with the **tree anchoring and irrigation bags.** As well as established a **perennial flower bed**. The community project participated on the **Weekend of Opened Parks and Gardens in 2021** organised by the National Trust (See Fig. 1).
The funding all together in 2020-2022 was **7 700 €**. The **85%** was granted by the **Foundation of COOP Jednota**, the local community support programme, other **15%** donated by the **Tvrdošovce Municipality**.
S**ource:** [Park Rodín]. Facebook, [OZ VIzia]. Facebook, interview with co-founder Attila Tóth

Fig. 1: Guided tour in the park by Attila Tóth – Weekend of Opened Parks and Gardens 2021, Source: https://www.facebook.com/OZ-ViZia-112084020561540/photos/323184156118191

Green plan Galanta / Green Plan (NGO)

Is the **main activity** that started in **2019** by the **Green plan NGO** founded in **2018.** From the beginning the organisation offers conceptual, strategic approach for **the protection and development** of green spaces in Galanta. The project emphasize on the use of current environmental concepts, stormwater management in both urban and landscape environment. One of the **mission** is to create and promote the latest solutions for better and sustainable public space and environment. One of the **objectives is** to support, propose and promote solutions and methods of landscape architecture and urban design and management of settlements and landscapes in the context of climate change. The co-founders and members of the association (Eva Sušková and Pavel Suško) are **professionals and engaged citizens** who want to educate the public for the benefit of society. The community grows very slowly despite the professional approach of the NGO.
Since **2019-2022** has Green plan NGO carried out **6 variouse projects** in the town of Galanta. Activities began with **21 page strategic document** of 10 ideas for the development of greenery and public spaces in the Town of Galanta. This kicked off the rest of the projects where **44 trees** were planted with **tree anchoring,** established **653 m² of meadow** (See Fig.2) and **443 m² of perennial flower beds. 6 oak benches** were constructed in total, **fence and the gate** in one of the projects. The

NGO has received **69 500 € in 4years**. The Ministry of Investment donated **57,7%** , the Municipality of Trnava **28,8%**, the Municipality of Galanta **7%** , the Ekopolis **3,6%** and the private donation was **2,9%.** Most of the **maintenance** is organised by TSMG (Technical services of Galanta).
Sources: [Zeleny plan o.z.]. Facebook, www.zelenyplan.sk, interview with the co-founder of the project Eva Sušková

Fig. 2: Project perspective of the Cherry orchard with neighborhood bench, 2021, Source: https://www.facebook.com/zelenyplan

Tree as a gift Nové Zámky / ETC…, civic assoc. (CA)
Is the **project** that started in **2017** under the **ETC…,(CA) Ecological training center** founded in **2008.** The (CA) was founded by one of the project members in the past. Non of the volunteers except the founder are members of the (CA). **The mission** of (CA) is to open a space for creative activity and self-knowledge through active mental development and physical recreation and the search for values in simple and natural things. One of **the main objective is** to increase a civic engagement in public realm and raise environmental awareness. Two experienced landscape architects - Slobodníková, Balogová and their friends were looking for an **effective tool to influence management of municipality** through public spaces in the city. The pilot project started on the 8 000 m² public space in front of the cinema Mier. The area had no concept of future development. (CA) esigned an agreement with the municipality for the use of this space for the purpose of planting and caring for trees. **The outcomes** of the project in **5years** are **63 planted trees**, **510 planted shrubs** and **132 m² of extensive perennial beds** were established (See Fig.3). During the planting a hidden historical path called Mlynská Street **was discovered** with granite paving, which we used for **constructing of 6 new, unique benches**. **The funding** from 2017-2021 was **15 440 €**. Except from donation of the residents **34,5%** , there was Participatory budget of Nové Zámky **50%**, Orange Foundation **11%** and the Municipality of Nové Zámky **4,5%**.

Discussion and conclusion

While examining all 3 organisations thiese topics occurred to be discussed and researched further. If the organisation shows a small interest of volunteers on the project, does it lead to include constructors work in the budget when applying for funding? The help of volunteers and the Municipality with the establishment of greenery and the post-planting maintenance is one of the most important things in the context of sustainability of the projects. For example watering is challenging when there is no well on site or the only source of water is the potable one.

Fig. 3: Autumn planting of perennial flower bed, 2020Photo: Dominika Danczi
Photo: Dominika Danczi
https://www.facebook.com/search/top?q=strom%20darom
Sources: [Strom darom]. Facebook, Personal volunteer experience as a co-founder – author, interviews with other co-founders of the project Tree as a Gift Lucia Balogová, Martin Slobodník

As Falťan (2010) writes, public space is a very socially sensitive phenomenon and needs to be the subject of a broader social discourse. The biggest challenge of volunteer associations changing the public space is how to attract more interest of general public and to establish a healthy, collaborative relationship with the local Municipality! Authorities, professionals and the public in Slovakia need to learn new methods, strategies for planning the public space. The case studies serve as a source of information for further research in the field of bottom-up participatory planning in Slovakia.

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Souhrn
Studie představuje 3 dobrovolnické iniciativy, které se podílejí na proměně veřejných prostor v městském a venkovském sídle v jihozápadní části Slovenska. Je to náhled na proces vzniku, představení hlavních aktivit a financování. Společným rysem dobrovolnických organizací je přinášet nové trendy zakládání a údržby zeleně ve veřejném prostoru. Všechny projekty chtějí propojit

jednotlivce a skupiny ve snaze vytvořit komunitu, která bude společně pracovat na změně tváře veřejného prostoru a ochraně životního prostředí.

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HISTORICAL EVIDENCE OF HUMAN ECONOMIC ACTIVITIES IN THE FORESTS OF THE DRAHANSKÁ VRCHOVINA HIGHLAND AND THEIR REFLECTION IN ARTS

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Abstract
Some preserved pieces of evidence of historical human economic activities are presented in three forest localities of the Drahanská vrchovina Highland (Czech Republic), which represent different environmental sites. These activities include coppicing, lime industry, metallurgy, charcoal burning and transport of materials and goods. We demonstrate the proofs of evidence by tangible and intangible cultural heritage objects, especially fine arts, belles-lettres, and legends. Primarily those that are closely related to the area of interest can be used in the interpretation of local heritage, thereby increasing attractiveness for tourists. Thus, the preserved pieces of evidence of historical human activities in the forests become not only a historical but also a cultural monument heritage that deserves adequate care and conservation.

Key words: natural conditions, cultural heritage, fine arts

Introduction
The concept of "local heritage" aims at strengthening the identity of the place, particularly by means of preserved natural, cultural and historical monuments (Carter a Ptáček 2004). Nevertheless, it is the phenomena of material nature that are usually considered the most attractive tourist destinations that visitors can view, admire and nowadays also capture on photographs or videos. The identity of the place (genius loci) is however doubtlessly also supported by objects of non-material nature such as stories, rumours, memories, local traditions, culture, cuisine etc. Interpretation of heritage conceived in this way is then understood as an "*educational activity which uncovers a deeper sense and deeper relations through the original objects, direct experience and illustrative means*" (Tilden 2007). It is therefore an *"activity uncovering to visitors something from the beauty and magic, inspiration and spiritual content lying behind everything that a visitor can perceive by his/her senses*" (Tilden 2007).
Remains of human economic activities in forests have been subject to mapping on three sites of the Drahanská vrchovina Highland (Czech Republic) since 2020. The goal of this paper is to find out if and in what forms these historical activities reflect in arts, which can be used to enhance the area attractiveness for tourists by means of the interpretation of local heritage.
Regarding the limited extent of the paper on the one hand and in fact the unlimited range of verbal, literary and artistic etc. sources, the submitted overview is only indicative and incomplete.

Material and methods
Natural conditions of the territory were assessed (mainly using the forest typological classification system developed by Forest Management Institute - ÚHÚL) (Ústav pro hospodářskou úpravu lesů Brandýs nad Labem 2020) on three sites in the Drahanská vrchovina Highland (Czech Republic) with an area of 5 km^2 with the following working names: North (mainly includes cadastral areas of Holštejn and Housko), Middle (mainly cadastral areas of Klepačov and Olomučany) and South (mainly the cadastral area of Pozořice). Archives were used to provide data on the historical methods of using forests, and remains of this use were then verified in the terrain. Information about selected economic activities was sought especially in the regional literature, databases of fine arts etc. in order to reveal whether they are reflected in arts, too.

Results and Discussion
Each of sites is situated in different natural conditions characterized by forest altitudinal vegetation zones (FAVZ). The South site lies at the interface of Beech-Oak (FAVZ 2) and Oak-Beech (FAVZ 3) zones and represents the warmest and driest parts of the territory. The Middle site is characterized by the clear dominance of Oak-Beech (FAVZ 3) and by the significant representation of limestones as well as iron ore deposits in the past. The North site represents the highest altitudes, with the dominant Beech (FAVZ 4) and emerging communities of Fir-Beech (FAVZ 5).
All three localities comprise a number of variously preserved objects and traces of historical human economic activities in forests, which include coppicing (South), lime works (South) and transport of

materials and goods showing in the development of sunken roads and sunken fields (South). In the Middle locality, it was iron ore mining and processing, and charcoal burning which was frequent also in the North locality.
Coppicing is one of the oldest forms of forest management and was predominant in lowlands in the Middle Ages (Szabó et al. 2015). It is not surprising that it is featured in a number of fine art works. Their detailed list was presented by Lacina (Lacina 2016). A beautiful illustration of active coppicing can be seen on the plate of the Prague Astronomical Clock by Josef Mánes, devoted to November (Fig. 3). His father Antonín Mánes then captured a motif of forest edge with adjacent coppice with bizarrely twisted trees in his painting *Landscape with trees and a building* (Fig. 3). Attentive viewer will definitely notice a headed tree in the background, which is another phenomenon closely related to vegetative regeneration of trees by coppice shoots. Although the motif of coppices is relatively abundant in fine arts, we failed to find one that would relate directly to our area of interest. Thus, at least the locality of “Pařezí” (Coppice), situated north of the Brno-Lesná district (approximately between the localities of Middle and South) can remind us of earlier ways of using forests.
All three sites are interwoven with a pattern of sunken roads which are densest in the South. How such a sunken road could have looked like when it was actively used can be seen in the above mentioned painting by Antonín Mánes (Fig. 3).

Fig. 3: left: Josef Mánes – November, right: Antonín Mánes – Landscape with trees and a building

The dense pattern of sunken roads is a conspicuous feature of the territory, which could not have been neglected by artists. Writer Jaroslav Marcha (Marcha 1946) recalls for example the logging of beech halves in a wider area between the Middle and the South, and their transport to Brno. Carriages with heavy loads had to have “*both wheels closed in sharp*”, i.e. firmly attached by chain to the fixed part of the carriage in winter. As the wheels were slipping on the chain, the road was continually sinking.
Basically the whole territory has been affected by the lime industry, which is nicely captured in the local story “*About the drowned lime burner*” (Klvač a Mikulka 2006). It says about farmers from around Lipovec (North) who burned lime and distributed it to a wide area. The way back they made shorter by drinking liquor. Horses knew the way home very well and need not be driven. One day, an exhausted lime burner was going back home through a deep sunken road from Drnovice (near South). His thirsty and tired horses got close to the dreaded swamp called “Žumpy” (Sumps) where they wanted to have a drink. But the carriage weight pressed them into water so quickly that they disappeared in it together with the carriage and the unlucky lime burner. Poet Miroslav Daněk from Drnovice (Daněk 2008) captured the story in verse: “*Coming to wetland along the field path / you see Holy Cross knowing not why / it is no mystery, no nightmare / a lime burner and horses drowned there*.” It is remarkable that nearly an identical story is mentioned also by Jaroslav Marcha (Marcha 1946), only the place of the event is different: “*And a lime burner drove towards Znojmo. He slept in the basket, ate a half of the goose, drank a bottle of wine, horses became thirsty too, and rushed down to the river through a sunken way! The lime burner was sleeping like a log, twenty quintals of lime on the carriage. … The road to the Dyje river is like a roof, and thus they all invaded there like a plum, the waves just licked and closed above them.”*
Rich and long time exploited iron ore deposits at the Middle site and in its close surroundings were tourist attractions minimally from the beginning of the 19th century (Golec 2014). It is therefore not surprising that many of local iron works were captured by artists of whom let us mention at least František Richter (Fig. 4), or Jakob Alt (Fig. 5). Both of them captured in their painting smelters that do not exist today and used to occur in the Punkva R. valley directly at the Middle site.

Fig. 4: František Richter (1821) – Blast furnaces near Blansko. (Mariánská huť Smelter). Collections of Moravian Gallery in Brno.

Fig. 5: Jakob Alt – Starohraběcí huť Smelter (Die Altgrafenhütte). Coloured lithograph from album "Blansko und dessen Umgebung"

In the forests of Middle and North sites, a great number of platforms after charcoal heaps have been preserved until these days, on which charcoal was burned in the past. The significance of this phenomenon in the area can be documented by the name of one street in Klepačov "On Charcoal Heap" or by the name of a forest road "At Charcoal Heap" - both in the Middle locality. Charcoal platforms in the wider surrounding of the studied area were described also by Jaroslav Marcha in his novel "Bird bread" (Marcha 1946): "*And on the charcoal heap, the beater points up to the hillside, they found herdsman Týn. Pšajuch killed him. Pity the good boy!"*, or: "*One day*, *Vencl Stolář shot a roe-doe and buried it in the leaves on a charcoal heap."*
As charcoal burning was generally widely spread in our countries, the activity understandingly very often mirrored in various arts. In relation to the studied area, one has to mention namely the folk literature. Charcoal burners play a decisive role in many versions of the story about an evil stepmother who threw her stepson into the today's Macocha abbys (between Middle and South) because they found the boy hanging on a tree above the abbys, and rescued him (Bufková-Wanklová et al. 2021). Charcoal burning near Molenburk (North) was described in detail also by Antonín Jirušek (Jirušek 2018). Concluding his treatise, he even adds a part of the song sung by charcoal burners: "*We are black charcoal burners and have to get up early every day. Whether it's cold or raining, we have to stand up outside, no other way".*

Conclusion

Historical forms of forest management very often reflect in arts. Even in relatively small localities sized 5 km^2, representing three different sites of the Drahanská vrchovina Highland, we can find both material and non-material objects of cultural heritage directly bound to the studied area. These objects are a key component of the tertiary landscape structure, which complete the genius loci in a unique way. Approaches highlighting the local cultural heritage are very useful in enhancing the area attractiveness for tourists. Thus, the preserved objects of human economic activities in the forests become not only historical but also cultural monuments which deserve adequate care and conservation.

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Souhrn

Na příkladu tří lokalit reprezentujících odlišné polohy Drahanské vrchoviny (Česká republika) jsou ve vazbě na přírodní podmínky území prezentovány některé dochované pozůstatky historických hospodářských aktivit člověka v lesích, a to především pařezení, vápenictví, železářství, pálení dřevěného uhlí a dopravy materiálu a zboží. Doložen je jejich odraz v hmotných i nehmotných objektech kulturního dědictví, zejména výtvarného umění, krásné literatury, či pověstí. Zejména ty, které jsou vztaženy přímo k zájmovému území, mohou být využity při interpretaci místního dědictví a zvyšovat tak jeho turistickou atraktivitu. Dochované objekty hospodářské činnosti v lesích se tak stávají nejen historickou, ale také kulturní památkou zasluhující adekvátní péči a ochranu.

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HOW CAN BIOCHAR PROTECT AGRICULTURAL LAND FOR AGROUTOURISM FROM DROUGHT CAUSED BY CLIMATE CHANGE?

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Abstract
Due to climate change pursue, the necessity of building resilient farms becomes even more apparent. Farmers are more often dealing with intensive rainfall, floods and droughts. Many innovative soil water conservation methods have emerged and are being practiced all over the globe — some have been practiced for centuries and others are much newer. Most of these methods provide additional benefits as well, including soil conservation and improvement, enhanced biodiversity, and increased yields. Biochar is one of the materials to improve soil retention properties, water retention in land and landscape protection. The results of our research confirmed increased available soil water content in silt loam soil after biochar application.

Key words: biochar, climate change, soil water retention, tourism

Introduction
Soil moisture limitations in agroecosystems will be aggravated by climate change-driven increases in drought frequency. Increased climate variability will further destabilize dryland crop production and drive an overall spatial expansion of dryland agriculture (IPCC, 2014; Huang et al., 2016). Soil drought is an increasingly pressing issue deleteriously impacting soil organic matter contents (SOM) and soil fertility, with consequent implications to crop productivity and therefore food security (Lei et al., 2020). Maintaining and enhancing SOM can build physical, biological and chemical resilience to drought in soils (Magdoff and Weil, 2004). Water-limited agricultural systems are not only vulnerable to reduced crop yields but are often characterized by low concentrations of SOM and soil organic carbon (SOC) (Robertson et al., 2017). Since SOC is a proximate control on soil moisture, soil water retention may thus be further reduced, exacerbating an already water-limited system (Franzluebbers, 2002). Soil water retention can often be enhanced through the maintenance of crop residues and the addition of amendments including manure, compost, biochar, or engineered gels (Głąb et al., 2018). The positive effects of amendments on soil moisture are driven partly by subsequent increases in SOC, altering soil structure (e.g., promoting aggregation, modifying pore size), and because of SOC's own water adsorbing capacity (Franzluebbers, 2002). At higher moisture levels, water movement is capillary, driven by pore size and distribution (Or and Tuller, 1999). Soil water is attracted in the soil by forces that are smaller than those that the roots attract. Values of soil water content, which characterize the state and availability of soil water to plants are called “hydrolimits” (Novák and Hlaváčiková, 2019). Hydrolimits are possible to estimate from a soil water retention curve (SWRC). The SWRC describes the functional relationship between the soil–water content, and soil matric potential in unsaturated soils that is characteristic for different types of soil. The SWRC is affected by soil physical and chemical characteristics; e.g., soil texture, structure, amount and degree of aggregates, amount of colloids, type of clay mineral, and amount of soluble salts (Taylor and Ashcroft 1972). Available soil water content (ASWC) for plants is possible to estimate from the SWRC as difference between hydrolimits field capacity and wilting point (Novák and Hlaváčiková, 2019).
We focused on comparison between ASWC at variants with different amount of biochar and variant without biochar, in this laboratory study.

Materials and methods
In laboratory conditions were prepared soil-biochar mixtures and pure soil samples, which were used to measure SWRC on pressure plate apparatus.

Soil-biochar mixtures

In this research was used Haplic Luvisol soil with particles diameter ≤ 2 mm. The content of sand was 15.2 %, silt 59.9 % and clay 24.9 %, it was classified as silt loam soil (Simansky and Klimaj, 2017). The used biochar was obtained from wooden parts of grapevine (*Vitis*) in reactor by pyrolysis at 520 °C. The size of biochar pieces was 0 – 10 mm. Elemental composition of the biochar characteristics is listed in Table 1.

Tab. 1: Basic chemical characteristics of biochar (C – carbon, H – hydrogen, N – nitrogen)

C	H	N
%	%	%
81.4	2.4	1.09

The biochar was mixed with the soil at a ratio of 20, 40 and 80 t/ha (in dry weight basis). Measurements were provided on samples with volume of 100 cm^3 (Kopecky cylinders). Four different variants were established: a soil without biochar (soil), soil amended with biochar of 20 t/ha (G20), soil amended with biochar of 40 t/ha (G40) and soil amended with biochar of 80 t/ha (G80). Each variant had 3 replicates.

Soil water retention curves estimation

All mixed samples were saturated with water and moved to the pressure plate apparatus. The 5 Bar Ceramic Plate Extractor 1600 (Soil moisture, USA) at pressure heads from −20 to −4800 hPa was applied using the standard method (Soilmoisture, 2008) for 9 months. ASWC for plants is divided into easily available water content (EAWC) for plants, which is defined as a difference between field capacity and point of limited availability hydrolimits, and limited available water content (LAWC), which is difference between point of limited availability and wilting point hydrolimits. These hydrolimits are different for different types of soils. Šútor and Rehák (1999) determined the field capacity (FC) hydrolimit at pF 2.5 and the point of limited availability (LA) at pF 3.3 for this type of soil. The hydrolimit wilting point (WP) is standardly determined at pF 4.18.

Statistical analysis

Differences between the group means of retention parameters estimated for different variants were evaluated using single factor ANOVA with Tukey's Honest Significant Difference (HSD) post-hoc test. The Tukey-Kramer method (also known as Tukey's HSD method) uses the Studentized Range distribution to compute the adjustment to the critical value. The Tukey-Kramer method achieves the exact alpha level (and simultaneous confidence level ($1 - \alpha$)) if the group sample sizes are equal and is conservative if the sample sizes are unequal. The statistical significance in the analysis was defined at $P < 0.05$.

Results

Fig. 1 shows that the highest differences between soil water content in pure soil and in variants with biochar are at saturation and at near pressure heads (pF 0.1 – 2). The soil water retained in very large soil pores is not available for plants but is still present in soil (land). With increasing of biochar amount increases also the value of soil water in these pores. We found the statistically significant increase in the amount of ASWC (difference between FC and WP) in biochar variants compared to pure soil (Fig. 2). Increase in ASWC in biochar variants was 14% (G20), 15% (G40) and 20% (G80), respectively. We found also significant increase in EAWC value in biochar variants compared to soil. Increase in EAWC was 1.1% (G20), 2% (G40) and 1.4% (G80), respectively.

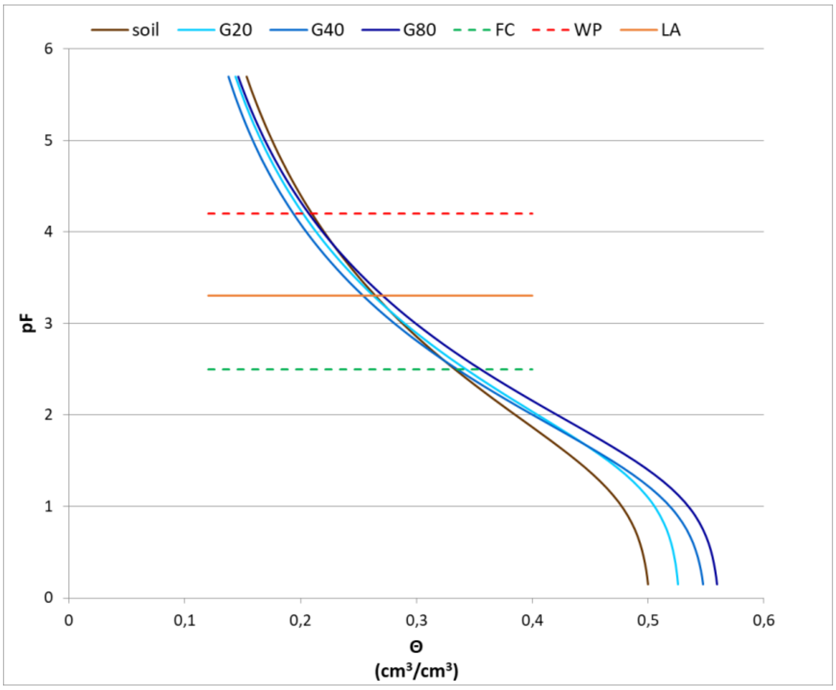

Fig. 1: SWRC of pure soil (soil), soil-biochar mixture of 20t/ha (G20), soil-biochar mixture of 40t/ha (G40) and soil-biochar mixture of 80t/ha (G80) in comparison to hydrolimits FC, LA and WP

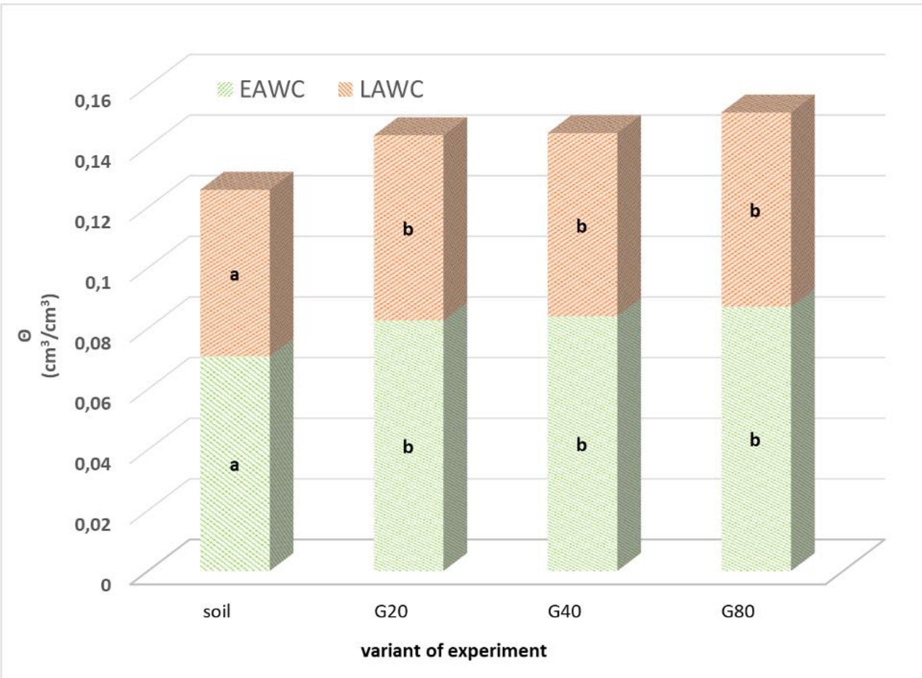

Fig. 2: Statistical analysis of differences between the easily available water content (EAWC) and water content with limited availability (LAWC) in pure soil (soil), soil-biochar mix of 20 t/ha (G20), soil-biochar mix of 40 t/ha (G40) and soil-biochar mix of 80 t/ha (G80). Arithmetic means with the same letter are not significantly different from each other (Tukey's HSD test, $P < 0.05$)

Conclusion and discussion

Many people use agro tourism as one of the forms of recreation, especially with their children. For people providing such types of services is necessary to reduce impact of climate change on crop quality and quantity and protect their agricultural land. The soil's ability to retain water is determined by many factors and soil structure is one of them. Water enters to the soil in the form of precipitation or irrigation and drought, that causes stress to crops, is very often phenomena in last years. Soil structure could be improved by the addition of biochar. Measures (for increasing the water retention capacity of soil) of longer retention of water in land are very needed due to frequent periodicity of non-precipitation periods, especially in summer season. In our study was confirmed that the application of biochar to the soil can increase the retention of water in the land. A part of retained water is not available for plants, but it is still present in the soil. It has been shown that this type of biochar can retain more water in the agricultural land - the amount of ASWC for plant was higher compared to pure soil without biochar. Our results also showed that the application of this biochar is sufficient in the amount of 20 t/ha or 40 t/ha, respectively because the G80 variant did not show a statistically higher positive effect on soil water retention. By applying biochar to the soil, it is possible to improve its structure and water-air regime, which results to longer soil water retention in soil (land) and its availability to the roots of cultivated plants. Biochar has properties which can retain more water in soil during drought times, improve soil structure and thus ensure the satisfaction of agro businessmen and vacationers.

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Souhrn

Mnoho lidí využívá agroturistiku jako jednu z forem rekreace, zejména se svými dětmi. Pro lidi poskytující tyto typy služby je nutné snížit dopady změny klimatu na kvalitu a kvantitu plodin a chránit zemědělskou půdu. Schopnost půdy zadržovat vodu je dána mnoha faktory a struktura půdy je jedním z nich. Voda se do půdy dostává ve formě srážek nebo zavlažování a sucho, které způsobuje stres plodinám, je velmi častým jevem posledních let. Struktura půdy se může zlepšit přidáním biouhlí. Opatření na delší zadržování vody v krajině jsou velmi potřebná z důvodu časté periodicity bez srážkových období, zejména v letní sezóně. V naší studii se potvrdilo, že aplikace biouhlí do půdy dokáže zadržovat vodu v krajině. Část vody není k dispozici pro rostliny, ale stále je zadržována v půdě. Ukázalo se, že tento typ biouhlí dokáže zadržet více vody v zemědělské krajině – množství dostupné půdní vody pro rostliny bylo vyšší v porovnání s čistou půdou bez biouhlí. Naše výsledky také ukázaly, že aplikace tohoto biouhlí je dostatečná v množství 20 t/ha, respektive 40 t/ha, protože varianta G80 neprokázala vyšší pozitivní vliv na strukturu půdy. Aplikací biouhlí do půdy lze zlepšit její

strukturu a vodně-vzduchový režim, což má za následek delší zadržování půdní vody v krajině a její dostupnost pro kořeny pěstovaných rostlin. Biouhlí má vlastnosti, které dokážou zadržet více vody v půdě v období sucha, zlepšit strukturu půdy a zajistit tak spokojenost agropodnikatelů i rekreantů.

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HYPOTHETICAL WILLINGNESS TO PAY FOR ENERGY ALTERNATIVES IN UGANDA: MARKET INCENTIVES AND POLICY TOOLS TOWARDS ZERO DEFORESTATION AND CLIMATE CHANGE

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Abstract

At the height of climate change, the world target of zero deforestation by 2030 seems like a dream in Africa's developing nations, where over 90% of household energy needs depend on wood fuels and charcoal. This is followed by time series increasing demand for round wood. This study conducts a Willingness to Pay for Energy Alternatives (WTPEA) in Uganda, where the populations depend on wood for almost all the energy needs at the household level. This research used a questionnaire to collect and analyze data collected between 2018 and 2019. A total of 1200 responses were collected, coded, and analyzed. The average willingness to pay an amount (WTPA) was 15 USD and the median 10 USD. Most of the respondents were observed to prefer gas and electricity for household cooking. Following a logistic regression, it was found that the socioeconomic characteristic did not impact the Willingness to Pay for Energy Alternatives (WTPEA). However, sex and age were found to have a very weak impact on the WTPEA. The respondents' Willingness to Pay for Forest Conservation (WTPFC) [0.0011] and Knowledge of Forest Functions and services (KFF) [0.0001] were found to have a positive and significant impact on the WTPEA. Ceteris paribus, the Government of Uganda, ought to employ policy tools to boost energy alternatives imports and production in Uganda. This would promote and improve the conservation of virgin Tropical rain forests.

Key words : Contingent Valuation Method, forest functions and services, energy mix, electricity, Zero Deforestation

Introduction

As the world sets to achieve zero deforestation by 2030, drivers of deforestation are yet to be attended to, especially in the deforestation hotspots. Deforestation in the Tropical African region has reduced forest cover and affected the provision and protection of forest functions and services, such as ecosystems and biodiversity loss (Bamwesigye et al. 2020a, CIFOR-ICRAF 2022). Wood fuels and Roundwood production and export form one of the biggest challenges (CIFOR-ICRAF 2022, Bamwesigye et al. 2020b). Biomass is the most significant energy source for the biggest percentage of Uganda's population (Bamwesigye et al. 2020b, Bamwesigye et al. 2017). Biomass accounts for about 90% of Uganda's total primary household energy consumption, i.e., charcoal, firewood, and crop residues (ERA 2012, ERA 2020). Electricity adds about 1.4% to the nationwide energy balance, whereas oil products for thermal power plants and vehicles cover approximately 9.7% (USEA 2019). The Ugandan Government has amplified electricity generation by installing 822MW, with around 692MW accounting for 84% hydropower (ERA 2020).

Charcoal offers the cooking requirements of the town population while firewood for the rural population (Du Can et al., 2018, Bamwesigye et al., 2020b). The high demand for uneconomically wood fuels is sought to result in the misuse and exhaustion of forests (Bamwesigye et al. 2020b, Bamwesigye et al. 2019, Bamwesigye et al. 2018, Bamwesigye et al. 2017)

Even though there are numerous drivers of deforestation, woodfuel and demand play a big role given the trend. Moreover, illegal logging increases amid the forest conservation laws coupled with weak implementation authorities (EnDev 2018, Bamwesigye et al., 2020b). Charcoal production is a mainly poor method with tremendously low efficiency (Cumbers 2016). The government of Uganda's efforts to employ market incentives to boost trade and demand for clean energy alternatives is also another problem (URA 2014,UIA, 2019). Even though Uganda seems to have the best conservation and sustainable energy policies, putting some of them to work is a different issue. There seems to be a lack of coordination on the uniformity and/or conflict between departments such as the energy ministry and the Uganda revenue authority that collects taxes (URA 2014).

Therefore, government policies such as reducing taxes on renewable energies equipment and the rural electrification schemes are bound to increase electricity accessibility and other energy products, thus the demand (Deichmann et al. 2011, du Can et al. 2018, Bamwesigye et al., 2020b). Therefore such direction would lead to less demand for wood fuels hence conservation of forests.

This study aimed to investigate the energy situation in Uganda and the willingness to pay for energy alternatives to reduce deforestation. The study used a contingent valuation questionnaire to analyze charcoal use, preference for energy alternatives, and hypothetical WTPEA. Logistic and ordinary least regression were used to understand the influences on WTPEA and the willingness to pay an amount (WTPA). The contingent valuation approach results have been presented. The regression results and policy recommendations are discussed and demonstrated for policy planning and decision-making on forest conservation to boost forest functions and services.

Material and methods

The study was carried out in the capital of Uganda, Kampala Capital City, and its neighboring town of Wakiso. With the expansion of the capital city, the neighboring towns to Kampala grew very fast, and most of them are now districts of their own. Both the capital city and her neighboring towns have had an influx in population increase over the years.

The study employed face-to-face questionnaire interviews. The study was conducted between December 2018 and May 2019. A total of 1200 questionnaires were filled, checked for completeness, coded, and analyzed using statistical software.

The questions ranged from Willingness to pay for energy alternatives (WTPEA), willingness to pay for forest conservation (WTPFC), knowledge of forest functions and services (KFF), preference for energy alternatives (PEA), and the Willingness to pay an amount (WTPA).

The Contingent Valuation Method (CVM) has some drawbacks, such as bias. The study employed cheap talk to mitigate the bias associated with the method. The interview talked to the respondents before answering the questions and expounded on the importance of their responses. More so, a question on the maximum WTPEA amount.

The study conducted a logistic regression following a CVM approach to model the WTPEA regarding demographic characteristics and the KFF, WTPA, and WTPFC. Logistic regression helps to understand the influence of explanatory variables on the WTPEA. Logistic regression is the most appropriate to study the relationship between categorical predictor and binary categorical variables in a study.

The study assumed that the WTPEA is either 1or 0, thus the probability of WTPEA effort in the selected residential areas of Wakiso and Kampala. π_i = probability (WTP) =1, is related to the explanatory variable Z.

The logistic regression is presented herein (1).

$$Log\left(\frac{\pi i}{1-\pi i}\right) = C + yZ_i$$

Z is the vector of the explanatory variable that may impact the WTP, C is the intercept. y is the vector of coefficient and $\left(\frac{\pi i}{1-\pi i}\right)$ is the odd ratio for the WTP i.e., probability of willingness to pay and the probability of the unwillingness to pay. The study assumes the log of odds is a linear function of the explanatory variables, Z.

WTP Estimation using Contingent Valuation Method

Contingent Valuation Method (CVM) is the most used approach to estimate the value and or price of non-market resources and products. The study further employed an Ordinary Least Square (OLS) regression to estimate the WTPA amount and determine the factors that influence the value of the residents' WTPEA in the selected districts in Uganda (Table 1). The subsequent equation demonstrates the OLS model.

$$WTPAi = \beta 0 + \beta 1Si + \beta 2Ai + \beta 3MSi + \beta 4EAi + \beta 5Ei + \beta 6Ii + \beta 7PEAi + \beta 8KFFi + \beta 9WTPFCi + \beta 10CUi + \varepsilon i$$

Tab. 1: Description of the variables

Code	Definition of variables	Description of variables
S	Sex/gender	Male =1, and female =0
A	Age	Continuous
MS	Marital status	Married =1, and others =0
EA	Economic activity	Employed =1, and others =0
E	Education	Number of years spent in school. Continuous variable
I	Income	Continuous

PEA	Preference for energy alternatives	Gas =1, Hydroelectricity =2, Biogas =3, Others………… =4
WTPEA	Willingness to pay for energy alternatives	Yes =1, and No =0
KFF	Knowledge of Forest Functions	Very Good =1, Good =2, Neutral =3, Bad =4, Very bad =5, and Don't know =6
WTPA	Willingness to pay amount	Continuous
WTPFC	Willingness to pay for forest conservation	Yes =1, and No =0
CU	Charcoal use (wood fuel use)	Yes =1, and No =0

Results and Discussion

Data were collected from household residents using a survey face to face interviews which took place from December 2018 to May 22019. A sample of 1200 was interviewed; 772 (64%) were males while 428 (36%) were females. The majority of respondents were between the ages of 24 and 36 years, 54% (650), and 261 (22) were between 36 and 48 years. More so, 61% were employed, 54% were married, and 58% had at least 16 years of education. 67% had over 16 years of education equivalent to bachelor's education, assuming no repeated classes (Figure 1). The trend in all variables can be observed in (Figure 1).

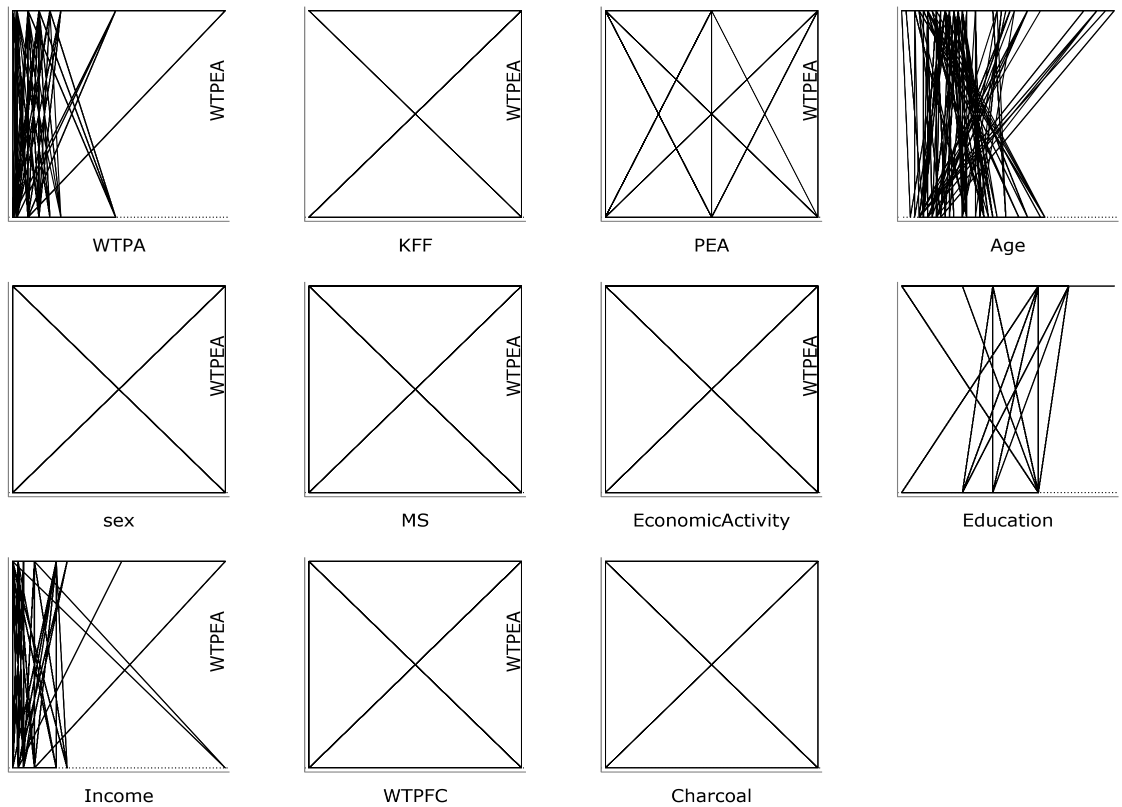

Fig. 6: Illustration of other factors against the WTPEA

Preference for energy alternatives (PEA) and willingness to pay (WTPEA)

The survey respondents' results demonstrated that 59% (702) prefer gas for their household cooking, 34% (408) preferred hydroelectricity and 8% (90) chose biogas (Figure 2). The hypothetical WTPEA results illustrated that 960 (80%) were willing to pay for the energy alternatives monthly, 236 (20%) were not willing to pay.

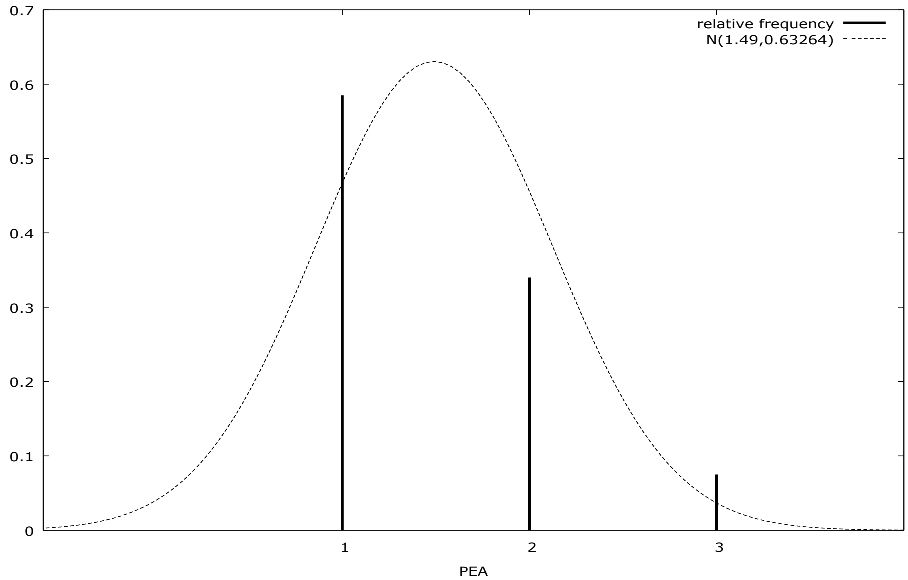

Fig. 7: Preference for energy alternatives; i is gas, 2 is electricity, and 3 is biogas

There is a potential for bias regarding WTP. The study mitigated this problem through a cheap talk where the interviewer conversed with the respondents before asking the WTP question. The talk included why using alternative energy sources is important in efforts to conserve forests and fight deforestation.

The majority of the respondents expressed their disappointment with the government in the management of forests and no effort to subsidize energy alternatives to incentivize them market forces. The majority were willing to pay and use the energy alternatives. The majority (581 or 48%) respondents were willing to pay up to 20 USD, while 26% (300) respondents and about 7% were willing to pay more than 50 USD for energy alternatives monthly. The summary statistics showed that an average of more than 80% were willing to pay the mean amount of 15 USD and the median payment 10 USD. This corresponded with an average response of more than 87% with good knowledge of forest functions and services. The average age illustrated 33 years, and the median is 31, which shows that most respondents are young. Moreover, 94 % of the respondents used charcoal/wood fuel. This justifies why most of them were willing to pay for alternative energy sources to save the forests (Figure 3).

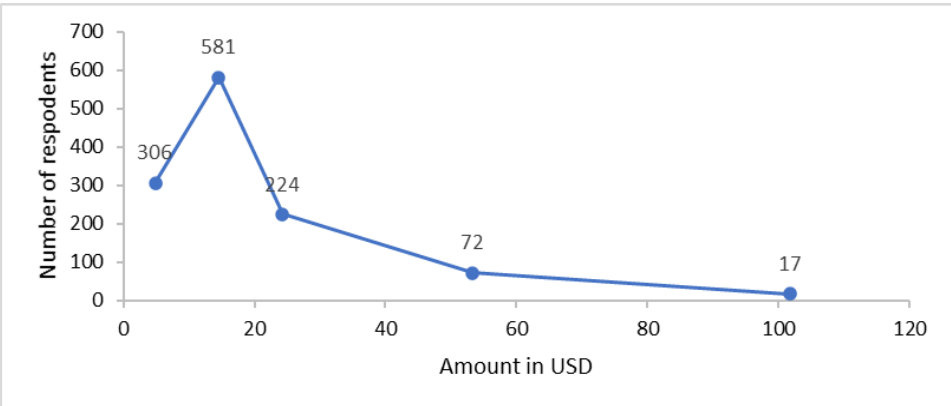

Fig. 8: Willingness to Pay Amount (WTPA)

The logit regression results showed that socioeconomic factors do not influence the hypothetical WTPEA. However, gender was found to negatively influence the willingness to pay for energy alternatives at 10% in model 1 and 2. This influence is very weak, as indicated by the result. WTPEA was observed to be significantly influenced by the knowledge of forest functions and services (KFF) [$p<00.0001$] and the willingness to pay for forest conservation (WTPFC) [model 1 and 3= $p<0.0006$, and model 2= $p<0.0011$] at 1%. This demonstrated very strong evidence against the null hypothesis. Preference for energy alternatives and charcoal use was found not significantly influence the WTP.

More so, the willingness to pay amount was found to have a very weak positive but significant influence on the WTPEA [model 1 and 2] (Table 2).

Tab. 2: Determinants of the hypothetical willingness to pay for energy alternatives (WTPEA)

Variables	Model 1		Model 2		Model 3	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Constant	0.408645	0.5268	0.361451	0.3841	−0.01840	0.9321
WTPA	0.0138663	0.0835*	0.0143127	0.0700*	0.0119226	0.1274
KFF	1.27678	<0.0001***	1.20880	<0.0001***	1.15842	<0.0001***
PEA	0.122627	0.3139	0.125713	0.3009		
A	0.0061200	0.5159				
S	−0.278353	0.0881*	−0.270276	0.0916*	−0.232822	0.1428
MS	0.004546	0.9781				
EA	−0.157035	0.3749	−0.228006	0.1591		
E	−0.02649	0.4515				
I	5.56182e-05	0.1372	5.55152e-05	0.1093	4.89414e-05	0.1525
WTPFC	0.543033	0.0006***	0.505553	0.0011***	0.524976	0.0006***
CU	−0.431000	0.1549	−0.451874	0.1350		
***p<0.01, **p<0.05, *p<0.1						

The influencing factors of the WTPA presented very interesting results. Economic activity was found to have the highest Coefficient 4.2, followed by charcoal use with 4.0, willingness to pay for forest conservation 3.9, gender 2.3, the knowledge of forest functions and services 1.8, and willingness to pay for energy alternative 1.4. However, the knowledge of forest functions and services was not significant throughout. This indicates the strength of the impact of the factors behind the WTPA. On the other hand, other socioeconomic factors such as age, marital status, education, and incomes have weak but positive and significant influences on the WPTA. Age, economic activity, gender, incomes, WTPFC, and charcoal were found to have very significant at 1% and positive, respectively. The preference (PEA) and willingness to pay for energy alternatives were significant at 10%, respectively, and education at 5%.

Conclusion

The study conducted a hypothetical and real willingness to pay study using the CVM approach. Questionnaire survey results showed an average willingness to pay of 80% of the respondents. The average willingness to pay an amount (WTPA) was 15 USD, and the median WTPA 10 USD. Most of the respondents were observed to prefer gas and electricity for household cooking. The study recommends that ceteris paribus, the government of Uganda, and development partners consider policy tools and market incentives such as subsidies for cleaner energy production and consumption tax reliefs local producers, traders, and importers. The availability of energy alternatives and mix will guarantee energy security and food security since some poor families cook once due to energy poverty characterized by high prices for charcoal and firewood. Moreover, this will also translate into relief to the current pressure on forests to meet increasing energy demand in the country. This would promote and improve the conservation of virgin Tropical rain forests, which are at the blink of extinction given the already dare climatic conditions in the East African nation and the region (Cumbers 2016, Bamwesigye et al. 2020a).

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Souhrn
V době vrcholících klimatických změn se celosvětový cíl nulového odlesňování do roku 2030 zdá být v afrických rozvojových zemích, kde více než 90 % energetických potřeb domácností závisí na dřevěných palivech a dřevěném uhlí, jen snem. Na to navazuje časová řada zvyšující se poptávky po kulatině. Tato studie provádí průzkum ochoty platit za energetické alternativy (Willingness to Pay for Energy Alternatives, WTPEA) v Ugandě, kde je obyvatelstvo závislé na dřevě pro téměř všechny energetické potřeby v domácnosti Tento výzkum použil dotazník ke sběru a analýze dat shromážděných v letech 2018 až 2019. Celkem bylo shromážděno, kódováno a analyzováno 1 200 odpovědí. Průměrná ochota platit částku (WTPA) byla 15 USD a medián 10 USD. Bylo zjištěno, že většina respondentů preferuje pro vaření v domácnosti plyn a elektřinu. Po provedení logistické regrese bylo zjištěno, že socioekonomická charakteristika nemá vliv na ochotu platit za energetické alternativy (WTPEA). Bylo však zjištěno, že pohlaví a věk mají na WTPEA velmi slabý vliv. Bylo zjištěno, že ochota respondentů platit za ochranu lesa (WTPFC) [0,0011] a znalost funkcí a služeb lesa (KFF) [0,0001] mají pozitivní a významný vliv na WTPEA. Ceteris paribus, ugandská vláda by měla použít politické nástroje ke zvýšení dovozu a výroby alternativních zdrojů energie v Ugandě. To by podpořilo a zlepšilo ochranu panenských tropických deštných lesů.

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IDENTIFICATION AND DRONE AERIAL PHOTOGRAPHY OF SELECTED HISTORIC IRRIGATION STRUCTURES IN THE CZECH REPUBLIC

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Abstract

Since the 19th century, the irrigation industry in Bohemia and Moravia has undergone considerable technological development and an increase in irrigated areas. Irrigation has become an important part of the Czech cultural landscape. In the 1990s, however, there was a considerable decline. Complex irrigation systems and buildings have ceased to be used in many cases. They were often destroyed, devastated, left without maintenance. In connection with climate change, drought and uneven distribution of precipitation during the growing season, the issue of irrigation is currently gaining prominence again. In this study, selected historic irrigation structures were documented using a drone - Unmanned Aerial Vehicle (UAV). The aim was to analyze the current state of these buildings in the irrigation industry and to show the true story of these buildings and constructions. These often forgotten buildings and infrastructures with cultural and historical value can be one of the interesting tourist destinations.

Key words: UAV; irrigation; aerial photography; tourist destination

Introduction

Irrigation systems are an important, but until recently neglected, part of the industrial cultural heritage. In general, their importance has been growing, especially in the last decade, in connection with climate change and the increased need to use irrigation. Thus, historical irrigation systems, which originated in the Czech Republic mainly in the second half of the 19th and the beginning of the 20th century and then from the 1960s onwards (Dvořák et al, 2004), gradually came to the forefront of interest. This is in terms of assessing the potential for their renewal, reconstruction, or, conversely, the removal and replacement of a modem functional system. From this point of view and the point of view of the connection to the cultural heritage of the Czech Republic, it is important to identity in time the possible monumental values of these buildings and to define the criteria and possibilities of their monument protection. In this context, it is also important to strengthen the awareness of this type of industrial heritage, both within the professional and lay public (Hudcová, et. al. 2021). The historical context of the administration of hydromelioration structures is part of the publication (Kulhavý, Z., Pelíšek, I. et al., 2017).

Methods and Results

The identification of historic irrigation structures takes place in several steps. This is the identification of specific buildings based on the original project documentation. If this documentation exists, it is stored in archives. Its condition often corresponds to its age and manner of storage over time.

Fig. 1: Sample of historical project documentation of irrigation constructions

Project documentation is then processed in GIS software and stored in a web database. Based on them, specific buildings with cultural and historical value are identified in the field.

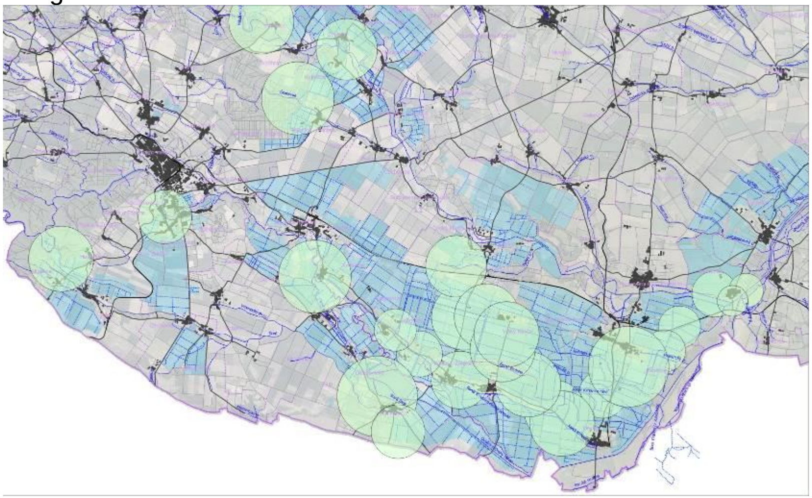

Fig. 2: Example of coverage of the area of interest of irrigation systems of South Moravia drone images (blue color indicates irrigation areas, green circles indicate orientation coverage of drone images)

Sites and irrigation buildings interesting in terms of historical significance and cultural heritage are selected for closer examination. A drone operated at the VUMOP, v.v.i, specifically the DJI Mavic 2 Pro type with a 4k camera and a maximum photo resolution of 5472x3078 pixels.

Fig. 3: Dron DJI Mavic 2 Pro used for photo documentation *of sites of irrigation construction*

The documentation takes place for irrigation buildings and systems that are still functional and used in operation, as well as buildings and systems that are not functional and often destroyed and abandoned. These are often unused storage water reservoirs, unused water filling stations. At the same time, they are part of our landscape and an important historical example of the irrigation industry in agriculture.

Fig. 4: Functional irrigation equipment on the Krhovice-Hevlín irrigation canal

Fig. 5: Historic aqueduct on the Krhovice-Hevlín irrigation canal

Fig. 6: Water reservoir and water filling station Závlahy Dyjákovice, spol. s r.o.

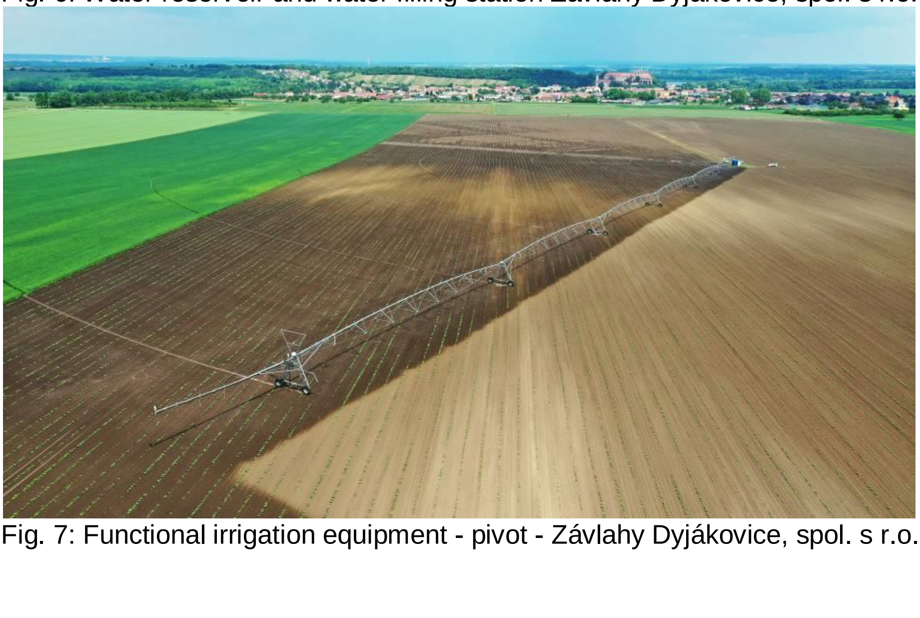

Fig. 7: Functional irrigation equipment - pivot - Závlahy Dyjákovice, spol. s r.o.

Fig. 8: Non-functional and abandoned irrigation water filling station (Brandýs nad Labem)

Fig. 9: Non-functional and destroyed irrigation water reservoir and water filling station (Rakovník)

Fig. 10: Non-functional irrigation water reservoir (Brandýs nad Labem)

From a detailed survey of a large part of the Czech Republic, it is evident that to this day, some objects or canals are partially preserved. However, a large number of objects are irretrievably damaged and destroyed. The project includes their documentation, condition assessment, and digitization of archival materials.

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Acknowledgement

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Souhrn

Od 19. století prošlo odvětví závlah v Čechách a na Moravě značným technologickým rozvojem a nárůstem zavlažovaných ploch. Závlahy se staly důležitou součástí české kulturní krajiny. V 90. letech však došlo ke značnému útlumu tohoto hospodářského odvětví. Složité závlahové systémy a budovy se v mnoha případech přestaly používat. Často byly zničeny, zdevastovány, ponechány bez údržby. V souvislosti s klimatickými změnami, suchem a nerovnoměrným rozložením srážek během vegetačního období se v současnosti opět dostává do popředí otázka závlah zemědělsky využívaných ploch. V této studii byly vybrané historické zavlažovací stavby zdokumentovány pomocí dronu. Cílem bylo analyzovat současný stav těchto staveb. Tyto často zapomenuté budovy a infrastruktury s kulturní a historickou hodnotou mohou být jedním ze zajímavých turistických cílů.

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IMPACT OF CLIMATE CHANGE ON RECREATIONAL URBAN FORESTS

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Abstract
The paper presents the results of a case study that was developed as a basis for decision-making processes in the context of the impacts of global climate change. It deals with a very important part of the urban environment, namely urban forests, which on the one hand are one of the main objects to mitigate the impacts of climate change (in the landscape and urban space), but are themselves at risk from the impacts of climate change in the first place. When planning measures in suburban forests, these two facts must always be addressed in parallel, so it is necessary to consider both measures to mitigate the effects of climate change on the forest complex and its use to mitigate the effects of climate change in its vicinity. The case study is addressed on the territory of the town of Mladá Boleslav. In addition, the forest park in question is the most important natural object in the municipality's intravilan in terms of its size and functions.

Key words: SCS-CN method, Rational method, runoff conditions

Introduction
The city parks represent the phenomena in the city urban structure. It's necessary for the good function of the city organism, which is a manmade space without any connection to the nature (Kulhankova, 2016). The service road network is a prerequisite for park access for citizens and management (Hrůza, 2014). Urban trees provide many ecosystem services to cities: alleviating the urban heat island effect, absorbing stormwater runoff, and contributing to residents' social and psychological well-being (Sonti, 2019). The construction of urban green spaces usually leads to the replacement of native species by alien species, resulting in the homogenization of species composition across cities in different climatic zones (Chen et al., 2021).
The case study is the basis for the preparation of the adaptation strategy of the city of Mladá Boleslav. Its purpose is to analyze the hydrological regime of Štěpánka Forest Park, and in the context of the current state of the site, especially in the context of tree communities that currently occur in the site and assess how this state would change in significant impacts of climate change (drought).

Materials and methods
The site of interest, Štěpánka Park, is located in the south-eastern part of the town of Mladá Boleslav, in the Central Bohemia Region (Czech Republic). The altitude ranges from 204 to 238 m above sea level and the total area is 31.02 ha. The locality falls into the climatic warm region, which is characterized by warm and dry summers and short and drier winters. The average annual air temperature is around 8˚C and the annual average precipitation is around 550-700 mm.
The Klenice River, a left-side tributary of the Jizera River, flows through the site at km 37.00. It is an extensive complex of vegetation, playgrounds and sports activities. The park was founded in 1881, and was revitalized in 2014. The subject of revitalization and reconstruction were paths, public lighting, furniture (benches, waste bins, bicycle stands and information boards), small river catwalk and gradings.
Although the site is not located on holdings intended for forest functions, it has the character of a mature forest stand and is thus still treated in this way. The field survey was focused mainly on the evaluation of the existing vegetation and runoff conditions at the site. Based on the field survey, it was decided that the calculation of the outflow from the site, resp. water retention at the site for two scenarios, for the current state and for the state of deforestation at the site, which would theoretically arise as a result of the cessation of forest functions of the site in connection with the impacts of global climate change.
The characteristics of runoff and water retention at the site for the current state and for possible deforestation of this part of the park were compared. This is a part of the park with steep wooded slopes, where significant changes in runoff conditions (water balance parameters) due to deforestation can be expected.
Hydrological modeling using a rational method of runoff calculation (UNMZ, 2012, TP 83) and DES-RAIN short rain intensity model (Kovář and Vaššová, 2011), was performed on interpolated data of a

digital relief model DMR 5G for the Czech Republic. The analysis and formulation of the target state of the vegetation area and the technological basis for planning the implementation of its restoration was prepared using GIS and CAD software.

Results

The threat of drought in the locality is mainly due to the lack of available water in the rhizosphere of woody plants forming the forest communities of the locality. The potential water shortage in the rhizosphere of woody plants is a function of two variables, namely the location of the locality in one of the warmest climatic regions of the Czech Republic and the progress of global change (increasing average annual temperature). In addition, the occurrence of some species or genera of woody plants, which are already on the border of their ecological optimum (especially conifers of the genera *Picea*, *Abies*, *Larix*, or the family *Cupressaceae*), or are in the phase of senescent maturity, is added as a consequent effect. with significantly limited ability to adapt to changing climatic conditions. If due attention is not paid to the care of the stands, then the potential risk of drought in the park in the medium term (approximately 30 years) is relatively significant. With adequate care, this threat can be reduced to a minimum in the context of current predictions of the development of global change parameters.

For the purpose of quantifying the change in the type of surface due to the simulated loss of forest cover, a separate forest segment on the left bank of the Klenice was distinguished. The area of the segment is 16.59 ha, the representation of forest stands is about 95%, the rest is roads and a negligible area is the built-up area. The mean value of the segment runoff coefficient at the current state of the forest stand is 0.11 (on the basis of the analysis of land use and runoff coefficient).

The simulation of the change in precipitation-runoff conditions based on the change in the condition of the forest stand is based on the assumption of a change in the value of the runoff coefficient. The simulation evaluates the condition of the site after the death of the forest stand, thanks to which such areas are more susceptible to surface runoff. The mean value of the runoff coefficient of the simulated state segment reaches the values 0.30 (Fig. 1).

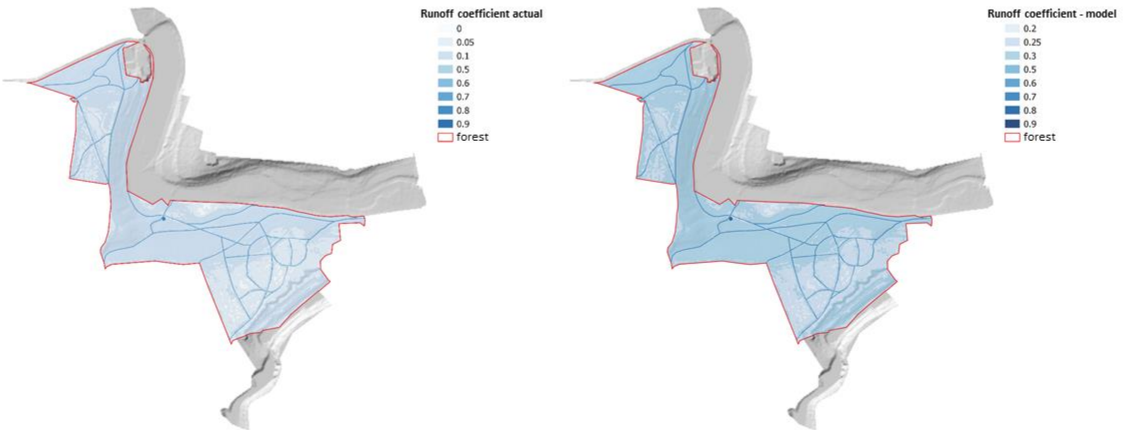

Fig. 1: The change of runoff coefficient due to potential deforestation

The results show that despite the relatively sloping terrain of the locality, the current forest stand has a high retention capacity (it retains about 90% of precipitation). This efficiency is, of course, reflected in absolute form, especially in extreme rainfall of lower intensities (longer durations) and higher probability of occurrence. Specific runoff in given hydrological situations can then be considered as a unit (hectare) quantity usable, for example, in simplified calculations of partial deforestation.

Graphically expressed ability of retention of rainwater of forest communities of the park in the current state and in the state after its potential destruction is presented in Fig. 2. The retention coefficient, so the closer it is to 1.0, the higher the potential retention. It is evident that the destruction of forest communities in the locality would reduce the retention by about one third.

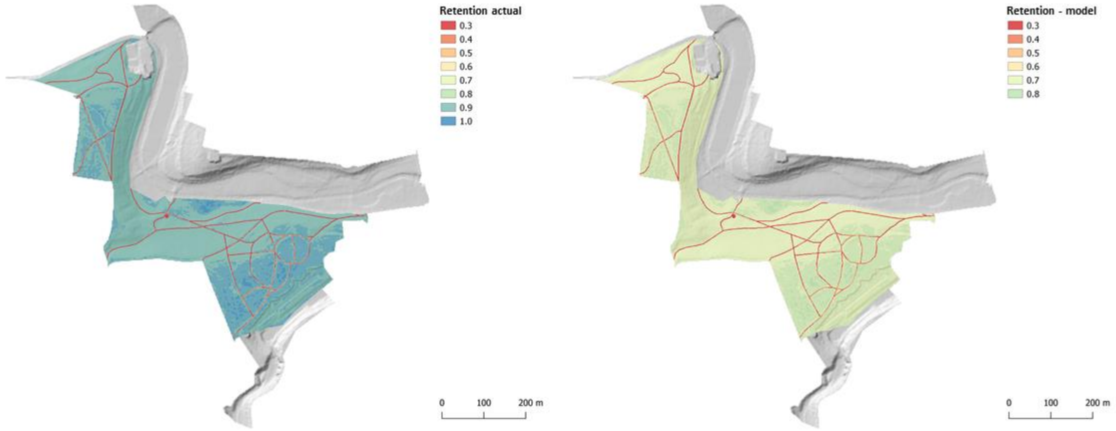

Fig. 2: The retention – current state and the model

Discussion

The park is of considerable social importance (recreational, social, historical, educational and aesthetic value) as well as important ecological functions that were not evaluated in this study (positive impact on the climate of the adjacent district, reduction of dust and noise, zoo and phytobiotic functions). For important quantifiable functions, which park, resp. especially its forest communities, significantly positively affects its surroundings, water retention can be marked (and thus ensuring quantitatively balanced outflows from the site and subsequently flows in the recipient Klenice) and soil erosion control. The related indicator is runoff coefficient with related rain analysis and water balance (UNMZ, 2012; Vaššová and Kovář, 2011). Potential deforestation would mean a triple value of runoff coefficient. This means that the hydrological efficiency of the site (in the sense of rainwater retention) will be reduced to about 70% in its originally forested part. The consequence of this phenomenon will be, in addition to the increase of specific runoff from the site in less extreme hydrological situations, approximately three times the peak flows in extreme hydrological situations than are potentially in the current state, i.e. in a fully functional forest stand at the site.

Basic management measures were formulated on the basis of a species-diverse stand composition since we can determine two characteristic categories of vegetation. Compared with natural forests, the tree species diversity of urban green spaces is greatly affected by human activities (Chen, 2021). First, there are stands of autochthonous species with an admixture of commercial woody plants and species, which can be described as invasive, however, they were introduced into the stands probably for economic reasons. The autochthonous species are represented by mainly oak, linden, maple, hornbeam, ash, beech, less alder and tree willows (*Quercus petraea, Tilia cordata, Acer platanoides, Carpinus betulus, Fraxinus excelsior, Fagus sylvatica, Alnus glutinosa, Salix alba*). The larch and pine (*Larix decidua, Pinus syslvestris*) represent commercial species. The spruce (*Picea abies*) was probably also found in the locality, but it was already removed from the stands after its death due to drought. The locust (*Robinia pseudoacacia*) is an invasive species, also Douglas fir (*Pseudotsuga menziesii*) can be found.

The other category of species are park trees, the function of which is primarily compositional and aesthetic. It is possible to include some of the above-mentioned species (fir, Douglas fir), but the red yew, various species of exotic firs and pines and representatives of the cypress family are especially important (Kupec et al., 2022).

Due to their ecological setting, the species of natural tree composition are still able to cope with the changed conditions (increasing temperature, changed rainfall distribution and reduced water reserves in the soil). Habitual symptoms of drought damage can be observed in older (resistant) individuals rather than in younger (resilient) individuals.

The cultivation of skeletal forest stands (except for park and aesthetic species in solitary or group plantings and compositions) corresponding in their ecological constitution to the original forest stands ensures the sustainable existence of forest stands. The goal of the spatial structure of the forest is the involved vegetation with lower density (fewer individuals in the area) and shorter forest restoration (rotation).

These aspects of skeletal forestry ensure its sustainability, in particular the sustainable water operation of trees in the context of lower water resources in the rhizosphere and the higher ability of relatively younger individuals to adapt to changing habitat conditions – replacing the resistant type of stress resistance with a resilient type (Kupec et al., 2022).

An important aspect is the good condition of the forest soil, resp. the state of humus as an essential attribute of retention and subsequent usability of rainwater by forest stands. During the restoration and maintenance of forest stands in the locality, it is necessary to avoid repeated movements of mechanization across the area and, in particular, to reduce the sliding and pulling of wood during the implementation of restoration or remediation timber harvest. It is appropriate to implement these methods of timber extraction only in slopes of up to 10% and to consistently use the existing road network for the movement of technology. The renewal of the forest stand of the park should be essentially continuous, since the simplified phasing is not desirable for maintaining forest cover at the site.

Conclusion

The study is the basis for the preparation of the adaptation strategy of the city of Mladá Boleslav. Its purpose is to analyze the hydrological regime of the Štěpánka forest park, especially in the context of tree communities that currently occur in the locality. The aim was to assess how this would change in the event of significant impacts of climate change (drought). Based on the analytical and synthetic part, management recommendations were set.

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The study was prepared with consent of Mladá Boleslav city.

Souhrn

Studie je podkladem pro přípravu adaptační strategie města Mladá Boleslav. Jejím smyslem je analyzovat hydrologický režim lesoparku Štěpánka, a to zejména v kontextu společenstev dřevin, která se na lokalitě v současnosti vyskytují. Cílem bylo posoudit, jak by se tento stav změnil v případě významných dopadů projevů klimatické změny (sucha).

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IMPLEMENTING A LANDSCAPE INFORMATION MODELLING (LIM) TOOLFOR PLANNING LEISURE FACILITIES AND LANDSCAPE PROTECTION

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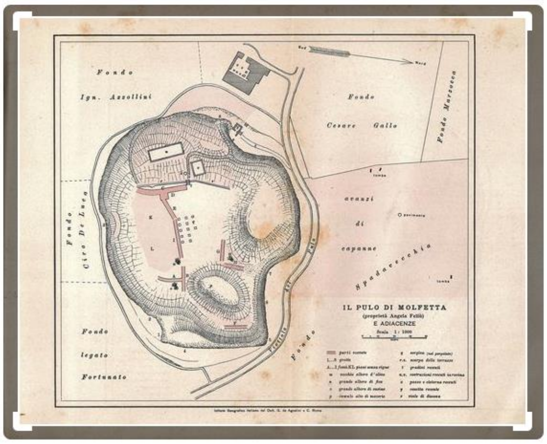
Abstract
Building Information Modelling (BIM) is growing in the Architecture, Engineering and Construction (AEC) Industry. With the new strategy to mandate BIM, there is a need to identify its importance in architectural landscape design. It has the potential to challenge some of the limitations of designing, constructing and managing the built environment. Using BIM tools and applications, landscape analysis can be explored, developed and documented for design, planning and organization as well. This application, known as Landscape Information Modelling (LIM), may store object information such as: irrigation pipelines; areas allocated to specific plants; list of different plants involved in landscape projects; *etc*. Annotations used in landscape drawings would be accompanied by information attached to it. In this paper, a first application of LIM aimed to landscape protection has been implemented, so as to help in planning leisure facilities. Indeed, with many details involved, it can also be used to store data for landscape architects, who would easily develop and organize detailed information. Hence, with the ability for simulation and visualization, they should be able to produce detailed plans, walk-through animations and renderings for presentation, while exploring the scope and nature of work and making informed decision at early design stages.

Key words: Built environment; Public recreation; AEC Industry; Landscape architects; BIM

Introduction
Building Information Modelling (BIM) is growing in the Architecture, Engineering and Construction (AEC) Industry. With the new strategy of many European Governments to progressively mandate BIM, there is a need to encourage BIM adoption in architectural landscape design as well. The use of BIM best practices can lead to efficient and effective BIM collaborative technology and partnering. BIM has the potential to challenge some limitations in designing, constructing and managing the built environment (Ahmad & Aliyu, 2012).
Landscape Information Modelling (LIM) is the process used in landscape architecture discipline which have specific objectives, principles and methodologies in conservation and management. It is necessary to explore an integrated information framework to facilitate the digital management of cultural landscape information (Yang et al., 2019). Anyway, even if increasingly popular among landscape architects and urban planners, an information model in the way of BIM seems to be still missing in landscape design (Borkowski & Wyszomirski, 2021). A LIM application would include: quantity counts; error reduction with organization of data; smart symbol use; landscape presentation (plants) before they eventually grow; storing data; site information modelling; cutting and filling sites (site analysis details); assigning plants types at areas that suit their nature (site analysis details); and exploring and presenting ideas to clients. (Ahmad & Aliyu, 2012). In the present paper, a first application of LIM aimed to landscape protection has been implemented in an environmentally-sensible study area, so as to help in planning leisure facilities and landscape management.

Material and methods
The study area is the “Pulo di Molfetta”, a doline located two kilometers south-west of the city of Molfetta (Apulia Region – Southern Italy). It consists of an oval shape karst depression of 30 m, having diameter variable in the range [130–170] m (Figures 1, 2). In the vertical calcareous walls, several grottoes open, located at different heights, often communicating each other through a series of galleries. In the pre-protohistoric period, the site was used for cultural funerary activities.



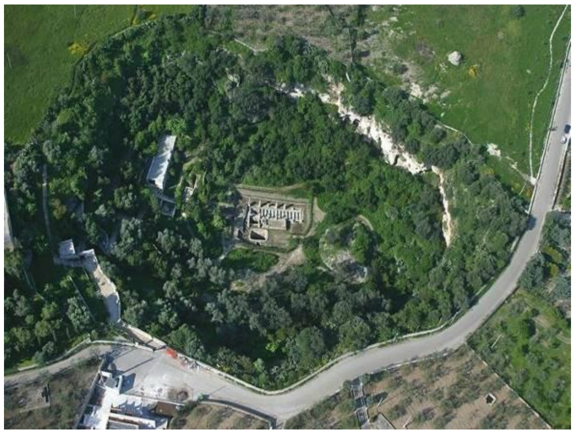


Fig. 9: Doline plan drawn up by M. Mayer (1901)   Fig. 2: Overview of the Area

The findings discovered during the archaeological works carried out from 1997 to 2003 are of significant historical and architectural interest, since they revealed complexes of factories datable to the Bourbon period, located at various levels from the middle to the bottom of the Pulo (Figure 3).
Following the studies carried out afterwards, it has been possible to attribute the pre-industrial structure, located at the middle level, as the *"Regia Nitriera*" (Royal Saltpeter Factory) constructed in 1784 (Figure 4). The caves were rich in potassium nitrate or saltpetre, very requested and extracted during the Kingdom of Naples and used as component of explosive for guns and mines. The plant remained active for some decades and then was closed due to its low productivity. In fact, since 1808, it was described as already totally abandoned.

For a detailed representation of the entire environment of this area, a dedicated LIM model was developed. In fact, compared to a classical BIM model (purely architectural), current LIM consists of a three-dimensional digital model, not only of the terrain but also of the historical and architectural parts present within the site. The modelling has been realized with the software BIM Autodesk Revit that, in combination with Office tools, allows the creation of an interactive environment, where it is possible to interrogate every element, obtaining all associated information (Figure 5). This model itself is a database that contains a variety of site data, attributable to three macro areas: Landscape, Architecture and History.

Fig. 3: Nitrous soil leaching tanks at doline bottom


Fig. 4: "Regia Nitriera" (Royal Saltpeter Factory)

Fig. 5: Revit property tab of the topography

<u>Landscape</u>
The first step was to create the three-dimensional model of the terrain, starting from the contour lines of the site (Figure 6). This three-dimensional element has been populated with all the necessary information, *i.e.*:

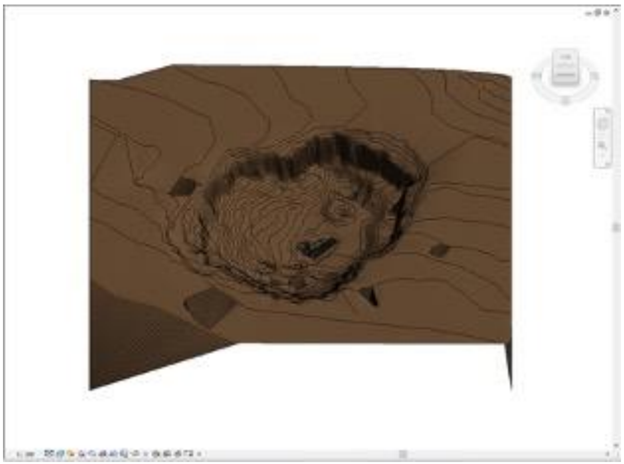


Fig. 6: 3D visualization of the Pulo in Revit

topographic survey and GIS database; Technical/administrative framework: economic/maintenance reporting framework; historical cartography data; level of rurality; photographic survey; type of soil; chemical composition; flora and fauna.

<u>Architecture and History</u>
Buildings and architectures, historical and not, have been surveyed and reported in three-dimensional elements, under the form of walls and floors. Each modelled element brings with it a deepening, with BIM parameters reporting: technical/economic data; technical-administrative data; architectural and photographic surveys; physical data on materials; data (if any) on the structural composition. Regarding the historical part of buildings, the following additional elements have been considered: historical info and state of conservation; chemical/physical data from specific surveys (*e.g.:* thermo-scanner); possible information on the seismicity of the place; indications on conservation and

maintenance methods. Another step of the work has been the creation of a schedule, intended to help to know what is present in the area, the quantities of each single category of elements. All the information is accessible in a single work environment. It can be shared and accessed by everyone through IFC formats, and can be exported to document formats such as XLS and PDF.

Results

The large database of information which has been created thanks to the use of a LIM, seems to constitute a very powerful tool for facilitating the area's manager in their daily work, that would be, otherwise, complicated to manage and control. This LIM enables indeed the graphical representation of the whole area, including every connected information relevant to the environmental, cultural, historical, landscape, etc. characteristics (Figure 7).

All these information may contribute in this way to the best planning, design and management of an area - like this one considered in this study - having an extraordinary value from several different point of view. This LIM represents therefore a digital representation of tangible and intangible components of a landscape. It constitutes a shared knowledge resources for information about a landscape, forming a reliable basis for decision in the management processes including heritage/environment assessment, conservation plan, monitoring impacts and assessing changing circumstances (Picuno C.A. et al., 2017).

Fig. 7: Property tab and plan view of the Saltpeter Factory in Revit

Discussion

The LIM model is capable to give not only the 3D information, but to go beyond, expanding the number of dimensions to other additional levels (Figure 8).

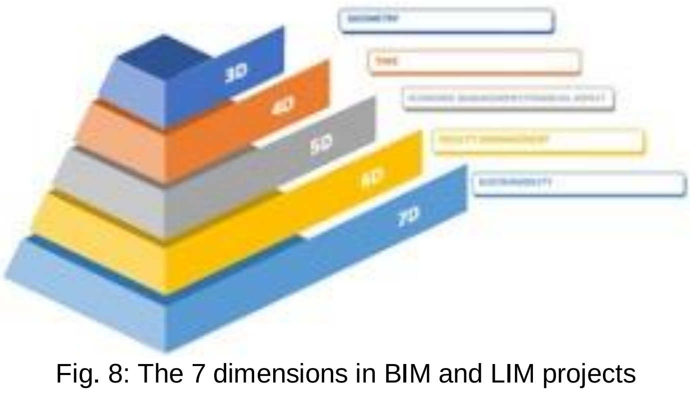


Fig. 8: The 7 dimensions in BIM and LIM projects

The timely availability of this information gives the operator the ability to make strategic decisions about interventions that may be:

- Grafting new species of threes, knowing the terrain;
- Planning a new strategy for cultural heritage valorization (Godosi et al., 2021), knowing the history of the place and identifying the most suitable areas for public recreation and leisure facilities;
- Planning the financial costs of future interventions and its frequency, knowing all the technical specs and the quantities;
- Safeguard the flora and fauna, knowing its peculiarities.

All these activities can be defined by the LIM model, providing tools and empowering decision-making team to do a thorough multidisciplinary work.

Conclusion

This paper presents a preliminary work on the design of a landscape information model applied in a environmentally-sensitive area. It is expected to be implemented with additional data and information obtained as a result of interventions undertaken by the Municipality of Molfetta for the exploitation and fruition of the whole area. Benefits of this LIM would be: (i) the formalization of knowledge in landscape design; (ii) information model to support multiple participants in landscape design process; (iii) improved information exchange and integration between landscape design, architecture and urban design.

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Souhrn

Informační modelování budov (BIM) se jako jeden z nejnovějších trendů ve stavebnictví rychle stává klíčovým přístupem k digitální integraci informací potřebných pro navrhování, výstavbu a správu objektů. V současných projektech BIM a integrovaných projektových a stavebních postupech je však informační modelování pozemků (LIM) podceňováno. Krajinářští architekti by se měli orientovat na BIM. Je obtížné určit specificky BIM software pro krajinářské architekty, to vytváří potřebu, aby se krajinářští architekti spojili a požadovali software, vytvořili trh pro dodavatele softwaru, realizovali výrobu krajinářského BIM softwaru, se specifičtějším krajinářským softwarem by krajinářští architekti mohli být schopni poskytovat inovativnější projektování s efektivními kompetencemi a efektivně spolupracovat s ostatními uživateli BIM. V tomto článku byly analyzovány dva účely BIM - tj. vizualizace fyzických aspektů krajiny a pochopení neviditelných aspektů krajiny. Na základě těchto dvou účelů je ontologie zásadním problémem LIM. Byly identifikovány dvě skupiny složek krajiny: 1) místa zahrnující terén, terénní podmínky, počasí, mikro- a makroklima atd.; 2) krajinné objekty zahrnující "měkké" materiály (např. vegetaci) a "tvrdé" materiály (stavební objekty). Podobně lze navrhnout kombinaci některých základních krajinných prvků: reliéfu, vegetace, vody, staveb a atmosféry.

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KNOWLEDGE, ATTITUDE, AND PRACTICES OF STAKEHOLDERS IN TUMALINTINAN POINT MARINE PROTECTED SANCTUARY

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Abstract
The study was conducted to determine the Knowledge and Attitude of the stakeholders of Tumalintinan Point, San Lorenzo. It aimed to (1) To determine the profile of the stakeholders of the marine protected sanctuary; (2) evaluate the prevailing knowledge, attitude, and practices of stakeholders relative to the specific coastal and marine ecosystem. Whereas most of the respondents were knowledgeable that coral reef and seagrass affects fish productivity, whereas the mangrove forests and mudflats affect the source of food of various wildlife species. Additionally, they are also knowledgeable about ocean/marine pollution, climate change, biodiversity, and people's contribution to climate change. The result of the survey indicates that respondents living in the specific MPA vicinity were knowledgeable on the different environmental and resource issues. The respondents who participated in the survey have a positive attitude outlook towards their support on marine protected areas established in their locality or area of residency. On the practices on the marine protected area, respondents merely use tin cans, plastic straws, plastic bottles, and other plastic materials, directly harvesting fish for family sustenance, joining tree planting, and taking photos of natural scenery. Furthermore, they never throw garbage anywhere, but some of them are involved in cutting mangroves for charcoal production.

Key words: Marine protection, Coastal ecosystems, Stakeholder's surveying

Introduction

Coastal and marine ecosystems are some of the most prolific ecosystems. However, it is also one of those that are threatened. These ecosystems include open ocean marine areas, nearshore coastal areas, where freshwater and saltwater mix, and certain terrestrial ecosystems such as sand dunes. Most of the world's population lives in coastal areas that are dependent on the various ecosystem services that marine and coastal ecosystems such as coral reefs, mangroves, and seagrass beds provide (UNEP, 2015). The coastal ecosystems are completing the life cycles of a wide variety of commercially and ecologically important marine life that supports the livelihood of nearly 60% of Filipinos (DENR, 2016b). Given the importance of coastal and marine resources, a coastal and marine ecosystems management program (CMEMP) was developed.

The Coastal and Marine Ecosystems Management Program (CMEMP) is a national program aiming to "comprehensively manage, address and effectively reduce the drivers and threats and degradation of the coastal and marine ecosystem" (DENR, 2016a).in order to effectively establish Marine Protected Areas (MPAs), this CMEMP was implemented together with the local government units and the community. (Wahle, Lyons, Barba, Bunce, & Fricke, 2003).

In 1999, the Municipality of San Lorenzo declared the Tumalintinan Point waters as a Fish Sanctuary by the Municipal Ordinance No. 99-005 Series of 1999, for the purpose of conservation, protection, and preservation of the existing natural flora and fauna in the area. Section 1 of the ordinance states that a restricted zone – a body of marine waters surrounding the Tumalintinan Point, geographically located at North Western Coast of Guimaras Strait with latitude from 10º36'43" to 10º37'48" and at longitude from 122º43'28" to 122º44'18" northwest of Guimaras Strait - shall be "off-limit" or prohibited to fishing operations and/or exploitation/utilization of marine species. Section 2 of the same Ordinance also states that the fish sanctuary shall encompass the body of marine waters surrounding the Tumalintinan Point with a total area of 363.72 hectares (core zone – 60.23 has, buffer zone – 303.49 has.).

Although the Tumalintinan Point waters were declared as a fish sanctuary by the relevant Municipal Ordinance, it has not been managed well because the Tumalintinan Point Marine Protected Area Management Plan has not been formulated. Also, the relevant ordinance states to designate a core zone, that is, "No-Take Zone", in the Tumalintinan Point area; however, it does not mention any buffer zone, that is, multi-use zone, which is also very important to protect and conserve the core zone.

Baseline information is necessary as this will be the basis for evaluating the impacts of the program in the community, and this can be done through the Knowledge, Attitudes, and Practices (KAP) Survey. Hence, KAP Survey was carried out in these MPA sites at Guimaras Island.

Objectives of the Study

This study was conducted to determine the Knowledge and Attitude of the Tumalintinan Point Marine Protected Sanctuary of San Lorenzo, Guimaras, Philippines.

Specifically, it aimed to:

1. To determine the profile of the stakeholders of the marine protected sanctuary;
2. To evaluate the prevailing knowledge, attitude, and practices of stakeholders relative to the specific coastal and marine ecosystem.

Material and methods

Research Design

The research design of the study was descriptively utilizing the survey method of data gathering. This was the most appropriate design to be used because the study aimed to determine the Knowledge and Attitude of the stakeholders relative to the implementation of MPA's in Tumalintinan Point, San Lorenzo, Guimaras.

Analysis of the Data

The analysis of the data was processed using SPSS. The statistical tools used were frequency, percent, and ranking.

Results and Discussion

Profile of the Respondents

There were one hundred thirty-one (131) respondents. Respondents were classified as to their cluster, age, sex /gender, number of years residing in the area, religion, and civil status. For the cluster majority of the respondents were from the student's cluster (age 15 and above) several numbers of 86 (65.6%), and was followed by 27 (20.6%) from the cluster of wives of the fishermen and farmers. The rest were local chief executives, heads of households and local organizations, local business owners, and school heads/teachers. It implicates that the stakeholders are comprised of a bigger percentage of student clusters. As to the age, 45.8% were from the age ranging 15-19 and was followed by respondents aged 20-24, since the majority of them were students.

Respondents have 75 (57.3%) females, 55 (42%) males, and only one gay in a total of 131. It implies more women participating and the majority of them stayed in the area for 15, 16, and 17 years with a percentage of 17.6%, 9.9%, and 8.4% respectively. For the religion, a higher percentage of the respondents were Roman Catholic, Baptist, and Born Again Christian with a percentage of 56.5%, 17.6%, and 13.7%, respectively. Most of them are single, with 67.2%.

On the data on the number of family members, highest educational attainment, and organization affiliation. About the number of members of the family, many of the respondents have four members or 25.2%, while those having five members were 20.6 % and six members were 19.1%. This means that the composition of family members among the MPA families in Tumalintinan Point can be categorized as big, which ranges from 4 to 6 members in a family.

In terms of highest educational attainment, most of them were high school level (62 or 47.3 %), followed by those who graduated high school (26 or 19.8 %), college graduate (14 or 10.7%), college-level (13 or 9.9%) and the rest have attained elementary and vocational education.

For their organizational affiliation, 89 or 67.9 % were not a member of any organization, and 10 or 7.6% only were 4P's members, since the majority of the respondents were students and they are not yet inclined to have membership in community organizations.

Other Sources of Livelihood

The majority of the respondents considered agriculture (42.7%) as another source of livelihood; some are involved in piggery (25.2%), poultry (12.2%), carpentry (3.1%), and others (21.4%).

A. Knowledge on Marine Protected Area (MPA)

Biodiversity

It was found out that of the 123 respondents, 94.0% said yes, they know what biodiversity, while only 6 or 5 % answered no, they don't know about biodiversity, and 2 or 1%, were not aware. This simply shows that the educational campaigns of the different organizations, especially by the Provincial

environmental office in the Province, have already paid off relative to the responses made by the respondents on their level of knowledge on biodiversity.
Respondents who know about biodiversity identified what composes diverse bio areas; 93.9% answered animals and microorganisms, 89.3% for trees/plants/forests, 86.3% answered estuaries/coastal areas, rivers/lakes/streams, 46.6% of the responses, and caves with 24.4%. Multiple responses among respondents were made.

Ecosystems

On the item which queried on what are the roles of the coastal and marine and other ecosystems in the area, the respondents replied that the most important role of coastal marine and other ecosystems is as "habitat of various species" (127 or 96.9%), this was closely followed response as "provide food, livelihood and medical benefits to the people" (115 or 87.8%), "protect us from extreme/destructive effects of storm surges, waves, and currents" (110 or 84%). It could also provide recreational, physical, and mental benefits, tourism activities, spiritual activities (96 or 73.3 %), and economic and environmental benefits (91 or 69.5%).
Coastal, marine, and other ecosystems are interconnected (58 or 44.3%) was also one of the roles of the marine ecosystem. What can be gleaned from these responses was that the respondents have high knowledge of the importance of these coastal and marine ecosystems, which surround them either in their personal lives or in the protection and preservation of life. However, they less believed that the interconnection on coastal, marine, and other ecosystems were among the roles of the coastal marine ecosystem.
Respondents identified different ecosystems in the area, wherein almost all of them identified mangrove forests (129 or 98.5%), followed by coral reefs (125 or 95.4%), seagrass beds (122 or 93.1%). Meanwhile, the least of the respondents consider mudflat areas (106 or 80.9%), rivers (66 or 50.4%), salt marshes (59 or 45%), lakes (30 or 22.9%), and lowland forest (17 or 13%) being part of the marine ecosystem. It can be gathered from these answers that the respondents are only aware of the marine ecosystem, which they are so familiar with, and they are not so familiar with other ecosystems considering that their immediate surroundings are within a marine ecosystem.

Mudflats

When the characteristics of mudflats were evaluated, the respondents have varied responses. The majority of them (114 or 87%) described mudflats as muds are deposited by tides or rivers. Flooded due to change of tide level (55 or 42%) was another characteristic according to their answers, and were found in areas where tidal waters flow slowly (48 or 36.6%). For The Importance, 109 or 83.2% said that mudflat is important because it served as nursery areas for some fishes, 108 or 82.4% stated that it provides feeding and resting areas for water birds and is rich in nutrients supporting a diversity of species by 53 or 40.5%.
Mudflats can be affected by some influencing factors, and as identified by the respondents, weather (87%), location of mudflats (48.1%), and tree-planting (19.8%) may affect mudflats. Respondents were also asked if the mudflats may affect the source of food of various wildlife species; 109 or 83.2% said YES, 8 or 6.1% said NO, and there were 4 or 3.1% unaware about how mudflat may affect food for various species.

Mangrove Forests

Results showed that 113 or 86.3% of the respondents believed that mangrove forests are composed of trees and shrubs in salty coastal areas, as well as it has prop roots, thick and waxy leaves 88 or 67.2%), and having a soft substrate (86 or 65.6%).
Almost all of the respondents also appreciated mangrove forests as a natural breakwater (128 or 97.7%), providing refuge to organisms (118 or 90.1%), and source of food to many organisms (112 or 85.5%). Some factors/activities that affect mangroves were illegal logging with 121 or 92.4%, followed by charcoal making with 104 or 79.4. Furthermore, close to half said that mangroves are affected by fishing grounds with 65 or 49.6% responses. These assessments of the respondents about mangroves showed that they have enough knowledge and understanding of the characteristics, importance, and factors/activities that affect mangrove forests. Their observations speak truly of the present conditions of the mangroves in their area because they observed these situations every day.
Respondents were also asked if they are aware that the condition of mangrove forests may affect the source of food of various species like mollusks, crustaceans, and fish. All of the respondents (131 or 100%) responded that the condition of mangrove forests might affect the food of various species.

Seagrass

Results showed that in terms of the important seagrass characteristics, the majority of the respondents believed that the seagrass beds entirely immerse in seawater (129 or 98.5%), grow in marine and brackish water (65 or 49.6%), responses, but few (57 or 43.5%) said that depth distribution is limited by the availability of light. These results only showed that some of the fisher folks do not have enough knowledge and understanding of the distribution and habitat of seagrasses. According to Reynolds (2017), the depth of seagrass location is dependent upon the availability of sunlight.

About the importance of the seagrasses, 121 or 92.4% of the respondents acknowledged that seagrass beds are an important nursery ground for fish and other invertebrates, 116 or 88.5% respondents appreciated that seagrass beds are important for maintaining biodiversity because they provide shelter, while and food for marine animals and 95 or 72.5% replied in affirmative that seagrass stabilizes coastlines and absorb nutrients from runoff. Furthermore, one of the major factors that affect seagrass beds is accidents resulting in oil spills with 124 or 94.7% affirmative response, 88 or 67.2 responses for boat docking, and tree planting 66 or 50.4%.

When the respondents were asked if the condition of our seagrass beds directly affects fish productivity, 126 or 96.2% responded YES, one or .8% said NO, and there were 4 or 3 % were not aware of the effect. This means that almost all of the respondents knew that the condition of the seagrass beds might affect the fish productivity in the area.

Coral Reefs

The 130 or 99.2% out of 131 respondents have agreed that coral reefs affect fish productivity. This implies that the knowledge of the respondents on the role of coral reefs in fish production is high. Furthermore, data shows the important characteristics and factors that affect coral reefs. Results revealed that 112 or 93.3% of the respondents agreed that coral reefs are made of either soft or hard organisms; it was also live, bleached, or dead with algae (69 or 57.5%), and extensive or patchy (54 or 45.0%). Despite the high percentage of the respondents who have agreed on the identified characteristics of the coral reefs yet many of them did not agree on these pre-set notions of the coral reefs characteristics.

About the importance of coral reefs, 128 or 97.7% of the respondents agreed that indeed coral reefs are habitat for fish, that it can help in reducing strong wave action (117 or 89.3%) and can be a source of recreation for people, especially those who are fond of scuba diving (93 or 71.0%). Factors or activities affecting coral reefs were dynamite fishing (126 or 96.2%), global warming (99 or 75.6%), and poaching (86 or 65.6%).

Ocean and Marine Pollution

The majority of the respondents answered YES; they know about the ocean and marine pollution (129 or 98.5%), one or .8% said NO, and the same percentage responded that they are not aware. This means that people living near the Tumalintinan Point were fully aware of ocean and marine pollution. Furthermore, respondents responded that people directly contribute to ocean/marine pollution (125 or 95.4%), few said NO (4 or 3.1%), and 2 or 1.5% said they are not aware. The identified sources of ocean/marine pollution were plastics (117 or 89.3%), the noise produced by supertankers, other large vessels, and machinery (115 or 87.8%),(110 or 84.0%) are saying ballast water, runoff from sewage, deforestation, farming, and other land use (106 or 80.9%), pathogens from sewage and livestock (76 or 58.0%), oil from cars, heavy machinery, and industry other land-based sources (72 or 55.0%), and sedimentation due to erosion from mining, farming and coastal dredging and toxins (47 or 35.9%). According to the respondents, the most contributory factor to ocean/marine pollution is improper waste disposal, especially plastics.

Climate Change

In terms of the knowledge on climate change, out of 131 respondents, 124 or 94.7% know climate change, but still, there's 4 or 3.1% responded NO, and 3 or 2.2% were not aware of climate change. On the idea of people, direct contribution to climate change and its catastrophic effects, 121 or 92.4% responded YES, 9 or 6.8% said that they are not aware, and one or .8% responded NO.

For the knowledge of respondents on climate, respondents claimed that climate change was anchored to shifting of weather patterns (120 or 91.6%), global warming (120 or 91.6%), and caused by humans, use of fossil fuels have extreme weather conditions such as drought and flooding can compromise terrestrial crops and pressure on coastal and marine resources (93 or 71.0%), which releases carbon dioxide and other greenhouse gases into the air (89 or 67.9%). In addition, a minority of the responses were identified that climate change could make coastal areas vulnerable to sea-level rise, warming of the sea/oceans, intensified weather disturbances (69 or 52.7%), low lying coastal communities being highly vulnerable to sea-level rise (51 or 38.9%), and ocean acidification (28 or 21.4%).

B. Attitude on Marine Protected Area

For the evaluation of the attitude of the respondents, data shows that out of 131 total respondents who participated in Tumalintinan Point marine protected area, wherein the majority of the participating fisher folk feel the need to protect the various ecosystems because it affects their source of livelihood (61.8%), they are always willing to help to protect the various ecosystems by promoting sustainable use of biodiversity resources (56.5%), they will support and participate in local and national government efforts/ programs in protecting our biodiversity (52.7%), they believed every Filipino citizen's obligation and responsibility to protect our country's biodiversity, and I have to find ways to do so starting in my area/community (48.1%), and want to show to my family, relatives, and friends the ways to conserve and protect our biodiversity (45.8%). Meanwhile, they decided to be more conscious of the actions so that they could contribute to increasing resilience against the adverse impacts of climate change (42.7%).

Additionally, they depend on people who are more knowledgeable in protecting our biodiversity because they know better (30.5%); they will blame other people for floods and other calamities that are happening because of their irresponsible actions (16.8%). They will not disregard critical issues about our biodiversity because of lack of knowledge (4.6%) and want to contribute to the country's biodiversity conservation activities because it is not my primary concern (.8%).

The result implies that selected respondents who participated in the survey have a positive attitude outlook towards their support on marine protected areas established in their locality or area of residency. This was a good indication of the participatory approach of the community on the establishment of MPA, but proper implementation and education must be done in order to minimize the negative attitude of the community people when participating and cooperating towards the success of conserving MPA's.

Involvement in DENR and LGU Led Activities

For the past six months, a total of 73 respondents, or 55.7% are involved occasionally in the LGU/DENR activities, 50 or 38.2% were never involved, and only 4 or 3.1% were involved regularly. They were involved in this activity because they considered it as their obligation (35 or 26.7%) to learn updates and new information (17.6%) and only to clarify or ask a question (6.1%).

C. Practices on Marine Protected Area

On the practices on a marine protected area, out of 120 respondents, 28.2% always practice, and 64.1% sometimes practice the use of tin cans, plastic straws, plastic bottles, and other plastic materials, while 5.3% never use. For throwing garbage like tin cans, plastic straws, plastic bottles, and other plastic materials anywhere, 47.3% never practice, and 48.1% sometimes practice throwing garbage anywhere. For directly harvesting fish for family sustenance,8.4 % always practice,36.6 % sometimes practice while also there were 51.9% never practice directly harvesting fish for family sustenance. Almost all (98.5%) of the respondents sometimes practice cutting mangroves for charcoal production, and only 1.5% said that they never cut mangroves. In addition, 22.1% always join tree planting while 45.0% were sometimes joining, and 32.1% have never joined tree planting/clean-up activities. There were 4.6% always, 66.4% sometimes took photos of natural scenery, and 27.5% have never taken. They were also asked if they are calling the attention of local enforcers on illegal activities affecting the environment in the area; 53 or 40.5% never responded, 46 or 35.1% always calling, and for sometimes 32 or 24.4% respectively.

Furthermore, the majority of the respondents (89.3%) said YES that in their homes they are contributing to the conservation and protection of biodiversity by practicing proper waste management, and only 10.7% have responded NO. There were 67.2% who responded YES that they are advocating and participating in activities involving conservation and protection of biodiversity 32.1% said. Respondents were also asked about their home practices that contribute conservation and protection of biodiversity. There were 64 or 48.85% have practiced waste segregation, 28 or 21.37% have compost pit, 6 or 4.58% practiced 3R's and proper waste disposal, 5 or 3.82% for recycling, and the rest have other practices.

Conclusion

Based on the results and findings of the study conducted, the following were plausibly concluded.

(1) On the knowledge of the respondents who participated in the survey, it was significant to note that majority of them were knowledgeable on different areas or issues on MPA and environment. Whereas most of the respondents were knowledgeable that coral reef and seagrass affects fish productivity, wherein the mangrove forests and mudflats affect the source of food of various wildlife species. Additionally, they are also knowledgeable about ocean/marine pollution, climate change, biodiversity, and people's contribution to climate change. The result of the survey indicates that respondents or the fisher folks living in the specific MPA vicinity were knowledgeable on the different environmental and resource issues. This positive awareness or knowledge on those stated concerns can be associated with the information dissemination of concern and accountable having environmental concerns. The respondents who participated in the survey have a positive attitude outlook towards their support on marine protected areas established in their locality or area of residency. This was a good indication of the participatory approach of the community on the establishment of MPA.

(2) On the practices in a marine protected area, respondents merely use tin cans, plastic straws, plastic bottles, and other plastic materials, directly harvesting fish for family sustenance, joining in tree planting, and taking photos of natural scenery. Furthermore, they never throw garbage anywhere, but some of them are involved in cutting mangroves for charcoal production.

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Souhrn

Studie byla provedena s cílem zjistit znalosti a postoje stakeholderů v Tumalintinan Point, San Lorenzo, Guimaras, Filipíny. Mořská rezervace (Marine Sanctuary) byla vyhlášena v roce 1999 za účelem zachování, ochrany a zachování stávající přirozené flóry a fauny v oblasti. Průzkum byl proveden u všech stakeholderů žijících nejblíže chráněné mořské oblasti, (1) s cílem určit profil zúčastněných stran v chráněné mořské rezervaci; 2) vyhodnotit převládající znalosti, přístup a postupy zúčastněných stran ve vztahu ke konkrétnímu pobřežnímu a mořskému ekosystému. Na základě výsledků průzkumu výzkumníci doporučili následující: (a) je třeba provést řádnou implementaci a osvětu, aby se minimalizoval negativní přístup lidí z komunity při participaci a spolupráci na úspěchu

založení rezervace; b) odpovědné orgány musí pokračovat v šíření informací o významu a výhodách rezervace. Pozitivní vnímání rezervace ze strany místní komunity je dobrým kanálem pro vedení komunity k posílení spolupráce s vesničany a vesnickými sdruženími. Jakmile místní lidé rozpoznají přínos a význam ochrany životního prostředí pro budoucnost, program ochrany rezervace může být realizován s minimálním technickým vedením, ale je velmi zapotřebí soustředěného úsilí vědců, akademiků a orgánů společenské odpovědnosti a firem.

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LANDSCAPE PHOTOGRAPHY IN THE RESEARCH OF LANDSCAPE CHANGE

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Abstract:
The paper presents partial results of "entering" landscape photography, which can be considered as a complementary method for the research of landscape changes. Unlike the usual assessment of landscape changes using cartographic and other archival sources, old landscape photographs can contribute to the deeper knowledge of the local specifics of the examined places or supplement the conventional procedures. Thanks to the ongoing project, supported by the Technology Agency of the Czech Republic (TL02000222), we documented changes in photographic shots of various landscapes in the 20th century. We also added information about environment, vegetation, and geography and photo documentation of the details of the researched shot. This creates a comprehensive output for each old landscape photograph. Such processed photographs have been presented at exhibitions in museums and galleries. Furthermore, they will be available to municipalities and public at a web page created as a tool to support public recreation. Here we present some examples from the Bohemian-Moravian Highlands. They show four types of landscape changes: 1) afforestation and overgrowth by woody vegetation, 2) changes in the agricultural landscape, 3) loss of the grazing landscape, and 4) changes related to watercourses.

Key words: photographic shots, vegetation changes, landscape structure changes, public recreation, Bohemian-Moravian Highlands

Introduction

Usual methods of studying landscape „from a distance", i.e. with the help of various map sources, enable analysing landscape changes from the second half of the 18th century onwards (Havlíček et al. 2018). Such analyses provide efficient results for the landscape scale (Skokanová et al., 2020). On the local scale, however, more detailed information about biodiversity or landscape structure is lost during the generalization of the maps. Therefore, using photographic documentation can be considered as a supplementary method for providing such detailed knowledge. Historical photographs can be used as a complementary source, in e.g. calibrating satellite land cover images (de Nuelenare et al., 2014) or for studying environmental changes (Nyssen et al. 2014, Kemp et al. 2015). Both historical and contemporary photographs also can be used for extracting land cover and its changes (e.g. Hendrick and Copenheaver 2009, Russell and Ward 2015) and are quite popular in capturing historical vegetation changes, especially in connection to climate change (Rohde et al. 2019). Repeated photography can therefore provide spatial and time specific information about vegetation succession and trends in land use (Moseley 2006). The main advantage of using photographs can be seen in their ability to identify features that are not easily discernible from aerial and satellite imagery (Tracewski et al. 2017). However, using landscape photographs is restricted by their first occurrence at the end of the 19th century (Skopec 1963).

In this contribution, we show the fundamental changes of the Žďárské vrchy landscape on the example of 42 old photographic shots localized in the field, which were selected for the 50th anniversary of the Protected Landscape Area (PLA) Žďárské vrchy and presented at an accompanying exhibition (Halas et al. 2020). We also assess their availability for the development of individual tourism based on their accessibility and distance from existing tourist paths and other roads.

Materials and methods

For assessing landscape changes, we used photographs depicting landscape before the large-scale changes of its structure. We also used literature about local flora, ethnographic books, knowledge from the locals and our own field notes to assess the rate of landscape change. The rate of landscape change can also be derived from the representation or extinction of species from the black and red list

of vascular plants (Grulich 2017). For assessing usability for the tourism and recreation, we used photographs with localized attractive landscape features.
We compiled commentary for each photographic shot in order to provide potential tourist with both ethnographic and natural scientific information about features depicted in the shot and causes and consequences of the landscape changes. Since there are differences in the scope of each photographic shot and their motive, the commentaries are tailored to the particular photographic shot. Photographic comparison of old shot with the current state is supplemented by a map with exact location and direction of the shot and by photo documentation of details discussed in the accompanying text.
We categorized the locations of photographs according to the distance from the existing tourist paths and other roads into four categories: a) on the path, b) up to 100 m from the path, c) over the 100 m from the path, and d) off the path.

Results and Discussion
Only 7% of photographic shots were localized on a tourist path. Another 24% can be found up to 100 m from the path and 69% are localized even farther. Two-thirds (62%) of all photographs were made outside current road network.
To illustrate landscape changes the Žďárské vrchy PLA went through, we selected several examples of four types of the change.

1) Afforestation and overgrowth by woody vegetation

Rocky dominants are one of the typical features of the Žďárské vrchy PLA. Samotín Rock near a hill Teplá (782 m n. m.) is one of less known rocks. It became a repeated feature in the paintings of e.g. Josef Jambor and Rudolf Hanych. As a photograph from the 1970s (Fig. 1 left) shows, it created an interesting landmark against the backdrop of distant hills. The demise of domestic husbandry in the 1980s (Halas et al. 2021) combined with the landscape overgrowth by trees completely changed the shape of the surrounding landscape and the potential of the former lookout point (Fig. 1 right).

Fig. 1: left: Samotín Rock, cca 1970s, source: SOA Žďár nad Sázavou, Department of regional development, Volume 239; right: A view of the Samotín Rock in 2020, photo: Petr Halas (April 21, 2020)

The Dědek and Babka rock formation on Pavlov hill above Ubušín represents a rock wall probably created by frost weathering processes during the Pleistocene. The rock is associated with the legend of an inseparable love that will last forever. Geomorphological processes usually work so slowly that we do not perceive them during our lives. In the case of the Dědek and Babka, however, the rumours showed that the term “forever” is relative. While we do not see any significant changes on the wide main top of the rock (on the original photo on the right, Fig. 2 left), the rock tower on the left has practically disappeared since the original photo was taken – it collapsed, creating a field of massive boulders. With regard to the spread of vegetation (Fig. 2 right), it seems that the rock decay occurred several decades ago. The former clearing in the foreground turned into a mature forest, which hid the rock formation in its shadow. On the contrary, historical stone accumulations were revealed, which can be considered as an unmistakeable evidence that the land close to the rock was used for the agriculture.

Fig. 2: left: Ubušín – on Dědek, around 1930, source: archive of Ivan Remeš; right: View of Dědek and Babka from a greater distance, photo: Tomáš Koutecký (November 18, 2020)

Changes of agricultural landscape

Photographic shot of Blatiny (Fig. 3) shows how the village and its agricultural surroundings has changed in the last 50 years – from the homogenization of landscape structure to destruction of solitary trees, overgrowing of meadows and former arable fields by trees to afforestation. The photograph reveals that for two decades after the collectivisation, the landscape still represented a harmonious mosaic and that this mosaic was destroyed in later period.

Fig. 3: left: Jaroslav Hecl: Early spring in Horní Blatiny – whole, 1976, source: Horácké museum; right: Comparative shot, photo: Petr Halas (April 16, 2020)

Changes of the landscape and people's lives are well illustrated by comparing present with the photograph from the Nové Město photographer Josef Štursa. He captured a family from Křižánky on their land a hundred years ago, using primitive ploughing facilities (Fig. 4 left). While the socio-economic conditions of the population changed significantly during the second half of the 20th century, it was not until the 1990s that a substantial part of the agricultural land was transformed into permanent grassland (Fig. 4 right).

Fig. 4: left: Josef Štursa: Self-ploughing (Polanský family), Mor. Křižánky, 1922, glass plate, source: Horácké museum; right: Comparative shot, photo: Petr Halas (November 18, 2020)

Departure from cattle grazing

In the photograph from the 1930s, an otherwise inconspicuous landscape element is captured in the foreground of the shot – the upper part of the right-bank valley slope of Svratka (Fig. 5 left). Due to large inclination, it had limited use, yet it was mowed or regularly grazed, as evidenced by the captured vegetation cover. With the agricultural intensification and the disappearance of domestic cattle breeding in the second half of the 20th century, such parts of the landscape were neglected and overgrown with woody vegetation (Fig. 5 right).

Fig. 5: left: Josef Štursa: Parts from Křižánky with Čtyřpaličaté rocks, 1933, source: archive of Ivan Remeš; right: Comparative shot, photo: Petr Halas (November 30, 2020)

Watercourses

The shot from Moravská Svratka in the 1930s (Fig. 6 left) gives an insight into the landscape inspiring a number of painters from Czech–Moravian Highlands, including Rudolf Hanych, a native of Svratka. The original and current shot (Fig. 6 right) is dominated by the river Svratka, which was later heavily regulated. The regulation caused not only disappearance of places for painting's inspiration but also impoverishment of the river biota. However, behind the heavily regulated stream, we can still find less impacted landscape with a species rich meadow, which is drained only by a slightly sunken stream and draining canals. The dominants of old buildings, which have not yet been overshadowed by surrounding new buildings, also remain intact.

Fig. 6: left: Reproduction of a photographic postcard of the Vomáčka Pardubice Part on the river Svratka from 1930, source: archive of Ivan Remeš; right: Comparison shot, photo: Petr Halas (May 13, 2020)

Conclusion

Here presented results show that landscape photographs are a valuable source for studying landscape changes. Unlike landscape paintings, they provide a realistic picture of the captured landscape without artistic distortions. The photographs often prove how e.g. the height of a forest stand or overgrowth of the landscape with trees or disappearance of grazing management can significantly influence the landscape character, especially when they obscure features seen in the older landscape photographs (Hendrick a Copenheaver 2009).

Further, they provide more detail than maps or aerial photographs. At the same time, they are a work of art and therefore bring aesthetic aspects to the mix.

Photographs of attractive landscape shots with accompanying information (comments about nature, photographically documented changes of the locality) displayed on an educational board or on a web page (with QR code) are a prime example of capitalizing invested efforts connected with gathering relevant information about landscape depicted in the photographs in the tourism. They can be installed on already marked tourist paths or in their vicinity. Alternatively, they can be installed outside frequent tourist localities, leading to spreading visitors in the landscape.

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Souhrn
Navzdory kratšímu časovému rozpětí (ve srovnání s krajinomalbami) a nerovnoměrnému prostorovému zastoupení (ve srovnání s mapami) představují fotografie krajiny užitečný zdroj pro studium změn krajiny. Umožňují identifikovat různé prvky a skutečnosti, které v jiných pramenech chybí. Navíc jsou často cenným uměleckým dílem, které si zaslouží podobnou pozornost jako krajinomalby. Jsou tedy nejen doplňkovým zdrojem pro analýzu změn krajiny, ale jejich využití (a lokalizace) nabízí neobvyklý prostředek pro rozšíření možností individuální rekreace. Na rozdíl od běžných metod analýzy změn krajiny má využití a vizualizace krajinářských fotografií potenciál zaujmout veřejnost jak při pořádání společensko-kulturních akcí (výstav), tak při vytváření nových turistických cílů v krajině zachycené originálními fotografiemi. Tyto cíle mohou být označeny tradičními (ale často rušivými) informačními tabulemi nebo nenápadnými QR kódy umístěnými podle zeměpisných souřadnic.
Zde prezentované příklady historických i současných krajinářských fotografií ze Žďárských vrchů představují několik fází proměn krajiny v průběhu 20. století. Počátek 20. století ukazuje klesající tlak pastvy a zemědělství, spojený s vylidňováním v důsledku zániku sklářské výroby a následného zarůstání dřevinami. Padesátá léta 20. století představují přechod od původní dlouhodobě udržované jemnozrnné struktury zemědělské půdy k homogenním celkům. Přestože krajina druhé poloviny 20. století již byla výrazně zasažena velkoplošnými změnami, řada fotografií dokumentuje, že tradiční struktura krajiny na některých místech převládala až do 70. let 20. století.

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MODELING DRIVERS OF DEFORESTATION IN UGANDA USING REGRESSION ANALYSIS: EFFORTS TOWARDS ZERO DEFORESTATION BY 2030

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Abstract

Uganda, located in the Tropical region of Africa, is blessed with natural forests that serve enormous environmental ecosystems and biodiversity. Moreover, the country is known for its tropical rain forests and various hardwood, birds, and animal species. Over the years, the Trend in the natural forest land has declined at an alarming rate; hence need to investigate the possible drivers. The loss of such biodiversity and ecosystems risks desertification and extreme climatic condition. As the world moves towards Zero Deforestation 2030, understanding the determinants of deforestation and forest degradation is paramount. Therefore, the main objective of this study is to understand the impact and relationships between net forest conversion, energy emission, agriculture, and forest production of Roundwood. We used data from FAO for the period 2004-2016. Using the ADF and KPSS test, we checked for the unit root presence in the variables. Also, the study used two different regression models; ordinary multiple linear and dynamic linear regressions. The results showed that there were unit roots in the selected regressors. To analyze the determinants of deforestation, we used net forest conversion in Uganda. There was 94 % variation in the dependent variable (Net Forest conversion). The outcome of the dynamic linear regression showed that agriculture and energy emission positively impact net forest conversion, whereas forest production of Roundwood has a negative effect. Based on our findings, this study recommended the modernization of agriculture by the government of Uganda to stop cutting down the forests on a big scale. Also, the study suggested that, as Roundwood production has a negative impact on net forest conversion, there is a need for the government to strictly legislate to ensure effective and efficient management and production of Roundwood products towards total forest conservation by 2030.

Key words: Agriculture, climate change, energy emission, forest conversion, livelihood, wood fuel, Zero Deforestation 2030

Introduction

Forests globally play a critical role in human wellbeing and a sustainable environment through ecosystem and biodiversity services (Bamwesigye et al., 2020a). However, deforestation in Uganda has been rising for the past few decades, hence being seen as causing environmental degradation. Uganda is a developing nation that heavily relies on wood fuel (Bamwesigye et al., 2020; Jagger & Kittner, 2017). Like in other African countries, wood fuel is the core energy source for heating at factories, commercial, and household cooking in Uganda (Bamwesigye et al., 2017, Bamwesigye et al., 2018, Nabukalu & Gieré, 2019; Bamwesigye et al., 2020b).

It is not surprising that deforestation in Uganda is striking, as many people continue to use fuelwood for cooking. Other studies indicate that deforestation is somewhat driven by farming systems, which increasingly clear forested land for farming (Mwanjalolo et al., 2018). Furthermore, Waiswa et al. (2015) explain that clearing forests for commercial agriculture remain a common practice in Uganda. It could account for about a higher percentage in Uganda and other countries.

Recent studies indicate that deforestation has increased in the Northern Albertine region, in rural Western Uganda. Twongyirwe et al. investigated and presented findings of perceptions from local people in the region on the causes of deforestation for the period between 1985 and 2014 (Twongyirwe et al., 2015. Other driving factors mentioned in the study include population increase and moving forest protection boundaries. A few more studies investigated the core drivers of deforestation in the Lake Victoria Crescent in Uganda (1989 and 2009) (Waiswa et al., 2015). Their findings indicated that agricultural expansion into forest areas is one of the leading drivers. They also listed wood forest products and clearing forests for other non-agricultural activities as core contributing factors. Further, they categorized causes of deforestation as institutional, economic, and population growth as the leading factors (Waiswa et al., 2015, Bamwesigye et al., 2019).

There seem to be consensuses that deforestation is one of the biggest causes of climate change in Uganda and other countries (Nabukalu & Gieré, 2019; Waiswa et al., 2015). There is a possible solution to stop it, especially at the political and policy levels in many nations, including Uganda. Nonetheless, actions such as regulating the logging business, strict protection of natural forests, and addressing some pressing human issues that drive deforestation in Uganda can help reduce the practice.

This study aimed to analyze the possible factors that are said to be fueling deforestation in Uganda and the region sensitively. i.e., to understand the relationship between net forest conversion, energy emission, agriculture, and forest production of Roundwood. An ordinary multiple linear regression, dynamic linear regression (DLR), and multicollinearity statistical tests were conducted to better understand the impact, relationships, and the problem.

Material and methods

The aim paper was to investigate some of the determinants of deforestation and forest development in Uganda. To achieve this objective, we considered some factors/variables that are significant to the study. It is well-known that time series analysts have a different approach to analyzing economic data (Granger, 1981). Assessing the impact of the independent variables, we considered several tests which aim at getting a linear regression using the Ordinary Least Squares (OLS). However, we used both normal ordinary least squares and a dynamic linear model to conduct our outline goal of the study. These tests included summary statistics, correlation matrix, the autocorrelation of the error terms, Unit root, and multicollinearity.

The study used a secondary data source from the Forest and Agriculture Organization of the United Nations (FAO) from 2004 to 2016. A summary statistic was carried out using the observation number of 13 of all the variables to obtain the mean and the standard deviation. A correlation matrix is to check the relationship between the variable and how they influence each other. We employed the Augmented Dickey Fuller test (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to check for unit root test presence in the selected variables. Unit root tests help to determine whether the time series is stationary or non-stationary. The method of testing whether a time series has a unit root or equal in value is that the variable follows a random walk (Dickey & Fuller, 1979). We used the variants constant and Trend (time), without constant and with constant. The equations below indicate the test for all the variants.

$$\Delta Y_t = \beta_1 Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta Y_{t-1} + \mu_t \text{ .... (1)}$$

$$\Delta Y_t = a_0 + \beta_1 Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta Y_{t-1} + \mu_t \text{ .... (2)}$$

$$\Delta Y_t = a_0 + a_1 t + \beta_1 Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta Y_{t-1} + \mu_t \text{ .... (3)}$$

However, under the KPSS unit root testing, the null hypothesis (H_0), μ_t is constant, and the variance of ε_t is zero. The alternative hypothesis (H_1), μ_t is a random walk, and the variance of ε_t is positive. The KPSS is shown in equation 4.

$$X_t = r_t + \beta_t + \varepsilon_1 \text{...... (4)}$$

The KPSS test is build on linear regression, which breaks up the time series into three parts (a deterministic trend (β_t), a random walk(r_t), and a stationary error (ε_t) in the above regression equation. We performed a multicollinearity test using the variance inflation factors (VIF). It is greatly known that the symptoms of multicollinearity in a regression model is an increase in variance of regression coefficients. The approach of variance inflation factors VIF ($\hat{\beta}_j$) indicates the relative variance of the j-th coefficient of regression. It holds that VIF ($\hat{\beta}_j$) ≥ 1. If VIF ($\hat{\beta}_j$) exceeds the limit of 10, severe multicollinearity in the model. The variance of j-th regression coefficient can be written as in equation (5).

$$\text{Var}(\hat{\beta}_j) = \frac{\hat{\sigma}_e^2}{(1-R_j^2) \cdot \sum_{i=1}^{n}(x_j - \bar{x})2} = \text{Var}(\hat{\beta}_j) = \frac{\hat{\sigma}_e^2}{\sum_{i=1}^{n}(x_j - \bar{x})2} \quad \text{.... (5)}$$

However, the multicollinearity assumption states that none of the regressors should be a perfect or linear combination. Multicollinearity violates the classical assumption.

Conversely, verifying for no autocorrelation between predicted variables and the error terms from the regression outputs in our first model, we used the Durbin-Watson (DW) autocorrelation test. The null hypothesis (H_0): there is no first-order autocorrelation, and the alternative hypothesis (H_1): there is first-order autocorrelation. The test statistic calculation is shown in equation two (6).

$$d = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_t^T e_t^2} \quad \text{..... (6)}$$

In the dynamic linear model, we used the Breusch-Godfrey test for autocorrelation up to order 5. The Durbin Watson is ruled out because it cannot test for a regression model with a lag of the dependent variable at the right side of the equation. Breusch-Godfrey can test for autocorrelation of the highest order.

The significance level used for this is 5%. The p-values can be used as an index of the "strength of the evidence" against the null hypothesis(H_0) (Fisher, 1925). The proposed level of p=0.05, or α"1 in 20 chance is being exceeded by chance", is a limit for statistical significance (fisher, 1935). Fisher's reiterated the p= 0.05 (5%) threshold explained the logic, stating that it is usual and convenient for experimenters to take 5% as a standard level of significance. The study prepared results but ignored all outcomes that fail to reach this standard (Fisher, 1925).

Empirical Framework

As forestland conversation is significant for environmental protection. It is important to understand the impact of net forest conversion in Uganda. Therefore, the main objective of this study is to understand the relationship between net forest conversion, energy emission, agriculture, and forest production of Roundwood. For this reason, the study proposed two different regression models by using net forest conversion as the dependent variables and the others as regressors. The net forest conversion is measured in hectares, Roundwood production in meters(m^3), and emissions are measured in carbon dioxide (CO_2) equivalent. These two models are the ordinary multiple linear and dynamic linear regression models, as shown in Equations 7 and 8.

$$NFC_t = \beta_0 + \beta_1 Ag_t + \beta_2 Em_t + \beta_3 Fpr_t + \varepsilon_t \text{.... (7)}$$

Under the model equation (7) of the ordinary least squares, we expected agriculture to be positive, energy emission positive, and forest production Roundwood negative. In contrast, we anticipated the same sign coefficients from the variables but with an increased constant value in the dynamic linear model.

$$NFC_t = \beta_0 + \beta_1 + \beta_2 Fpr_t + \beta_2 Ag_t + \beta_3 Em_t + \beta_4 NFC_{t-1} + \varepsilon_t \text{.... (8)}$$

Where NFC is the Net Forest conversion, Ag is Agriculture, Em is Energy emission and $\beta_4 NFC_{t-1}$ is lag of the dependent variable. Also $\beta_1, \beta_2, \beta_3$, and β_4 are the regression coefficients, ε_t represents the error term, and β_0 constant term of the obtained model. All the analyses were done using Gretl software.

Results and Discussion

Our results were significant at 1%, 5%, and 10%. We restricted our significance level to 5%. Based on the regression output from both ADF and KPSS tests showed that there was a unit root presence in the time series. The unit root presence showed that the time series were non-stationary. Under the ADF test for unit root, the null hypothesis of unit root presence is equal to 1, and the asymptotic p-value was used to check whether there was a unit root or not. The table of the ADF test showed there was a unit root (Table 1). The KPSS test had the null hypothesis of no unit root present in variables based on the critical value. Analyzing the critical value from the KPSS table indicated a unit root presence. The results showed no multicollinearity among the variables as they were lower than the set value for severe multicollinearity (Table 2).

Model 1 of normal classic OLS seemed good. This showed that the constant was significant, and so were the regressors' coefficients. However, the forest production of Roundwood had a negative impact on net forest conversion. Net conversion had a positive effect on energy emissions and agriculture. The dependent variable for the model was Net Forest conversion. Model 1 is not affected by autocorrelation, heteroskedasticity, and specification error. Normality from model 1 had constant variance (Table 3).

Tab. 1: Unit root test results (ADF)

Variables	constant and Trend	Without Constant	With constant
Net Forest Conversion	Constant (0.06886*), Time (0.0968*), asymptotic p-value (0.5634)	Net forest conversion (0.2852), asymptotic p-value (0.2852)	Constant (0.4241), Net Forest conversion (0.8091), asymptotic p-value (0.8091)
Agriculture	Constant (0.0684*), Time (0.2019), asymptotic p-value (0.2274)	Agriculture (0.9616), asymptotic p-value (0.9616)	Constant (1.76e-05***), agriculture (6.39e-16***), asymptotic p-value (6.388e-16)
Energy emission	Constant (0.0281**), Time (0.5249), asymptotic p-value (0.3352)	Energy emission (0.8526), asymptotic p-value (0.8526)	Constant (0.0188**), Energy emission (0.1121), asymptotic p-value (0.1121)
Forestry Production Roundwood	Constant (0.0529*), Time (0.0656*) asymptotic p-value (0.5094)	Forestry production roundwood (1) asymptotic p-value (1)	Constant (0.4120), Forestry production roundwood (0.8794), asymptotic p-value (0.8794)

Source: Own analysis using Gretl

Tab. 2: KPSS Unit root test

Variables	Without Trend	With Constant and Trend
Net Forest Conversion	Constant (1.68e-61***), test statistics (0.384119), Interpolated p-value (0.089)	Constant (3.43e-56***), time (0.0001***), test statistic (0.0991501), P-value (> .10)
Forestry Production Roundwood	Constant (1.15e-15***), test statistics (0.45005), Interpolated p-value (0.056)	Constant (5.81e-20***), time (4.57e-11***), test statistic (0.117718), P-value (> .10)
Agriculture	Constant (2.28e-19***), test statistics (0.407545), Interpolated p-value (0.078)	Constant (1.25e-18***), time (5.74e-06***), test statistic (0.13465), Interpolated p-value (0.084)
Energy emission	Constant (2.06e-08***), test statistics (0.310885), p-value (> .10)	Constant (0.0004***), time (0.0483**), test statistic (0.10082), P-value (> .10)

Conversely, a robust approach was applied to reduce the standard error inaccuracy to improve the model's efficiency. The dynamic linear model in model 2 looks much better than model 1 because it had the lowest information criteria. The lower information criterion made the model much better and fit it well.

Tab. 3: OLS (model 1)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	51.0945	0.00208528	$2.450\text{x}10^{4}$	$1.60\text{x}10^{36***}$
Agriculture	$7.61799 \text{ x } 10^{7}$	$2.65769 \text{ x } 10^{7}$	2.866	0.0186**
Energy Emission	$2.14532 \text{ x } 10^{6}$	$5.73729 \text{ x}10^{7}$	3.739	0.0046***
Forestry Production Roundwood	$-3.03214\text{x}10^{10}$	$4.33369 \text{ x}10^{11}$	−6.997	$6.35\text{x}10^{5}$
Mean dependent var	51.09254		S.D. dependent var	0.000519
Sum squared residual	1.82e-07		S.E. of regression	0.000142
R-squared	0.943528		Adjusted R-squared	0.924705
F (3, 9)	50.12414		P-value(F)	6.11e-06
Log-likelihood	99.08520		Akaike criterion	−190.1704
Schwarz criterion	−187.9106		Hannan-Quinn	−190.6349
rho	−0.170643		Durbin-Watson	2.091400

The regression output for model 2 (Table 4) was based on heteroskedasticity-autocorrelation robust error using the Bartlett Kernel standard errors without truncation. The output of the dynamic linear model gives similar impact signs to the coefficients of the regressors in model 1. However, the lag of the dependent variable is not statistically significant. The coefficients in model 2 increased due to

limited size, which may have caused bias in the regression coefficients. However, there was no heteroskedasticity among the error term. This indicated that the error term had a constant variance. The normality for model 2 showed that the error term was normally distributed based on the p-value.
The Breusch-Godfrey test (table 8) indicated no autocorrelation among the error terms. The autocorrelation was performed up to lag 5. The p-values from the standard errors testing for serial correlation at 5% significance indicate no autocorrelation among the error terms.

Tab. 4: Dynamic Linear Model (Model 2)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	58.0027	9.06016	6.402	0.0004***
Forestry Production Roundwood	−3.56524x10^{10}	8.44400x10^{11}	−4.222	0.0039***
Agriculture	9.86756x10^{7}	3.52195x10^{7}	2.802	0.0265**
Energy Emission	2.79492x10^{6}	9.20668x10^{7}	3.036	0.0190**
Net Forest conversion	−0.135229	0.177339	−0.7625	0.4706

Mean dependent var	51.09250	S.D. dependent var	0.000522
Sum squared residual	1.58e-07	S.E. of regression	0.000150
R-squared	0.947443	Adjusted R-squared	0.917411
F (4, 7)	77.46977	P-value(F)	7.09e-06
Log-likelihood	91.85875	Akaike criterion	−173.7175
Schwarz criterion	−171.2930	Hannan-Quinn	−174.6151
rho	−0.212254	Durbin's h	−0.931832

Tab. 5: Breusch-Godfrey test

	coefficient	Standard error	t-ratio	p-value
const	3.40209	13.7058	0.2482	0.8271
Forestry Production roundwood	−4.87696x10^{11}	1.00606x10^{10}	−0.4848	0.6757
Agriculture	1.22528x10^{7}	3.90384x10^{7}	0.3139	0.7833
Energy Emission	−8.43410x10^{7}	6.52524x10^{7}	−1.293	0.3254
Net Forest conversion_1	−0.0665740	0.268265	−0.2482	0.8272
uhat_1	−0.847832	0.457970	−1.851	0.2053
uhat_2	-1.45126	0.508613	−2.853	0.1040
uhat_3	−1.63631	0.522725	−3.130	0.0887 *
uhat_4	−1.30817	0.687414	−1.903	0.1974
uhat_5	−0.944448	0.434299	−2.175	0.1617

Conclusion

This paper assessed some deforestation and forest development determinants in Uganda from 2004 to 2016. Using the ADF and KPSS test to check for the unit root presence in the variables, the results showed unit roots in the selected regressors. The OLS method analyzed the determinant of net forest conversion in Uganda compared to other techniques because it has several advantages over other alternative approaches. The was 94% variation explained in the dependent variable (Net Forest conversion). The outcome of the dynamic linear regression showed that agriculture and energy emission had a positive impact on net forest conversion, whereas forest production of Roundwood had a negative effect. The test on multicollinearity shows no severe multicollinearity among the variables. However, the test for autocorrelation in the error term using Breusch-Godfrey indicates no serial correction. Based on our findings, this study concludes by recommending more modernized agriculture by the government and individuals as it would boost production activities without cutting down forests. It also suggested that, as forest Roundwood production is negatively impacting net forest conversion, there is a need for the government to develop new ways of ensuring effective and efficient usage of forest Roundwood products. The limitation of this analysis can be a result of the small sample data size. However, further research needs to employ a large data sample size to carry out the same study to determine whether these variables would be statistically significant. Also, further research about this study could separately assess the short and long runs effect of the present situation on the future of Uganda's net forest conversion.

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Souhrn

V průběhu let se v Ugandě alarmujícím tempem snížil trend přirozených lesních ploch, a proto je třeba prozkoumat možné příčiny. Ztráta této biologické rozmanitosti a ekosystémů představuje riziko dezertifikace a extrémních klimatických podmínek. Vzhledem k tomu, že svět směřuje k nulovému odlesňování do roku 2030, je pochopení určujících faktorů odlesňování a degradace lesů nanejvýš důležité. Hlavním cílem této studie je proto pochopit dopad a vztahy mezi čistou přeměnou lesů, energetickými emisemi, zemědělstvím a produkcí kulatiny. Použili jsme údaje FAO za období 2004-2016. Pomocí ADF a KPSS testu jsme ověřili přítomnost jednotkového kořene v proměnných. Ve studii byly také použity dva různé regresní modely; obyčejná vícenásobná lineární a dynamická lineární regrese. Výsledek dynamické lineární regrese ukázal, že zemědělství a energetické emise pozitivně ovlivňují čistou přeměnu lesů, zatímco produkce kulatiny má negativní vliv. Na základě našich zjištění tato studie doporučuje ugandské vládě modernizaci zemědělství, aby se přestaly kácet lesy ve velkém měřítku.

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MODIFICATION OF BEACH SHORES - STABILIZATION OF THE HULÍN AREA

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Abstract
The grassland of a stream bank slope reinforces soil surface and, to a great extent, prevents the occurrence and development of erosion. When proposing suitable grass mixtures, we work on recommendations (Marhoun 1991, Šlezingr, 2005)
This will be the subject of a contribution.

Key words: Reservoir, water, beach,. recreation, bank, grass

Introduction
It is necessary to realise that grassland composition, its endurance, overall involvement and consequential viability depends on the number of created and sufficiently developed individuals in the first two to three months after seeding. Although seeding is the most common method of establishing grassland, it is not the only one.

Materials and methods
1. Establishment of Grassland by Seeding
Prior to seeding, the laying of a humus layer on disturbed planed stream bank slope is expected. The follow-up seeding is manual, or mechanisms may be used, from early April to late August. Seeds need to be fertilised in the soil by rolling. If possible, watering in the first month and top dressing are important. To prevent the undesirable development of weed, one or two weeding treatments are necessary after approx. 8 to 12 weeks of seeding. The protective function of stands starts to work within only 2 to 3 months of seeding.
2. Establishment of Grassland by Sodding
For fast and almost immediate effective grassing of banks, so-called sodding may be used. Sods can best be obtained from an adjacent site (meadow, pasture) that has approximately the same site conditions as the locality being reinforced. Sods shall be taken by means of special knives, cutting strips approx. 40 – 50 cm wide. Separate the strips from subsoil using a shovel to achieve optimal sod thickness. Thus removed grass strips shall be divided into squares with sides of 40 – 50 cm. The produced sod should immediately be placed on the site being reinforced.
3. Establishment of Grassland by Hydro-seeding
This is a hydraulic method of seeding when a mixture of seeds, water, fertiliser, organic substance and anti-erosive additives are sprayed under pressure. In this way, inaccessible slopes and other places can be re-vegetated. Within seeds, the prescribed grass mixture or seeds of tree species can be used.
4. Other technologies

In addition, pre-planted grass carpets, especially wherever an immediate aesthetic and stabilisation effect is requested, divided stabilisation strips, slope stabilisation by means of coconut or jute nets placed on the seeded area (prevents erosion) etc. can be used.

Examples of Composition of Grass Mixtures

Grass mixtures for the eulitoral zone:	kg/ha	% share
Smooth meadow grass	31	25
Swamp meadow grass	19	10
Annual ryegrass .	5	2
Reed canary grass	50	55
Meadow foxtail	17	8

Grass mixture for the supralitoral zone:	kg/ha	% share
White clover	15	11
Swamp meadow grass	12	9

Red fescue	20	15
Timothy	10	7
Annual ryegrass	5	. 4
Smooth meadow bluegrass	25	. 18
Creeping bentgrass	6	5
Meadow fescue	30	20
Perennial ryegrass	15	11

Grass mixtures with a high <u>erosion control</u> effect :	kg/ha	% share
Smooth meadow bluegrass	40	40
Red fescue, cultivar Tamara	38	25
Chewing's fescue	28	15
Perennial ryegrass	30	20

Results

Of course, grass mixtures may be modified according to particular conditions, or specific requirements and purpose of grassing. Details can be found, for instance, in the publication Vegetace v úpravách vodních toků a nádrží, L. Novák a kol.

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Souhrn

V rámci stabilizace břehů vodních toků a nádrží hrají vhodné travní porosty zásadní roli coby součást vegetačního doprovodu. Ten dělíme na břehové a doprovodné porosty. Břehové porosty – tedy porosty od hladiny vody po břehovou čáru - jsou základem protierozního a protiabrazního působení. V patě svahu tvořícího břeh je většinou navrhována technická či biotechnická stabilizace a výše po svahu přebírá stabilizační působení vhodná vegetace – dřevinná i bylinná.
Na nádržích s plážovými břehy (sklon do cca 10 stupňů) právě vhodný travní porost velmi dobře stabilizuje břeh především nad zónou výběhu vlny při maximální nejčetnější hladině. Pod touto zónou je pláž či vytvořená abrazní plošina nejčastěji tvořena písky či jemnozrnným štěrkem

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MONUMENTAL TREES AS A NEW PHENOMENON OF RECREATIONAL LANDSCAPE UTILIZATION

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Abstrakt
The contribution presents results of terrain mapping of monumental trees in the area of floodplain forests along the confluence of Thaya and Morava rivers in the Czech Republic. The study region is located within the Lower Morava Biosphere Reserve and is part of NATURA 2000. Therefore, this region represents an important object from the viewpoint of recreational landscape utilization, where monumental trees, so-called veterans, can increase the tourist potential of this region, especially in the context of the overall decline of monumental trees in the European landscape. Currently, the monumental trees are disappearing mainly due to ongoing climate change, changes in groundwater levels as well as fungal diseases.
Based on terrain mapping, a total of 648 trees were recorded in the categories: A) *veterans* - trees with largest dimensions in the region, B) *candidates* - trees with the potential to grow to veteran dimensions, and C) *fallen trees or torsos*. The following parameters were identified: GPS position, stem girth, tree height, crown diameter and health status. We recorded 245 *veterans* and 80 *candidates* for different tree species. Of this number, 69 trees grew as solitaires, i.e. the trees most attractive to the public using the area for recreation. This data can serve as a source of information for forestry management, nature conservation and recreational landscape use.

Key words: recreation, solitaire tree, tree veterans

Introduction
Trees are a natural resource, they have been associated with human life since time immemorial. The wood of the trees accompanies him from the cradle to the coffin. And above all, monumental or otherwise important trees have always been admired and worshipped by humans (Hrušková and Úradníček, 2021). The Christian tradition of Central Europe accentuates monumental trees as a necessary complement to sacred buildings in the landscape, remarkable trees also very often coexist with folk architecture and complete the urban structure of village monument reserves). Monumental trees form the basic skeleton of valuable castle parks, city orchards incorporated into the image of city monument reserves and historic settlements (Pacáková-Hošťálková et al., 2004; Kuča et al., 2015; Rudl and Machar, 2021). Monumental trees in the landscape, forests and solitaires are key components of ecosystems. In particular, old trees – solitairs represent the key habitats for huge number of biota and can serve as ecological niche for the spread of this species to the surrounding forest stands (Slach et al., 2016). Pollard willow trees or almost dying torsos are also very attractive from decorative point of view. Many monumental trees that have reached old age and massive proportions are scientifically valuable habitats, we often call these old trees veterans or "tree old men". Trees connection of the present with the past and their memory is also the memory of the nation (Hrušková, Hössl et al., 2017).
The first scientist who studied monumental trees in Bohemia and Moravia was Chadt-Ševětínský. He pointed out the largest trees of individual species and monumental trees became the first destination for tourists (Chadt-Ševětínský, 1899). Many years have passed since then, and monumental trees have entered in to the Central List of Nature Conservation in the Czech Republic and become protected by law. There are more than 53,000 items in the database (https://drusop.nature.cz/portal/). But there are still a large number of trees, for example in Pohansko (studied area), which are not protected.
The return to the study of monumental trees began again in our country during the 1990s. Not only NATURA 2000 habitat mapping has contributed to this, but also the television project "Trees are Watching Us" initiated by PhDr. M. Hrušková. Monumental trees have become popular in various competitions: Brno City Tree (2002), Tree of the Year of the Czech Republic and European Tree of the Year - organized annually by the Partnership Foundation. There is also an European initiative ECTF - European Champion Tree Forum, which unit together more than 300 people from all over Europe, dealing with monumental trees. One of the meetings took place also in the Czech Republic in 2016 (Hrušková, Úradníček, 2016).

The aim of the study was: 1) to mapping large tree species in a selected area; 2) to identify solitary trees as attractive trees to the public for recreation and 3) to evaluate the health status of these trees.

Materials and methods

Mapping of monumental trees was performed in the area of floodplain forests along the confluence of the Thaya and Morava rivers in the Czech Republic (Fig. 1). The studied area covers 4000 ha situated in the cadastral territory of the city Lanžhot, where the mean annual rainfall reaches 500 mm and the mean annual temperature 9.6 °C (Miklín and Hradecký, 2016). The area is relatively flat with a maximum elevation difference of 35 m. The area spreads on river geological sediments, while the higher sandy parts (called 'hrudy') represent remains of old dunes. A several-metre-thick layer of flood soils and clays has been deposited since the twelfth century as a result of deforestation of higher parts of the river basins (Miklín and Hradecký, 2016). The study area is located within the Lower Morava Biosphere Reserve and is part of NATURA 2000. The regulation of the Thaya River and the construction of three artificial water reservoirs above the studied area had direct anthropogenic impacts on this floodplain ecosystem (Šenfeldr et al., 2021). Since 1993, the revitalization was initiated using a system of channels and sluices, leading to an increase in the groundwater table (Maděra 2001) in selected parts of the Thaya River floodplain forest ecosystem. The most common tree species in the area are pedunculate oak (*Quercus robur*) and narrow-leaved ash (*Fraxinus angustifolia*). There are associated other tree species such as hornbeam (*Carpinus betulus*), field maple (*Acer campestre*), lime (*Tilia cordata*), European white elm (*Ulmus laevis*), field elm (*U. minor*), black and white poplars (*Populus nigra*, *P. alba*), white willow (*Salix alba*) (Klimo et al., 2008).

The mapping of monumental trees, so-called veterans, took place from 2018 to 2021. The mapping of trees took place through a systematic walking of the study area. Data from the studies Dreslerová (2011) and Miklín et al. (2016) were used as supporting material. The trees were evaluated as monumental according to the established registration values of the girth at breast height (Tab. 1) and according to the criteria of veteran trees (Read, 2000).

The following data were recorded for every mapped tree: GPS position, biotope (solitaires, edge of a forest stand, in the forest stand, riparian forest stand - trees located next the river or channel), diameter at breast height (GBH), tree height, crown diameter, health status and vitality (by the classification Kolařík et al. 2005). The mapped trees were categorized into three groups: veteran trees, candidates trees, fallen trees and standing torsos. All the data were recorded, processed and mapped using the app ArcGIS Collector and Esri ArcGIS (Desktop and Online) software.

Fig. 1: Localisation of the study area

Tab. 1: The species registration limits of girth at breast height (GBH) for their classification as the monumental trees.

Genus	GBH (cm)	Genus	GBH (cm)
Quercus	500	*Aesculus*	300
Fraxinus	400	*Juglans*	300
Populus	400	*Robinia*	300
Salix	400	*Acer*	300
Tilia	400	*Pyrus*	250
Ulmus	400	*Malus*	200
Carpinus	300	*Crataegus*	100

Results

In total, we recorded 245 veterans, 54 candidates and 349 fallen trees and torsos for 13 tree species (Fig. 2). The highest number of both veterans and candidates was recorded for *Quercus robur* (68 veterans, 38 candidates), and second highest number was found for *Fraxinus angustifolia* (49 veterans, 5 candidates). Some tree species were represented only by very low numbers of their veterans and candidates occurrence (*Populus nigra* – 5, *Aesculus hippocastanum* – 1, *Tilia cordata* - 3, *Tilia platyphyllos* - 1). The detailed distribution of recorded tree species within individual categories is presented in Fig. 3.

Most of the veterans as well as candidates were recorded in biotope category forest stands (111) and their edges (82), while 69 trees occurred solitary. The lowest number of trees occurred in riparian forest stand biotope category (Fig. 4).

Most trees were classified to critical health category (27%) while less proportion of trees (8%) showed excellent health status. Detailed distribution of trees in health status categories is showed in Fig. 5.

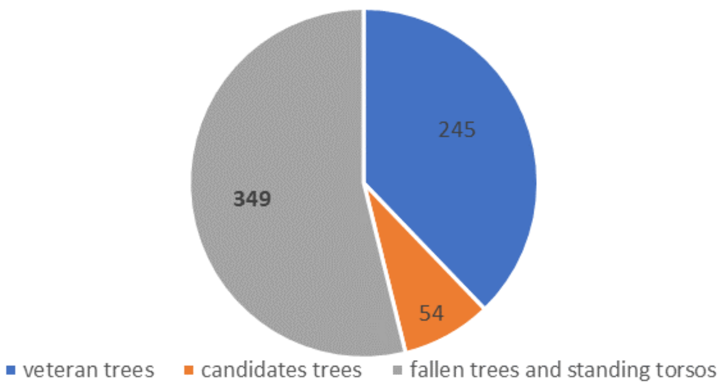

Fig. 2: Number of recorded trees in the categories: veteran trees, candidates trees, fallen trees and standing torsos

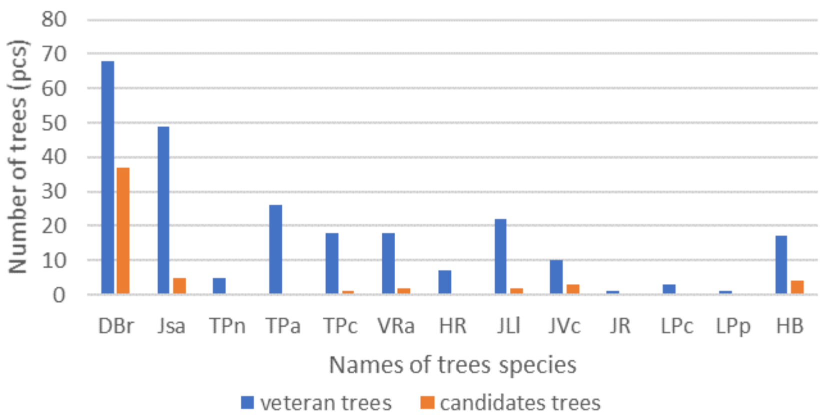

Fig. 3: Numbers of trees by the trees species and categories. DBr – *Quercus robur*, JSa – *Fraxinus angustifolia*, TPn – *Populus nigra*, TPa – *Populus alba*, TRc – *Populus canescens*, VRa – *Salix alba*, HR – Pyrus pyraster, JLl – Ulmus laevis, JVc – Acer campestre, JR – *Aesculus hippocastanum*, LPc – *Tilia cordata*, LPp – *Tilia platyphyllos*, HB – *Carpinus betulus*

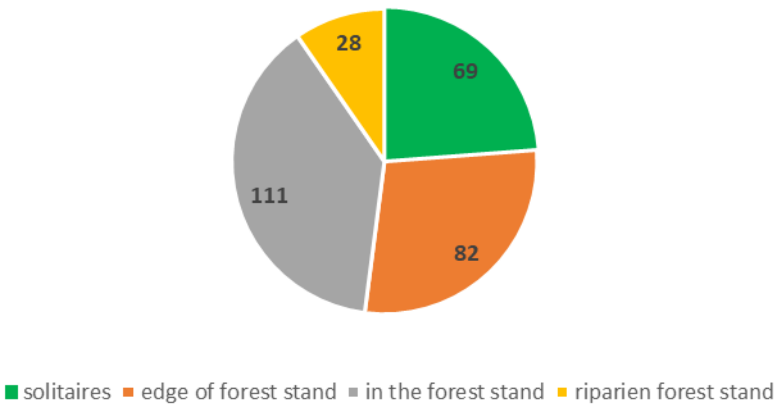

Fig. 4: Numbers of veteran a candidates trees by the biotope

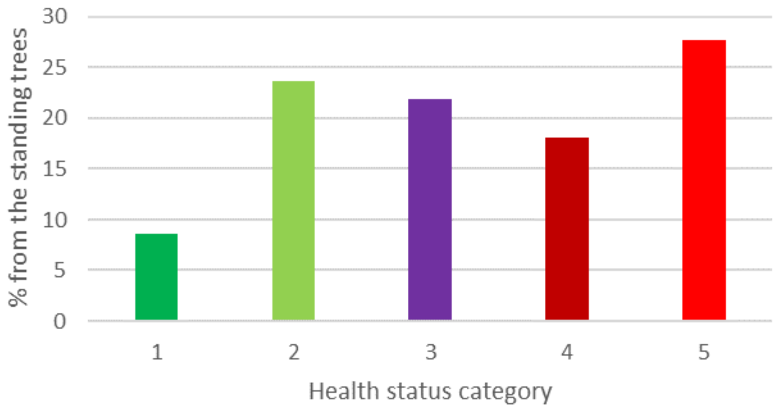

Fig. 5: Health status category expressed for the standing trees. Category 1 - excellent health up to Category 5 - critical health (Kolařík et al., 2005)

Discussion

In our study, we recorded 245 veterans, 54 candidates and 349 fallen trees or torsos. Most of these trees were oaks, ash trees, poplars and elms. The veteran trees have the greatest value for biodiversity as well as tourism (Machar et al., 2020). Only 69 trees have been recorded as solitary trees, which are considered to be most attractive for public in terms of recreational land use. The considerable decline of veteran trees during recent period is visible according to our results as most trees showed critical health status. This is caused by a wide range of biotic and abiotic factors (Klimo et al., 2008). The increasing drought severity with related decrease of groundwater levels as well as insects and fungi diseases (Klimo et al., 2008) represent the key factors which negatively affecting veteran tree health (Klimo et al., 2008). The effect of these influences is intensified by ongoing climate change (Kowalska et al., 2020). Most of the recorded tree species are sensitive to these health complications. Oaks as well as ash trees suffer from a drop in groundwater level caused by Thaya and Morava river regulation during 1970s and recent precipitation deficits (Šenfeldr et al., 2021). While ash trees show strong sensitivity to groundwater level fluctuation and drought (Šenfeldr et al., 2017), the oak revealed to be more resistant to these environmental variables due to its deeper root system better eliminating negative decrease of groundwater levels. On the other hand, the 1990s river revitalization activities led to back increase in groundwater levels, in some parts of the study area and had the positive effect on tree vitality (Šenfeldr et al., 2021).

Based on long term forest management experiences, the preservation of surrounding trees and shrubs in close proximity of veteran oaks is key for their survival. The surrounding trees and shrubs prevent the stems of veteran oaks to direct sunlight which doesn't make them so attractive to insects (e.g. *Cerambix cerdo*, *Lucanus cervus*). The removal of shaded trees/shrubs can cause very quick dieback of oak veterans.

During several last decades, ash trees have declined due to ash necrosis caused by the fungus *Hymenoscyphus pseudoalbidus* (Chandelier et al., 2011). This disease currently has a very negative effect on ash vitality and decrease their decorative value due to defoliation. Elms are long-term threatened by Dutch elm disease (Strobel and Lanier, 1981). Therefore, it is necessary to pay attention to veterans and especially to candidates, so that these trees continue to serve as the attractive tree for the public and recreational use of the landscape.

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Souhrn
Článek prezentuje explorativní výzkum mapování významných stromů v oblasti lužních lesů podél dolních toků řek Moravy a Dyje. Šetřené území je součástí UNESCO Biosférické rezervace a částí NATURA 2000. Jedná se tak o atraktivní lokalitu rekreačního využívání krajiny, kde významné stromy, tzv. veteráni můžou zvyšovat turistický potenciál území, zejména pak v kontextu jejich celkového ubývání v krajinném prostoru. Mizejí zejména z důvodů houbových chorob, poklesu hladiny spodní vody a přicházejících klimatických změn.
Při mapování bylo zaznamenáno celkem 648 stromů v kategoriích veteráni (stromy největších tloušťkových dimenzí v oblasti), čekatelé (stromy s potenciálem dorůst dimenzí veteránů) a padlé stromy či torza. Zjišťovány byly následující parametry: GPS poloha, obvod kmene, výška, průměr koruny, nasazení koruny a hodnocení zdravotního stavu. Celkem bylo vymapováno 245 veteránů a 54 čekatelů různých druhů dřevin. Z tohoto počtu rostlo 69 stromů jako solitéry, tedy stromy nejvíce atraktivní pro veřejnost využívající oblast k rekreaci. Většina z těchto stromů byly duby, jasany, topoly a jilmy. Z hlediska památkových stromů mají největší hodnotu. Bohužel je však vidět značný úbytek veteránských stromů v posledních letech. Příčinou jsou probíhající klimatické změny a abiotické/biotické poškození stromů. Většina vymapovaných dřevin je na tyto zdravotní komplikace citlivá. Duby i jasany trpí poklesem hladiny podzemní vody způsobeným regulací řek a deficitem srážek (Šenfeldr et al., 2021). Jako problematické se ukazuje odstraňování keřového patra nebo oslunění kmene dubů (způsobené jejich výrazným uvolněním), kdy jsou následně napadeny tesaříkem. V posledních letech ubývá jasanů v důsledku nekrózy jasanu způsobené houbou *Hymenoscyphus pseudoalbidus* (Chandelier et al., 2011). Jilmy jsou dlouhodobě ohroženy grafiózou jilmů (Strobel a Lanier, 1981). Je proto nutné věnovat významným stromů a zejména stromům - kandidátům, aby tyto stromy i nadále sloužily jako atraktivní stromy pro veřejnost a tedy rekreační využití krajiny.
Data získané v této studii můžou také sloužit jako zdroj informací pro management lesního hospodářství, ochrany přírody a rekreačního využívání krajiny.

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NATURAL POTENTIAL OF KVEMO KARTLI REGION IN SOUTH-EASTERN GEORGIA

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Abstract
Georgia, despite its relatively small territory, has a large number of valuable natural resources. Kvemo Kartli is a region distinguished by the indigenous natural wealth and beauty of Georgia. The province of Kvemo Kartli consists of six rayons or districts. This paper was focused on Bolnisi rayon.
In this article, we also focused on the impact of climate change and land use change on natural potential in Kvemo Kartli Region. For the purposes of this task, a land use scenario was created on the basis of the delimitation criteria, where the extreme land use changes were made. As a result, approximately 90% of the deciduous trees were removed from this scenario and replaced by short grass. The use of water on forested land is generally greater than that of other land-use types, which leads to reduced flows from river basins. Although forests have obvious effects on flood events for small-scale catchments, the effects of forests on floods are likely to be minimal for large-scale catchments. Climate change and land use change will not significantly affect natural potential.

Key words: Recreation, climate change, land use change scenario

Introduction
Georgia, despite relatively small territory, has a number of valuable natural resources. The climate is one of the most important components of recreational resources. Georgian climate is rather comfortable that gives an opportunity to develop the sphere of resorts and tourism. The variety of natural and climatic zones makes it possible to build coastal and mountain climate resorts, balneoclimatic and balneotherapeutic health resorts of which the most promising are resorts located in seaside and mountainous areas (Paresishvili and Mirzaeva, 2015).
Changes in land use may cause land degradation, defined as the temporary or permanent decline in the productive capacity of the land while the soil completely loses its productive capacity (Hlavčová et al., 2019). Agricultural activities on large blocks of land are considered as one of the main anthropogenic factors negatively influencing soil erosion and the landscape ecological stability, which however could be eliminated by effective landscape management activities (Výleta et al., 2019).
Climate change is causing an increased incidence of forest fires and changes in forest communities (Abram et al., 2021; Venäläinen et al., 2020). It is therefore clear that climate change and related land use change have a significant impact on potential natural.
In this paper, we focused on the development of a land use change scenario and soil moisture simulation for estimating potential changes under the changed land use conditions.

Material and methods
Study area
Kvemo Kartli Region is located in eastern Georgia, about 60 km south of Tbilisi. It borders the Republics of Azerbaijan and Armenia. The territory of Kvemo Kartli includes the municipalities of Bolnisi, Dmanisi, Tetritskaro, Tsalka, Marneuli, Gardabani and the city of Rustavi. The population is 424 thousand people. The administrative center of the region is the city of Rustavi. Kartli is spread in semi-desert, arid subtropical and high mountainous alpine zones. The region is rich in rivers. They mainly belong to Ktsia-Khrami and Algeti basins. Their number reaches 2422, the total length is 6980 km (Elizbarashviliet al., 2006).
By the end of the century on the eastern Georgia plains, in particular in Kvemo Kartli, annual precipitation amount will decrease by 50% or more, and will be only 150–200 mm, and the precipitation daily maximum will decrease by about 20 mm and be only 10–15 mm, which naturally intensifies desertification processes of steppe and semi-desert landscapes. In the large parts of eastern Georgia, annual precipitation decreases, decadal trend composes 1–3%. The largest decreasing in rainfall trend is observed in Kvemo Kartli, The same trends are reserved for precipitation in warm and cold periods of the year (Elizbarashvili et. al, 2019).

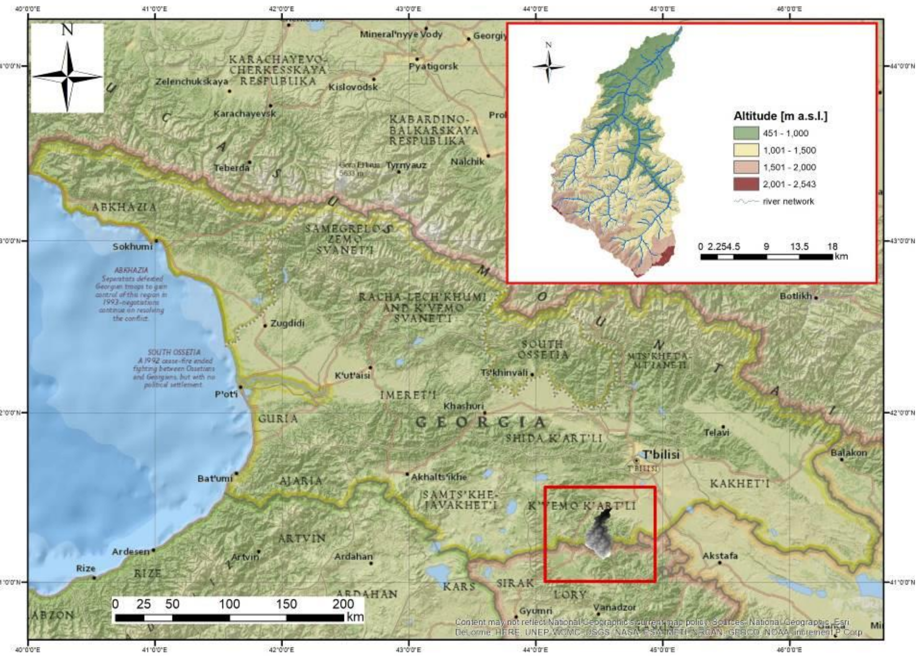
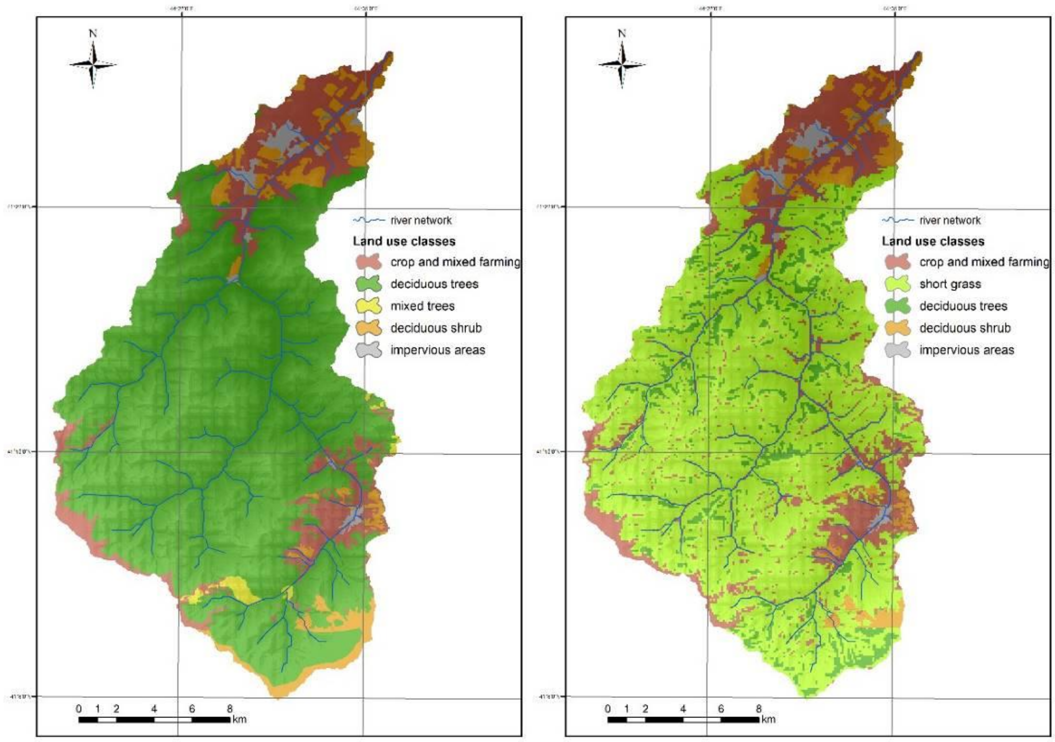


Fig. 1: Location Bolnisistskali River basin in Kvemo Kartli region.

Land use change scenario
An analysis of the land use in a territory involves the calculation of the individual areas of the land use. We are therefore talking about the percentage of each type of land use utilized in the catchment (Fig. 1). As part of this work, we have been working with the current land use and a land use change scenario. The land use scenario was created on the basis of the combination of the slope characteristics and land use classes (Fig. 2). Zones with slopes of less than 12% and covered with grass were changed to cropland. Areas with a declination (12-20%) covered with cropland were changed to grasses. Areas with over 20% slopes, cropland, and grasses were changed to deciduous trees. The percentages of the various land use types are expressed in relation to the total area of the selected river basin. On the basis of the delimitation criteria, the forested areas (-67%) in the scenario were mostly replaced by short grass (+64%).



a) b)
Fig. 2: a) Map of the current land use; b) Map of the land use change scenario.

To simulate the soil moisture from the basin, the physically-based WetSpa rainfall-runoff model was used. The model uses geospatially referenced data as the input for deriving the model parameters, which include most data types supported by ArcGIS, such as shape files, grids, and ASCII files. Digital maps of the topography, land use, and soil types are the 3 base maps used in the model, while other digital data are optional, depending upon the data availability, the purpose, and the accuracy requirements of the project (Wang et al., 1996).

Results and Discussion

The dynamics of mean daily soil water content in the diagnosed horizon of the soil aeration zone has a cyclical character with a one-year repetition period at study site. In most years of the analyzed period, this cycle can be divided into saturation period and period of discharge. Soil water content is increasing since the autumn with peak in the early spring months (Fig. 3). The beginning of the growing season is manifested by a significant decrease in winter reserves and the availability of soil water is fully influenced by the actual precipitation. This situation may generate conditions for plant water stress.

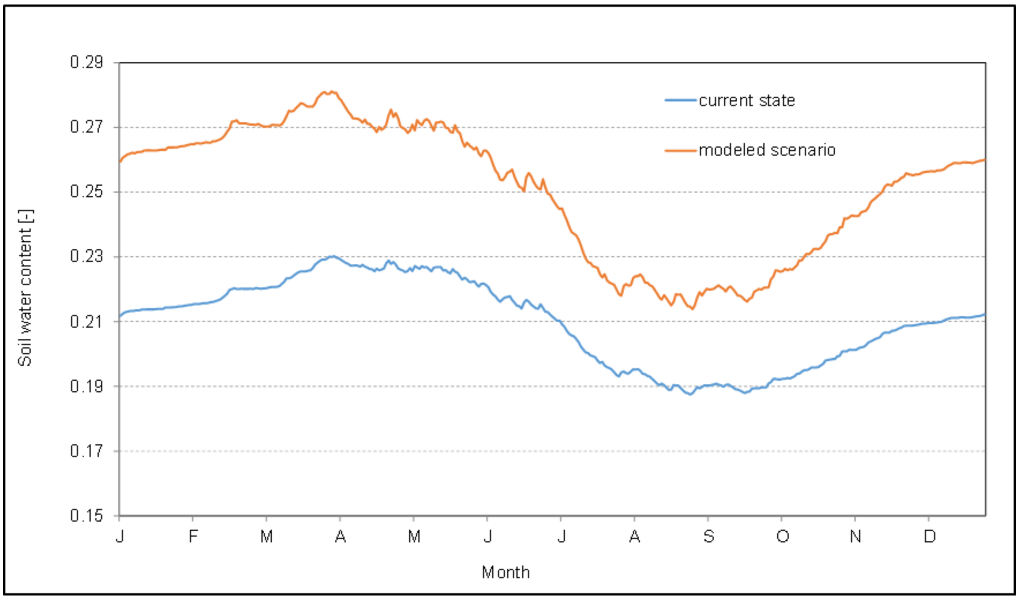


Fig. 3: The cyclical course of mean daily soil water content from period 1971–1985 estimated for 2 land use scenarios

Land use change scenario showed a positive effect on a soil water content at study site, as according to the modeling results, there was a statistically significant increase in the mean annual soil water content within land use change scenario compared to the current state. Such a change in land use, although relatively extreme, will not adversely affect the natural potential in Kvemo Kartli.

Conclusion

This paper describes the possible impact of land use change on the component of water balance. Soil moisture is important in many hydrological processes. Therefore, it is important to know their behaviour in the change conditions, especially how the land use change affect soil moisture. The soil moisture changes were evaluated by comparing the simulated average soil moisture for the current state and the land use change scenario. Land use change scenario showed a positive effect on a soil water content at study site, as according to the modeling results. The created scenario was also used to analyse the ability of the Wetspa model to simulate changes in land use. The WetSpa model demonstrated sufficient ability to simulate soil moisture under changing land use conditions.
One more aspect of the issue under consideration is environmental safety assurance. Along with the growth in demand for natural resources, anthropogenic impact on the environment grows as well; economic activities considerably damage flora and fauna of the country. Rational nature management, introduction of resources-saving technologies, waste recycling, water purification, land recultivation and some other arrangements will reduce negative impact on the environment.

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Souhrn

V tomto článku jsme se zaměřili na vývoj scénáře změny využití půdy a simulaci půdní vlhkosti pro odhad potenciálních změn v podmínkách změněného využití půdy. Na základě dosažených výsledků lze konstatovat, že změna využití půdy nebude mít negativní vliv na přírodní potenciál. Hodnoty půdní vlhkosti se zvýší, čímž se sníží riziko půdního sucha. Na druhou stranu může změna klimatu způsobit zvýšení počtu lesních požárů a změny ve složení lesů. V tomto výzkumu byl vytvořený scénář použit také k analýze schopnosti modelu Wetspa simulovat změny ve využití půdy. Model WetSpa prokázal dostatečnou schopnost simulovat vlhkost půdy v podmínkách měnícího se využití půdy.

Region Kvemo Kartli má rozhodně bohatý přírodní potenciál, ke kterému je třeba přistupovat zodpovědně. Důležitá je také snaha o využití jeho potenciálu, avšak na rozumné a udržitelné úrovni.

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NATURE PROTECTION IN EDUCATION AT SLOVAK SCHOOLS

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Abstract
Awarness of nature protection is an important issue in education. Environmental studies should be understood in the Slovak school system as a cross-cutting theme. Due to the fact that the separate subject of environmental education is not taught, it is necessary to introduce the current topic to students in a different way. A new educational program is coming under the auspices of UNESCO. EkoOlympiad is a knowledge game that offers topics related to climate change, nature protection, recreation and the environment. The game is intendet for 2nd grade primary school students and all secondary school students. The competition takes place in four environmental themes – water, climate change, waste and biodiversity. More than 6 109 students took part in the EkoOlympiad. In the preparatory phase, students had the opportunity to train one topic separately each week for four weeks. One competition topic was gradually unlocked each week of the month. The preparatory phase contained only a few questions, which were later published in the regular competition rounds.

Key words: environmental educiation, climate change, waste, water, biodiversity

Introduction
Environmental education has grown significantly in recent years (Števulová et al., 2017). Environmental topics are part of general subjects in schools. Despite these facts, a separate subject curriculum has not yet been developed. For this reason, the concept of environmental education based on sustainable development was created. The base output of the environmental activities were three parts: Eco centrum, Ecolab, and educational trail. The recommended form for implementation of cross-cutting themes is the project method. The method can create a space to connect educational process with other activities. The project method allows theoretical facts to more engaging way. Problem lectures or workshops are applied within the project method (Zemko, Jakab, 2015).
In the spring of 2022, the civic association Plant Lover presented the historically first Eco-Olympic festival (Ekoolympiáda) for primary and secondary school students. The Eco-Olympic is a knowledge game, which educates pupils and students in a playful way in the field of environmental and climate protection. It is a new, innovative way of educating in environmental education through the digital form, which is the easiest way for today's young people to acquire knowledge.
Eko-Olympis is a project implemented through the web application hra.ekoolympiada.sk, which is accessible to all students free of charge. Interested students from secondary and secondary school students can register and from that moment on they can train online, ie test their knowledge and answer questions. Each week is devoted to another important topic such as water, biodiversity, waste, climate change.
The Eco-Olympic game works on one training and two competition rounds. The training round lasted four weeks and each week was dedicated to one of four selected topics. Thus, during the four weeks, students had the opportunity to learn and review all the questions available for all topics. The questions in the game were formulated simply and according to the needs of the target groups.

Materials and methods
The pilot project Eko-Olympic was accomplished under the auspices of UNESCO. The main goal was to reach primary and secondary school students, and to raise environmental awareness in this target group. At the beginning, four selected environmental topics were defined – water, climate change, biodiversity and waste, which formed the mainstay of the content of the competition.
In the four selected topics, students had the opportunity to gain a basic overview of environmental and ecological issues, but they could also gain new knowledge and insights. The education was conducted in a modern and welcome form among students through a web application that students could install on their mobile phones. The whole game was in the spirit of test questions. In the four selected areas, students had a list of questions with three or four answers. The answers could all be correct, all incorrect, or only one correct or one incorrect.
During the test round, students could prepare for the first round of the competition, and competition questions were hidden among the training questions. The principle of learning was to repeat the game

as many times as possible. The longer a student played the game, the more correct answers he could get, because the game could be repeated indefinitely.
The questions and answers were formulated through the available literature (Wilson-Powell G., 2020). The first round of questions focused on a basic overview and statistical data taken from the mentioned literature. The second round of questions, to which several winning students from the first round advanced, followed up on the questions from the first round. Students had to think more critically and deduce the correct answers to the selected questions. Statistical processing of data from the Ecolympics is described in the following chapter.

Results

At the beginning, the unit of measure - player - was determined. The player was the student who played at least 50 questions. Of the total number of final registered students 9 078 were 7 145, which represents 78,7%. More than 3 000 schools (primary and secondary) were involved in the game.
Awareness of the Eco-Olympics spread through various information channels, but especially through social networks and through well-known Slovak artists and olympic athletes.
A detailed analysis and statistics of the results are still ongoing, but some results from the Eco-Olympic are currently available. The results can be divided into several categories, because in a project of this scale, various important indicators can be evaluated. The 5 best indicators of the Eco-Olympic are selected from the results.

1. The most active school - up to 166 players took part in the sharp game (according to the set unit of measure).

Students could participate in the game independently, during registration the name of the student - the competitor, the name of the teacher who nominated him for the competition and the school in which the teacher and the student attend. The motivation for students but also for teachers was the prize, where the first prize is an excursion to one of the most sustainable buildings, located in Lausanna, Switzerland in cooperation with the Slovak Olympic and Sports Committee. In the training round, students and teachers could use this application to deepen their knowledge, but also as a teaching equippment.

2. The most advancing students from one school to the finals – 6 high school students from High school in Bratislava.
3. The most played questions for the school – 81 853 questions, correct 54 325 of these.
4. The most correct answers – 13 007 correst answers.
5. The most successful topic – climate change with success 73,5%.

Other topics according to the achieved success of the answers:

- biodiversity – 64,8%,
- waste – 68,1%,
- water – 59,6%.

Students could play the training game without a time limit, they could play it several times. The main aim was to get as many correct answers as possible, and thus to gain as much knowledge as possible. The training round was to serve as an educational tool for students for the two competition rounds. It competed in three categories - 5th and 6th grade elementary school students, 7th, 8th and 9th grade elementary school students and high school students. In all categories, the winner with the most correct answers was chosen. If two students had the same number of correct answers, the one who answered the questions correctly in less time won.

Discussion

In the further statistical processing of the results, it will also be possible to point out the correctness of the answers to each individual question. From such an analysis, it is possible to deduce which area caused problems for the students in their answers and which, on the contrary, was the easiest for the students. The game can also be adjusted and modified according to the needs of the company for future years. Topics and topics can be added or changed up to date, the content of individual questions can be supplemented from other recommended literature. Due to the fact that this is a pilot project and thus the first year of this type of educational form, it is appropriate to consider improvements that will bring results to pupils and teachers in the form of increasing awareness, understanding and knowledge. Environmental knowledge are so important in education (Baryalai et al., 2013, Zeleňáková and Zvijáková, 2014).
At the same time, it is planned to implement a function in the next year that will guide students in the correct answers in an interpretative way. Currently, the application works on the principle of answer options. After checking the answer, the student will find out whether his choice is correct or incorrect. The new feature will give students an explanation - why the answer is correct and why the answer is

incorrect. In this way, the students' knowledge of the selected topic will increase, as they will be offered a source and an explanation of the issue. The awarness of environmental education will significantly increase nature protection and tourism as well.

Conclusion

The Eco-Olympics project has the potential for voluntary education in schools. Many teachers used the application as a teaching equipment in their lessons. Pupils learned a lot of new facts and data and in the second round of competition questions they had the opportunity to connect theoretical contexts from several areas into one whole.

The next year of the competition will be extended by new thematic areas. During the questions and answers, students will have a series of data and facts that will provide an explanation for the question. After reading the explanation, students will learn more new facts, but most importantly they will have a better explained subject matter.

The Eco-Olympics is currently only a project based on voluntary participation, because the subject Environmental Studies is missing in the curriculum, as well as teaching materials. However, with such projects it is possible to achieve systemic change and the inclusion of a new subject in schools.

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Souhrn

Pilotní projekt Ekoolympiáda vznikl pod záštitou UNESCO. Ekoolympiáda je projekt moderní formy vzdělávání žáků základních a středních škol prostřednictvím webové aplikace. Žáci mají možnost vyzkoušet si hru ve stylu školní olympiády, kde hledají správné odpovědi na otázky. Otázky se zaměřují na čtyři témata - voda, odpady, biologická rozmanitost a změna klimatu. Otázky jsou metodicky formulovány pro všechny soutěžní ročníky (5., 6. a 7. třída, 8. a 9. třída, žáci středních škol). Soutěže se zúčastnilo více než 9 000 žáků, z toho 7 145 hráčů (podle měrných jednotek). Do soutěže se přihlásilo více než 3 000 škol. Z každé kategorie byl vybrán jeden vítěz, který jako první cenu získal cestu do Švýcarska se svým učitelem.

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NEW POSSIBILITIES OF INCORPORATING THE HRANICE ABYSS INTO HIKER ROUTES

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Abstract
The Hranice Karst is an exceptional karstic area in the Czech Republic and Europe due to its hydrothermal genesis. In 2016, the Hranice Abyss was declared the world's deepest flooded abyss. Our study aims to propose appropriate measures that enable, once implemented, hikers and experts to benefit from visiting the territory while avoiding excessive damage to the natural world. Only the dry part of this deepest flooded abyss globally is visible to the average tourist. With its depth of 69.5 m and the fact that it is also hidden in the forest, the ordinary tourist misses other spatial contexts. Our proposed solution is constructing a lookout tower that would allow the hiker a view into the mouth of the abyss while staying safe and secure. Additional advantage involves the possibility of viewing the slopes of the Bohemian Massif (approx. 8–20 km away in northern direction) and the Beskydy Mountains that geologically belong to the Western Carpathians (the distance of approx. 20–40 km in N-E direction). This would provide a clear overview while giving realistic ideas about the geological and geomorphological forms of what is a region extending along the border of two geological units of European importance. For speleological research it is necessary to provide the descent down the slope of the abyss to the lake. The proposed option is the installation of via ferrata type belay at natural rock steps and the mounting of a metal staircase.

Key words: Hranice Karst, Hranice Abyss,Teplice nad Bečvou spa, lookout tower, via ferrata

Introduction
The hypogenic karst of *Hranický kras* (Hranice Karst) is located in a small outcrop (~5 × ~3 km) of Devonian to Mississippian carbonates located in the eastern part of the Czech Republic (N 49°31′, E 17°45′), at the line of contact between the eastern Bohemian Massif and the Outer Western Carpathians. Its most significant surface feature – the Hranice Abyss – was declared the deepest flooded abyss in the world in 2016. Our recent research is mainly focused to related issues in geology and hydrogeology (Sracek et al. 2019). The Hranice Abyss has thus fallen into the zoom-in range of domestic and foreign tourists and its visitor numbers have clearly multiplied. However, in the long term, there is no project or study dedicated to the sensitive and valuable accessibility of this exceptional site.
Furthermore, visiting caves and the need for their specific protection is a very specific issue. Visiting inaccessible caves within the framework of speleology professionals and enthusiasts is often missed out. However, in the context of the ever-increasing interest in what is referred to as outdoor activities, these activities cannot be ignored either. Visiting inaccessible caves is a potentially dangerous activity (Geršl et al., 2017). In the Hranice Karst caves, the danger is increased by the presence of underground lakes mineral water and layers of the suffocating carbon dioxide.
Our study aims to propose appropriate measures that enable, once implemented, hikers and experts to benefit from visiting the territory while avoiding excessive damage to the natural world.

Lookout tower above the Hranice Abyss
The greatest boom in the construction of lookout towers occurred at the end of the nineteenth century. The reason was the increased interest in tourism and the formation of tourist associations. The oldest tower is considered to be the Minaret in the Lednice-Valtice area, which is 220 years old. In 1825, the first mountain-based lookout tower was opened, Josefská věž located on the mountain of Kleť. The requirements for lookout towers and the possibilities of construction are presented, for example, by Nouza (1999); the possible evaluation of the landscape is dealt with by Hlavatá and Oťahel (2010) and the special meanings of the tower and its other meanings are considered by Drlík (2007).
Only the dry land segment of this deepest flooded abyss globally is visible to the average tourist. With its depth of 69.5 m and the fact that it is also hidden in the forest, the ordinary tourist misses other spatial contexts. Our proposed solution is consideration of the construction of a lookout tower that would allow the hiker a view into the mouth of the abyss while staying safe and secure. Additional

advantage involves the possibility of viewing the slopes of the Bohemian Massif (approx. 8–20 km away in the northern direction) and the Beskydy Mountains that geologically belong to the Western Carpathians (the distance of approx. 20–40 km in the N-E direction) (Fig. 1). This would provide a clear overview while giving realistic ideas about the geological and geomorphological form of what is a region extending along the border of two geological units of European importance. Usually, the presence of a lookout tower streamlines the steps of hikers so that sensitive natural places can be protected.
A lookout tower that would allow meeting these requirements would have to be located on the outer edge of the Hůrka u Hranic National Nature Reserve, along the extended axis of the Hranice Abyss, about 40 m southeast of the current viewing platform.

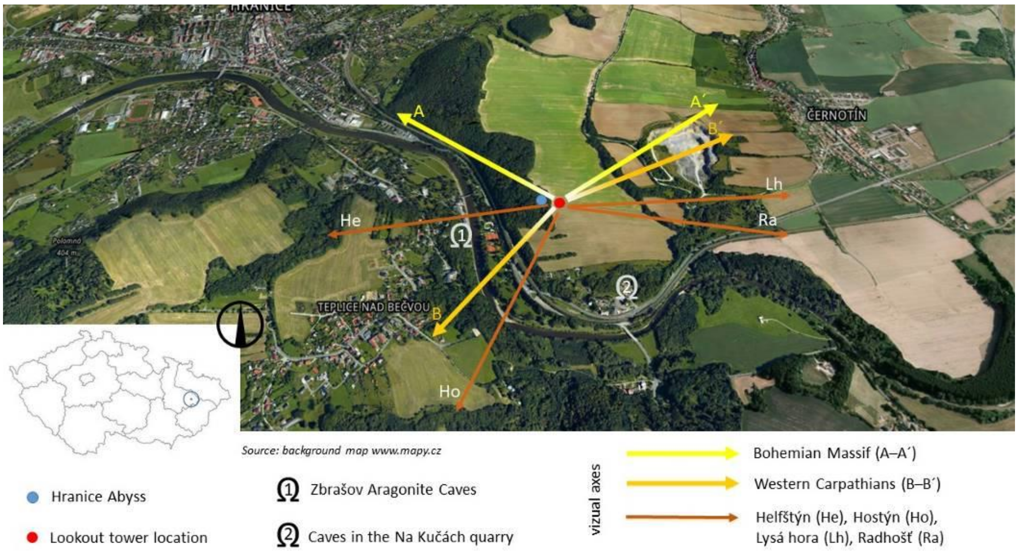

Fig. 1: An overview of wider territorial relations.

Access to the Hranice Abyss in history
The mouth of the Hranice Abyss has been *de facto* open to the general public since time immemorial. Making the Hranice Abyss accessible to the general public has already been implemented in the past in various forms. In historical times, the method of access route modification changed. The implemented staircase was also documented several times in writing and pictures. The most famous are the paintings of Josef Heřman Agapit Gallaš from 1816, which show a wooden staircase leading down the north-eastern part of the slope to the lake (Fig. 2). Later, in 1819, it was elaborated by J. Hess as a copper engraving and used with additional description in K. Nesrsta's work (1820). Finally, it is also used in an understandable form in works by J. Skutil (1934).
Gradually, all of the historical installations deteriorated and none of the technical elements has survived to this day. In the last century, for visitor safety and conservation reasons, access was restricted to research purposes only.

Fig. 2: Technical design of the staircase in the Hranice Abyss by J. H. A. Gallaš in 1816 (Skutil, 1934).

Proposal to make the Hranice Abyss accessible

The Hranice Abyss is the subject of scientific research, and speleological diving research is constantly being carried out here. Other research activities include monitoring of the local bat colony or botanical and ornithological observations. Undoubtedly, this is a very special site, which with its specifics attracts researchers from fields very distant from classical speleology and geology, i.e. people who may not be prepared to move in difficult terrain (e.g. television crews or research on non-tuberculous mycobacteria Pavlík et al., 2018).

At present, access is more or less by the free movement of people along the slope. The slope reaches a mean value of 45°. As people descend, the soil layer is trampled and eroded. If necessary, artificial steps or toeholds cut into the soil are created. In unfavourable conditions, when the slope is muddy or covered with ice, divers are secured with a static rope installed on fixed points using single rope technique (SRT) elements. However, the topsoil is still being trampled down, erosion continues and, last but not least, the botanical cover is being threatened. There are two options.

The first commonly discussed option is the installation of an uninterrupted metal staircase. The length of such a staircase was determined to be 150 m. This would be a comfortable and safe solution, the disadvantage is the very high purchase cost. Moreover, it would mean a gross negative interference in the natural environment of what is a national nature reserve, which is valuable precisely because it is a virgin natural site almost untouched by human intervention. Design-wise, such a work cannot be reconciled with the intact slope of the Hranice Abyss.

The second option is a secured *via ferrata* route. The path leading down the slope can be secured with a corrosion-resistant steel cable. The rock steps will then need to be equipped with an artificial toehold and a belay rope, all following previous experience and the relevant regulations (ČSN EN 958). The route of this path must, of course, be chosen in such a way as to minimize adverse impact on local objects of conservation. This will ensure safe access to the lake for those involved in the research of the abyss, without significant interference with the local natural settings.

Conclusion

The aim of the present project is the proposal of a lookout tower situated on the outer edge of the Hůrka u Hranic National Nature Reserve, along the extended axis of the Hranice Abyss, about 40 m southeast of the current viewing platform, which would enable observation of the Hranice Abyss and the geographic-geological context of the entire region. An associated role of the lookout tower would be to direct the steps of visitors to the Hranice Abyss to avoid visiting high-value elements of the reserve. The lookout tower would allow the installation of educational materials, preferably in the form of electronic panels. An important role of the lookout tower could be a rather small inner area allowing temporary storage of materials needed for the speleological exploration of the abyss.

Another objective of the project is to design a secured *via ferrata* type descent path to the lake of the Hranice Abyss so that the safe movement of cave divers and other experts can be enabled.

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Souhrn
Hranický kras je svou hydrotermální genezí výjimečným krasovým územím v rámci České republiky i Evropy. V roce 2016 byla Hranická propast prohlášena nejhlubší zatopenou propastí světa. Díky těmto skutečnostem se znásobila návštěvnost této oblasti. Cílem naší studie je návrh vhodných opatření, jejichž realizace umožní turistům i odborníkům přínosnou návštěvu této oblasti a zamezí nadměrnému poškozování přírody. Z nejhlubší zatopené propasti světa je pro běžného turistu patrná pouze suchá část o hloubce 69,5 m, ta je navíc skryta v lese, takže běžnému turistovi unikají další prostorové souvislosti. Námi nastiňovaným řešením je možnost vybudování turistické rozhledny, která by turistům umožnila bezpečný pohled do jícnu propasti. Významným benefitem uvažované rozhledny by byla možnost pohledu na svahy Českého masivu (vzdálenost cca 8-20 km, směr N a na Beskydy geologicky náležející Západním Karpatům (vzdálenost cca 20-40 km, směr S-E). Tento názorný pohled by umožnil realistické představy o geologické a geomorfologické podobě oblasti na hranicích dvou evropsky významných geologických celků. Přítomnost rozhledny také obvykle usměrní kroky turistů tak, že mohou být ochráněna citlivá místa přírody.
Hranická propast je předmětem vědeckého bádání. Pro přístup k jezeru je proto nutné zabezpečit sestup po svahu propasti až k plošině u hladiny. V žádném případě nelze uvažovat o umožnění přístupu široké veřejnosti. Jako nejcitlivější i ekonomicky nejpříhodnější se jeví možnost zajištěné cesta typu „via ferrata“.

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POSSIBILITIES OF UNUSED RURAL AGRICULTURAL LAND RENEWAL USING STRATEGIES OF CONTEMPORARY ECO-SOCIALISM

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Abstract
In response to the ever-growing need for community life caused by the current anti-social environment, we are increasingly confronted with different concepts and scenarios for open spaces conversions into more sustainable multifunctional areas for all. The presented paper explores the possibilities of restoring arable land located in the eastern part of the municipality Preseľany (Slovakia). The article focuses on the potential use of the space while supporting agriculture and community leisure activities, based on a compromise between contemporary human needs, in the form of high-quality public space, the values of original landscape and the local landscape character. The paper further discusses the challenges of the current food system and green socialism (also known as Eco-socialism), examines various forms of urban edible landscapes, and then comes up with alternative solutions for the site while using the analysed aspects. Considering the size, diversity and different functional content of the researched areas, the proposed interventions focus on a wide variability of possibilities. Research in its final stages outlines how to unify them visually and functionally regarding the fact that the level of comfort in public spaces is assessed based on a physical and social aspects combination. The result is the area zoning into functional units that are interconnected and open to the immediate surroundings within a pleasant walking distance.

Key words: landscape architecture, rural environment, eco-socialism, edible landscapes, social interaction

Introduction
In recent years, there has been an increasing need of people to change their lifestyles (Prochnow, 2020) and consumer habits (Adamková, 2018). Over time, due to the massive suburbanization, the countryside is getting intensively urbanised and, hand in hand with an extremely demanding work effort, people are looking for opportunities to have nature-based recreational activities in their surroundings (Castello & Back Prochnow, 2021). Because of constant pressure on space, it is important to incorporate functions and qualities associated with greenery in the development of rural agriculture (Marques et al., 2020). Responsibility towards the environment, combined with community responsibility (Lukas-Sithole, 2020) and the pursuit of meaningful leisure time, is the result of an increasing interest in horticultural and agricultural activities (Tóth & Timpe, 2017). In our conditions, agriculture is understood as a sector of the economy whose main task is to provide food (Tóth et al., 2015). Hence, food production is generally not part of the daily life of people who live in cities and there are only few examples in Slovakia, where rural arable lands and their premisses are an important recreational hub for citizens provides the social, educational, recreational, and cultural dimensions (Calaza-Martínez et al., 2019). Therefore, it is necessary to address the ideas of eco-socialism (Baša & Mura, 2021) as a possible alternative. Eco-socialist demands constitute a real utopia-a radical but possible transformation (Aidnik, 2022). The aim of this article is to present diverse design ideas, approaches and solutions of various leisure and recreational activities (Tóth et al., 2018) focused on functional diversity of rural arable land within one comprehensive study developed by author at the request of a private company. As part of its activities, the investor operates in agricultural production and intends to expand the business in the production of fruit to his own needs, by selling off surpluses at the local level, but also to gradually build a fruit processing plant.

Materials and methods
The object of design was the area of approximately 90 ha located in the eastern part of the municipality Preseľany (Western Slovakia) (Fig. 1). The current land use of the case-study area is arable land that borders on the residential area of individual housing construction. In the immediate vicinity is the Preseľany Municipal Office, the Parish Church of St. Elizabeth, and a reconstructed historic watermill (on the map marked with a red dot), which is delimited by the river Nitra on the northwest and west side and part of Dlhé Lúky on the east side. On the southern side, the area

borders on a field road. In terms of ecological stability, the case-study area is relatively unstable and does not use its significant potential.

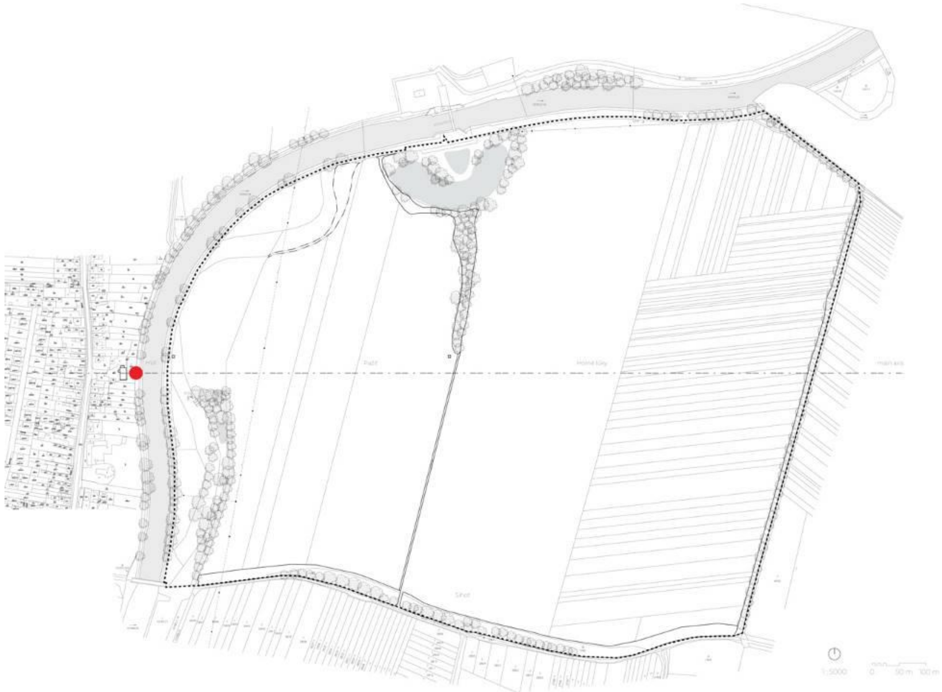

Fig. 1: Wider relations and location of the area.

The predominant land use is production greenery in combination with a commercial-recreational function. The space consists of areas of permanent grasslands, orchards, non-forest tree and shrub vegetation (linear, areal), commercial buildings, and sports/recreation facilities. There are many woody plants in the solved area, but fields and large areas of monoculture plantings still prevail. Woody plants in the area have an environmental, eco-stabilizing and aesthetic importance. These are mainly deciduous tree species typical for floodplain forests (poplars, elders, alders, willows, and lindens). The overall value of woody plants is mostly average to below average. Most of them are in the adult stage of age. The terrain is mostly flat with shallow depressions. Larger landscaping is planned in the northern part of the territory, where two lakes are under construction, and in the southwestern part, where there is one smaller lake. No paved road passes through the area, only a service gravel road running along the Nitra River connecting the entrance to the area with farm buildings and lakes in the north.

The quantitative and qualitative research used in this work is characterised by a certain sequence of steps and stages, which follow each other chronologically and overlap in time. The design process in its initial stages was mainly about field research and analyses of the current state, where the basic shortcomings of the space were identified. After identifying the research problem, the aim of the preparation of the research was to search for and collect primary and secondary available resources dealing with the researched issue and other related publications, to acquire the necessary theoretical knowledge and orientation in the researched field (Čibik & Štěpánková, 2021). Various spatial planning documents and map materials were used to analyse the current situation: territorial plan of the village of Preseľany, Landscape atlas of the Slovak Republic (2002), historical map of the first military mapping, historical map of the second military mapping, historical map of the military mapping of Hungary and aerial photo of the village of Preseľany. An important part of the process was the so-called in-depth interviews with the local stakeholders. In-depth interviews, also called informal or semi-structured interviews, are one of the methods of qualitative research and thus complement data collection through structured formal questionnaires. This method is one of the simplest and most efficient methods of collecting primary data. The interviews are based on intensive personal contact between the interviewer and the respondent. The interview is non-standardised but takes place according to a uniform scenario. The article also implements scientific research methods such as Research by Design as defined by Deming and Swaffield (2011), Hauberg (2011) and van den Brink et al. (2017) and Case Study Research as a tool to analyse design principles.

Results

The results of the design process consist of comprehensive study applied for the whole area (Fig. 2) as well as several detailed landscape-architectural and architectural proposals applied only to selected parts of the space. The design presented in this paper will bring multi-layered activities to the locality. Due to large groundwater reserves and high soil quality, efforts are being made to enhance diversity, mitigate the negative impacts of climate change, retain water in the landscape through bio-corridors and lakes, while raising awareness and creating suitable conditions for recreation and education.

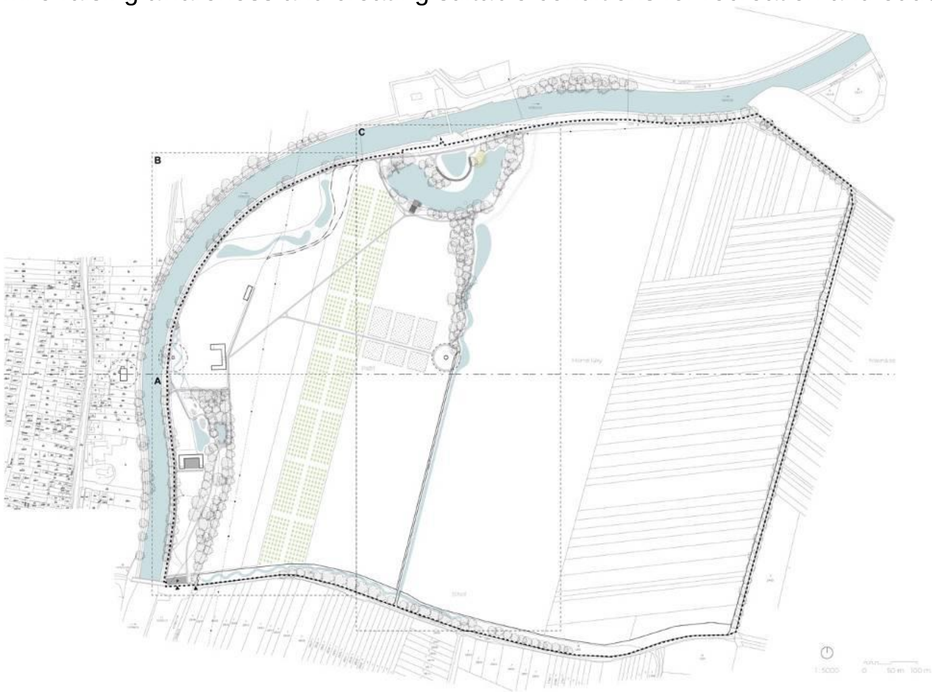

Fig. 2: Site plan of the final design. The whole area was divided into functional zones.

Through demonstrations of agri-environmental-climate measures, visitors will learn about the possibilities of increasing the adaptive capacity of ecosystems affected and used by humans to the expected negative consequences of climate change. The area also demonstrates examples of the use of renewable energy sources such as small hydropower or photovoltaics. Residents and visitors will be able to use hippotherapy and horseback riding, a petting zoo for children, seasonal fruit pick-up and they will have the opportunity to spend their free time meaningfully in an area that is sustainable, naturally scarce and supports biodiversity (Čibik et al., 2019).

Conclusion

This contribution focuses on contemporary trends in landscape design and agrosystems, as well as on finding connections between rural, peri-urban and urban structures through research by design. The presented study is based on a compromise between contemporary human needs, in the form of high-quality public space, the values of original landscape and the local landscape character. The project of adapting an area of approximately 90 ha to climate change in the eastern part of the municipality Preseľany (Slovakia) shows that a quality transformation of the landscape through agroforestry practices using contemporary eco-socialism strategies is possible and promising.

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Souhrn
O potřebě zásadně změnit přístup ke krajině se na Slovensku mluví již několik desetiletí. Tato potřeba je stále narůstající, ať už kvůli ztrátě biologické rozmanitosti, obrovským problémům s půdní erozí nebo narušením vodního režimu v krajině v důsledku jejího velkoplošného odvodnění v minulém století. Přesto je slovenská zemědělská krajina stále světem monotónních polí osetých monokulturami a systémová řešení jsou v nedohlednu. Předkládaný článek prezentuje studii konverze orné půdy v obci Preseľany (Slovensko) na multifunkční venkovský prostor s ohledem na současné trendy v agroturismu a eko-socialismu.

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POSSIBILITIES OF WATER RETENTION SOLUTIONS IN SUBURBANIZED AND AGRICULTURAL LANDSCAPE

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Abstract

The most effective adaptation measure is a suitably designed complex land consolidation (CLC) and the realization of the plan of joint facilities (PJF). However, the only problem is the local effect and duration of the whole process. On average, 151 CLC processes are completed per year, which therefore represents the affected area de facto 151 cadastral areas. The total number of cadastral areas in the Czech Republic (CR) is 13072. However, the CLC process does not mean that designed adaptation measures has been realized. According to the Superme audit office's data (SAO), only 8.7% of the proposed adaptation measures were realized until 2015. It is therefore necessary to look for a faster strategy for adapting to current climate change. This paper addresses the possibilities of placing low-cost retention elements in the landscape, which can be quickly implemented in various variants in small and medium-sized areas on land owned by municipalities. A frequent case of these plots are plowed field roads within large blocks of land. These measures must therefore be adapted in size to the available area within these plots. The network of elements created in this way brings, in addition to increasing the retention, evapotranspiration and erosion protection of the area, also other benefits within the framework of territorial system of ecological stability, landscape character, making the landscape accessible through roads and line water retention elements that also provide cultural intangible services in the sense of increasing the recreational potential of the locality.

Key words: land consolidation, retention, landscape accessibility, recreational potential

Introduction

Land consolidation programme in the CR is the most important instrument for landscape management. The sense of land consolidation can be divided into two parts: 1) organization of individual plots ensuring their accessibility and settling property rights, 2) designing of measures for improvement of environmental conditions, soil protection, water management and ecological stability in the frame of so called Plan of joint facilities (PJF) (Podhrázská et al., 2015; Vitikainen, 2004). Undoubtedly, the most effective adaptation measures against erosion and drought is a properly performed complex land consolidation process (CLC) and the realization of PJF. However, the only problem is the local effect and the duration of the whole process. According to SAO inspection of 2015 on average 151 CLC is completed annually. The total number of cadastral areas in the CR is 13,072. However, the finished CLC does not mean that their realization has been completed. According to SAO data, only 8.7% of the proposed PJF were completed until 2015. However, if we consider only hydrological and erosion control measures and measures to protect the environment, only 5.6% of the proposed measures have been realized. According to another SAO inspection of 2020, 68% of the proposed flood control measures approved under the Plans for Flood Risk Management in the Danube, Elbe and Odra River Basins for the period 2015-2021 will not even start realization until 2022. In the period 2010-2018, 87% of all realized flood control measures were a technical. Thus, these data show that naturally close flood protection measures are not being taken in to account and realized, although they can represent a cost-effective reduction of flood risk and at the same time increase the retention and evapotranspiration of the landscape and reduce the risk of extreme drought. From the mentioned statistical data and the current development, it can be assumed that the CLC and realization of the proposed measures will take place for several more decades. It is therefore necessary to look for a faster strategy for adapting to current climate change. The presented contribution proposes a solution in the form of an retention elements in the landscape to support evapotranspiration and a small hydrological cycle with fast realization potential and minimization of property disputes.

Based on the analysis of cadastral maps and archival aerial photographs, we identified a promising possibility of using areas owned by municipalities. The first phase of the solution therefore consists in the application of the adaptation measures in the area of municipal land in the land blocks, which minimizes property disputes and significantly speeds up the realization of adaptation measures and its positive effects. Emphasis is placed on efficiency, speed of realization and low cost. Part of these measures is also suitable accompanying vegetation, which, thanks to increased retention, will also increase the evapotranspiration of the area and thus also support a small hydrological cycle in the landscape and also other intangible benefits, including the improvement of the recreational potential of the place with the proposed protective, retention and adaptation landscape elements.

Materials and methods

An analysis of the effectiveness of completed CLCs was performed on the basis of documents from the State Land Office (SLO). All completed CLCs in the years 1991 to 2021 were analyzed. It was a total of 2806 CLCs. The analysis focused on several attributes and their development over time - duration, total number of CLCs during the period, ownership fragmentation and number of ownership plots before and after CLC, ownership structure of land used for PJFs, structure of proposed measures and realization percentage of proposed measures.

In order to be able to map potentially suitable areas of municipal land for the realization of the proposed adaptation measures, it was necessary to perform an extensive analysis of digital cadastral maps of the CR. As part of this very time-consuming analysis, polygons of all cadastral territories of the CR were manually downloaded and subsequently land ownership certificates (LOC) were analyzed. After downloading all the data and identifying the ownership certificates of the municipalities in most cadastres, the LOCs were assigned to individual plots using a script. In this way, it was possible to identify municipal land in 12,278 (out of a total of 13,076) cadastral territories of the CR.

Results and discussion

In the first step, an analysis of the effectiveness of CLCs was performed on the basis of data from the SLO. The graph on Fig. 1 shows the trend in the duration of CLCs courses from all evaluated cases, which clearly decreases below 5 years. The average duration for the whole period is 5.74 years with a standard deviation of 5.02 years. According to the graph on Fig. 1, the course of the CLC duration for individual periods is around this average and there is a gradual reduction in the duration to 4 years and also a significant reduction in the standard deviation (SD). It can therefore be expected that in the next period the duration of the CLCs will stabilize and standardize to 4 years for all cadastres.

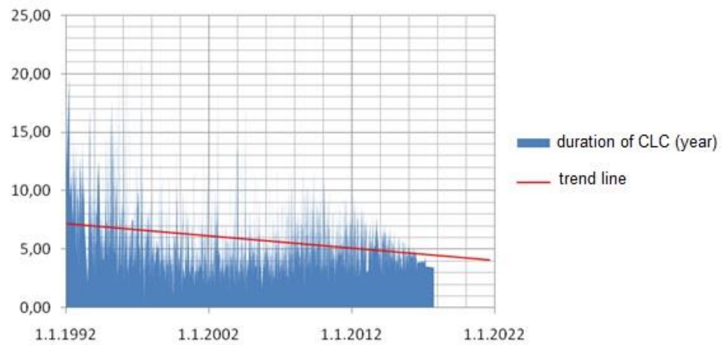

Fig. 1: Average duration of CLCs.

The graph in Fig. 2 shows the culmination in the period 2011 to 2015, when 825 CLCs were started, and the subsequent decline for the period 2016 to 2020, when 110 CLCs less were started.

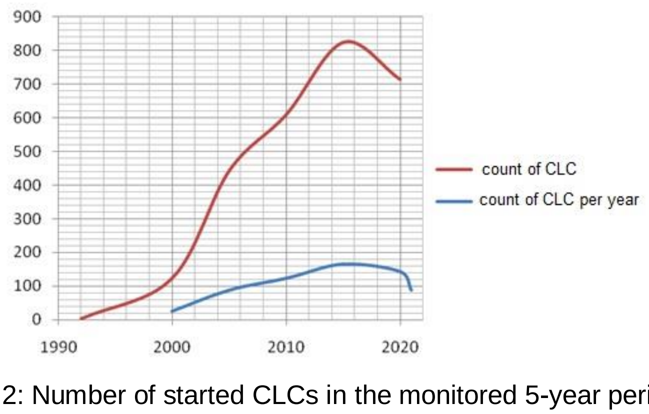

Fig. 2: Number of started CLCs in the monitored 5-year periods.

The analysis of land ownership fragmentation is shown in the graph in Fig. 3. The number of ownership plots before the start of the CLC fluctuates around the average of 1008.56 with a SD of 972.22 during the whole period. In many cases, the number of plots before the CLC can be around two thousand. After the CLC, ownership fragmentation is reduced to an average of 51.75%. The number of ownership plots will therefore be halved. The number of participants in the proceedings averages around 200 with a standard deviation of 220. The ownership structure of the land measured for the PJF is shown in Figure 4.

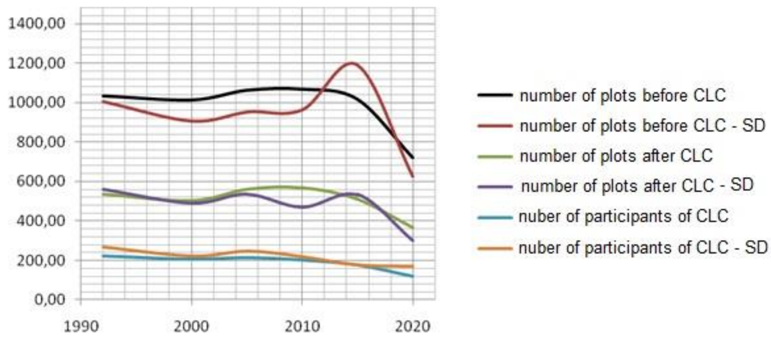

Fig. 3: Analysis of ownership fragmentation before and after CLC.

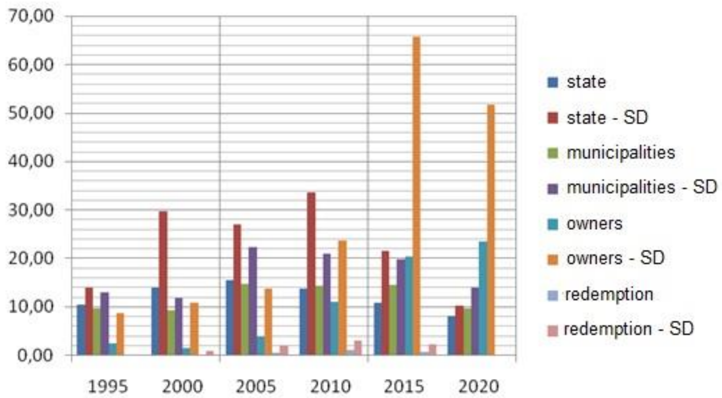

Fig. 4: Analysis of land ownership structure measured for PJF.

Furthermore, the structure of the proposed measures within the PJF (Fig. 5) was analyzed. However, the key problem is the percentage of realizations of the proposed erosion control, ecological and water management measures. This analysis on the graph on Fig. 5 shows that in terms of area, only 16.05% of erosion control measures (ECM), 10.1% of environmental measures (EM) and 40.11% of water management measures (WMM) were realized. It is also important to draw attention to the trend of increasing proposed areas for individual categories of measures and the constantly declining percentage of realizations, with the exception of WMM, where the percentage of realizations for proposals submitted in 2011-2015 increased significantly. In the period 1991 - 2005, an average of 5.87 ha of ECM, 13.66 ha of EM and 2.27 ha of WMM were proposed for each CLC, of which only 18.53% ECM, 11.9% EM and 30.98% WMM was realized. In the period 2006 - 2020, an average of 11.18 ha of ECM, 17.29 ha of EM and 2.29 ha of WMM were proposed for each CLC, of which on average only 6.06% ECM, 3.54% EM and 24.74% WMM were realized. The percentage of realizations of individual types of proposed measures and their development since 1991 is shown on the graph in Fig. 6. Since 2010, the data are incomplete or missing. According to this analysis, it is clear that the CLC cannot respond effectively to ongoing climate change.

It is therefore necessary to look for a faster strategy for adapting to current climate change. The presented contribution proposes a solution in the form of low-cost retention elements in the landscape to support evapotranspiration and a small hydrological cycle with fast realization potential and minimization of property disputes due to the promising use of land owned by municipalities.

The first phase of the solution therefore consists in the application of the adaptation measures in the area of municipal land in the land blocks, which minimizes property disputes and significantly speeds up the realizations and its positive effects. Emphasis is placed on efficiency, speed of realization and low cost. Part of these measures is also suitable accompanying vegetation, which, thanks to increased retention, will also increase the evapotranspiration of the area and thus also support a small hydrological cycle in the landscape.

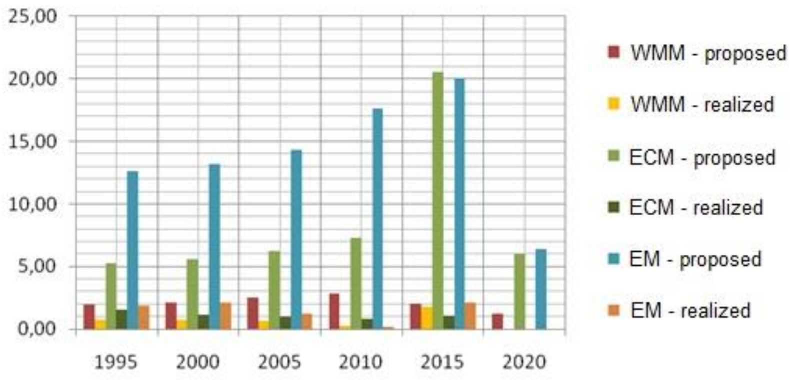

Fig. 5: Comparison of proposed and realized measures (ha).

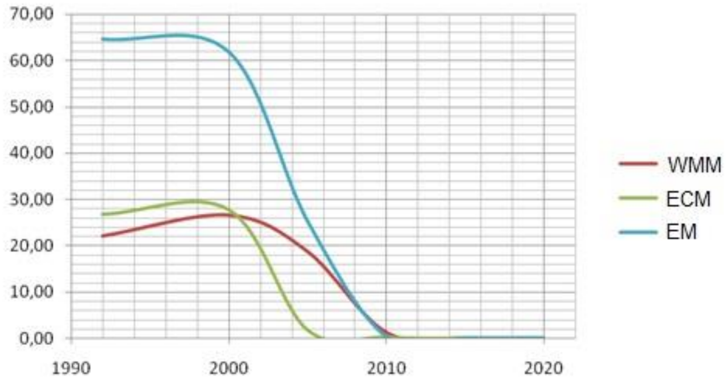

Fig. 6: Development of realizations of the proposed measures (%).

In order to be able to map potentially suitable areas of municipal land for the realization of the proposed adaptation measures, it was necessary to perform an extensive analysis of digital cadastral maps of the entire CR. A total 12,278 (out of the total number of 13,076) cadastral territories of the CR were analyzed. The current area of these municipal lands represents a total of 722,900 ha, which is 11.5 times larger than all erosion control, ecological and water management measures proposed in the CR since 1991. Potentially suitable areas of municipal land for the realization of the proposed adaptation measures are shown in map on Fig. 7. As can be seen from the map, it remains to analyze especially the area of the Šluknov promontory Krnov, Opava, Potštát, Bruntál, Přerov, etc. As part of ongoing research, further differentiation and categorization of these potentially suitable areas for the adapted adaptation measures will take place.

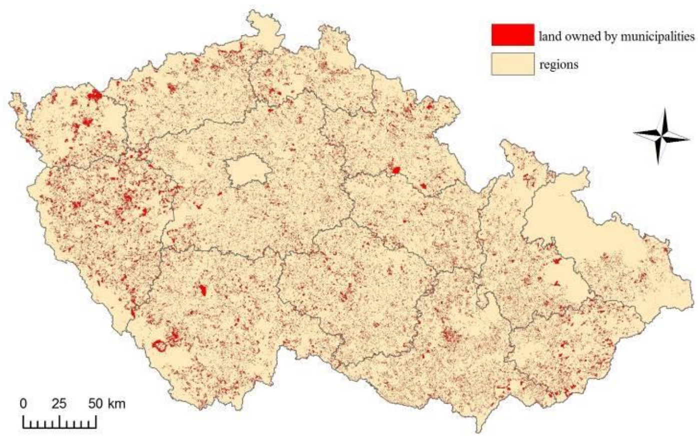

Fig. 7: Potentially suitable areas of municipal land for realization of adaptation measures.

Conclusion

A detailed analysis of the efficiency of land adjustments has been carried out. Based on the analysis of cadastral maps and archival aerial photographs was identified a promising possibility of using areas owned by municipalities for placement of adaptation measures which minimizes property disputes and significantly speeds up the realization of adaptation measures and its positive effects like increased retention and evapotranspiration of the area, support a small hydrological cycle in the landscape and other intangible benefits including the improvement of the recreational potential of the place with the proposed protective, retention and adaptation landscape elements. Base on detail analysis of digital cadastral map of CR were identified suitable plots for placement of adaptation measures of overall area of 722,900 ha, which is 11.5 times larger than all erosion control, ecological and water management measures proposed in the CR since 1991.

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Souhrn

Byla provedena podrobná analýza efektivnosti pozemkových úprav. Na základě analýzy katastrálních map a archivních leteckých snímků byla identifikována perspektivní možnost využití ploch ve vlastnictví obcí pro umístění adaptačních opatření, což minimalizuje majetkové spory a výrazně urychlí realizaci adaptačních opatření a nástup jejich pozitivních dopadů jako jsou zvýšení retence a evapotranspirace území, podpora malého hydrologického cyklu v krajině a dalších nehmotných užitků včetně zlepšení rekreačního potenciálu místa s navrženými ochrannými, retenčními a adaptačními krajinnými prvky. Na základě podrobné analýzy digitální katastrální mapy celé ČR byly identifikovány vhodné pozemky pro umístění těchto opatření o celkové výměře 722 900 ha, což je 11,5 krát větší plocha než všechna protierozní, ekologická a vodohospodářská opatření navrhovaná v ČR od roku 1991.

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POTENTIAL OF WATER MANAGEMENT FACILITIES IN THE HODONÍN DISTRICT FOR TOURISM

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Abstract
In the past, water management facilities were of fundamental importance in the development of industry, transport, and agriculture. Since 1990, there has started a trend to use them in the development of travel and tourism. This survey used old topographic maps from the years 1763-1768, 1836-1852, 1953-1956, current maps and additional database resources from the site www.vodnimlyny.cz. Based on the survey, there were found more than 200 water management facilities in the district of Hodonín in the period from the middle of the 18th to the middle of the 20th century. Water mills and pole wells were the most represented, which indicates the predominant agricultural production with a long tradition in this area. There were also registered numerous ponds for fish production here. In the first half of the 20th century, construction of the Baťa canal facilitated the transport of coal to industrial plants. This waterway nowadays serves as a tourist attraction number one with the possibility of sightseeing cruises and boat rentals. Another example of the use of the potential of the original WMF is the reconstruction of old watermills to expand the offer of accommodation. An original old watermill and sawmill can be seen in the Strážnice Museum of the Villages of South-east Moravia. However, there are further possibilities how to use historical potential of ex WMF in the district of Hodonín, e.g., a placement of new tourist information boards in the vicinity of tourist routes or a building of new nature trails in places with higher concentration of WMF objects.

Key words: water management facilities, water mill, water way canal, Czech Republic

Introduction
Historic water management facilities have a high potential for the development of tourism in regions. In some regions they may point to the beginnings of industrial development (Havlíček et al., 2022), in others to the mode of transport and transportation of goods (Dostál, Havlíček, Svoboda, 2021) or may refer to the importance of food supply, especially in pond areas (Pavelková et al., 2016). Water management facilities are most attractive in terms of tourism in the case of preservation of the building in its original form to operate the building within the museum, exhibition (Havlíček et al., 2020), or in the form of a building with a slightly changed function (e.g., recreational cruises instead cargo shipping). Some of the original water management facilities have rebuilt for other purposes to provide accommodation options in the field of tourism, or the operation of restaurants (Havlíček et al., 2019, Havlíček et al., 2020). In some cases, it is possible to use defunct water management facilities to support tourism, e.g., to place tourist information boards with maps, old photographs, or paintings or to add artefacts associated with the operation of the building there, such as mill wheels, turbines, or their parts. There is also the possibility of using some nature trails or build a new specialized circuit for pedestrians and cyclists (Havlíček et al., 2019).
The aim of this paper is to evaluate the current importance of historical sites of water management facilities in the development of tourism in the district of Hodonín in the Czech Republic. The following partial goal is to evaluate the potential of water management facilities, or their original locations in the development of tourism.

Materials and methods
Old topographic maps were employed to identify and localize water management facilities in the Hodonín district. The oldest map work represented the first Austrian military mapping from 1763-1768. This mapping has already captured WMFs, and other objects related to the use of water resources in sufficient detail, however, its accuracy is considerably limited due to the cartographic methods employed (Janata, Cajthaml, 2021). The other three military mappings from 1836-1841, 1876 and 1953-1955 already provide sufficient positional accuracy for locating objects, which ranges from 15 to 30 m.
To identify the WMFs, the map keys of the old topographic maps were analysed first and created a procedure for working in geographic information systems. Based on an age-long experience that the positional accuracy of military mappings generally improved in later periods, the WMFs were identified firstly on the 3rd Austrian military survey maps (1876). It was then retrospectively evaluated whether these objects were also registered on the previous two mappings from 1836-1841 and 1763-1768.

Subsequently, objects that were displayed only on the first and second military mapping were also added to the database. In addition to map data, the public database of water mills in the Czech Republic (www.vodnimlyny.cz) was also used. All localized objects are displayed below on a map and in a clearly arranged table. For the purposes of evaluating the use of these objects in tourism in the Hodonín district, the current tourist maps available at www.mapy.cz were studied and follow-up field research was carried out.

Results and Discussion

Based on the study of old topographic maps, a total of 233 water management facilities were registered in the Hodonín district. Most of them were registered in 1876, when a total of 115 buildings were identified in this area, the least in 1953-1957 (Table 1).

Tab. 1: Water management facilities in the Hodonín district

Facility type	1763-1768	1836-1841	1876	1953-1957
Grain mill	81	74	72	37
Balance-pole well	2	8	32	4
Floodgate	0	18	1	0
Well	0	1	0	16
Water tower	0	0	0	13
Water bridge	0	0	1	5
Water tank	0	0	3	0
Water refrigerator (Behälter)	1	1	0	1
Dam keeper building	0	0	2	0
Walk mill	1	1	1	0
Fish hatchery	0	0	0	1
Wellspring	1	1	1	0
Hydropower plant	0	0	1	0
Sawmill	0	0	1	0

In all periods, the most common type of building were watermills, their representation was not even throughout the territory, they were mostly concentrated on the Velička watercourse in the west of the district, it is a river with a regular flow springing in the White Carpathians (Fig. 1).
A higher occurrence of water mills was also recorded on the river Kyjovka in the northern part of the territory. Most of the former water mills in the Hodonín district are currently used for housing, some have been demolished, only 2 water mills are used for accommodation (the Hatěcký mill on the river Velička, the Kuchyňkův mill on the river Kyjovka). One mill building was adapted to the restaurant, it is a mill in the village of Velká nad Veličkou. In the case of several non-operating mills, the possibility of changing the original function is being considered, the project of conversion into a library and café in the village of Svatobořice is being developed the most. Rebuilt mills from other parts of the Czech Republic are the inspiration for building accommodation capacities (Havlíček et al., 2020).
In the vicinity of the river Velička, there is an educational trail with a newly installed tourist information board, which introduces visitors to the circumstances of building an above-average number of watermills in the area.
In similar ways, it would be appropriate to use the potential of water management facilities in other localities with their higher concentration, especially at the rivers Kyjovka and Trkmanka.
A reminder of the importance of water mills in the region is presented in the form of an exposition of a water mill and sawmill in the Museum of the Village of Southeast Moravia in Strážnice, the mill building is relocated from the White Carpathians (Fig. 2).
The second most common category of water management facilities in the Hodonín district are balance-pole wells (syn. sweep wells or shadoofs). It is a type of well that is typical of agricultural landscapes in floodplains and lowlands with low groundwater levels. Their current largest representation in European countries is in Hungary.
The potential for the restoration of these buildings in the Hodonín district can be found in every major agricultural village. Balance-pole wells could serve here as a reminder of the typical element that co-

created, even in the relatively recent past, the scenery of rural life in this region and visibly demonstrated the influence of nearby historical territory of today´s Hungary.
In the Hodonín district, the exhibit of the balance-pole well is presented only in the Museum of the Village of South-East Moravia (Fig. 3).

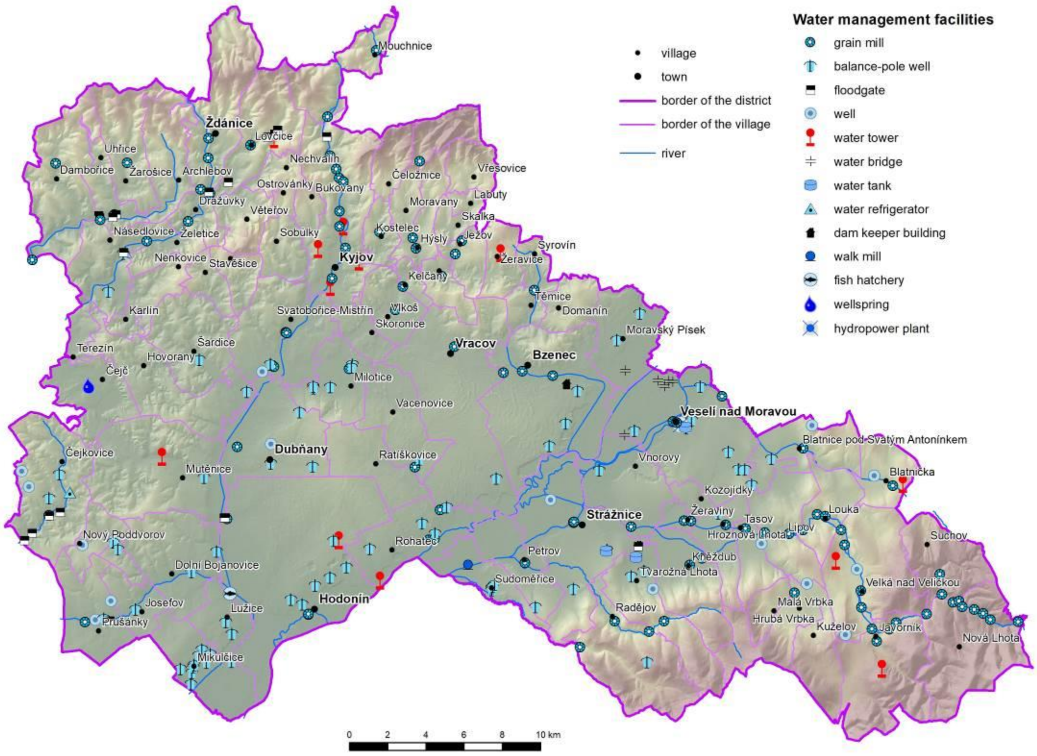

Fig. 1: Water management facilities in the Hodonín district


Fig. 2: The residential part of the mill in the exposition of the Museum of South-East Moravia in the town of Strážnice

Fig. 3: Balance-pole well in the Museum of the Village of South-East Moravia

In the district of Hodonín, there was a high concentration of ponds in the past, as evidenced by the number of registered floodgates in 1836-1841 (Fig. 1). However, the number of water bodies decreased significantly after the construction of sugar factories in the region (Havlíček et al. 2013). The localities of some preserved pond dikes also have potential for tourism. Interesting water management facilities also include a water refrigator (Behälter), mostly a smaller wooden structure for storing food or fish, in which cooling is provided by flowing water.

The most important WMF in the Hodonín district is the Baťa canal, which was built in 1934-1938. It was originally established for the transport of coal from the mine in the village of Ratíškovice to the factories of the Baťa company in the city of Zlín. Today, the Baťa Canal is used for recreational boating and sightseeing cruises (Fig. 4a, 4 b). There are several ports with boat rentals, along the canal are built bike paths and refreshments. However, there is still the possibility of expanding facilities and services, as well as a potential connection with the Morava River to the port in the city of Hodonín.

Fig. 4a, 4b: The Baťa Canal, a dock in Strážnice, a section of the canal around Strážnice

Conclusion

Based on a detailed study of old topographic maps of the First, Second and Third Austrian military mapping, there were identified 233 water management facilities in the Hodonín district. Water mills were the most represented, of which only 3 buildings are currently used for accommodation and meals. Several non-operating water mills offer the possibility of reconstruction to provide accommodation, restaurant services or to place a permanent exhibition.

The tourist information board in the place of higher occurrence of water mills has so far been established only at the cluster of mills on the river Velička. There is still the potential in the district to increase the promotion of preserved but also demolished buildings through new nature trails, information boards or leaflets and other promotional materials for tourists.

Great potential can be seen in the promotion of balance-pole wells, which were most abundant in traditional agricultural areas, especially in the cadastres of villages located in floodplains. Currently, one exhibit of the balance-pole well is presented only in the Museum of the Village of Southeast Moravia in the town of Strážnice.

At the same time, there is also an exposition of a residential building of a water mill and a sawmill, relocated from the surrounding village from the White Carpathians. The most extensive and most important attraction is the Baťa water canal, in which freight transport has been replaced by recreational cruising. However, there is also potential for improving services for tourists.

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Souhrn

Historické vodohospodářské objekty mají vysoký potenciál pro rozvoj cestovního ruchu regionu, mohou poukazovat na počátky rozvoje průmyslu, na způsob dopravy a přepravy zboží, na význam v zásobování potravinami, zejména v rybničních oblastech. Cílem tohoto příspěvku bylo vyhodnocení aktuálního významu historických lokalit vodohospodářských objektů v rozvoji cestovního v okrese Hodonín v České republice. Navazujícím dílčím cílem pak bylo vyhodnocení potenciálu vodohospodářských objektů, případně jejich původních lokalit v rozvoji cestovního ruchu. V okrese Hodonín se nacházelo historicky 233 vodohospodářských objektů. Nejvíce byly zastoupeny vodní mlýny, z nich jsou aktuálně k ubytování a stravování využívány pouze 3 objekty. U několika nevyužívaných vodních mlýnů existuje potenciál k přestavbě objektů pro účely expozice, ubytování nebo restaurace. Informační cedule ke koncentraci vodních mlýnů jsou pouze u řeky Velička, existuje potenciál k vyšší propagaci dochovaných i zaniklých objektů pomocí naučné stezky, informačních panelů, propagačních materiálů v obci. Velký potenciál lze spatřit v propagaci studen s vahadly, které byly koncentrovány v zemědělských obcích v nivách řek. Aktuálně je jeden exponát studny s vahadlem prezentován pouze v Muzeu vesnice jihovýchodní Moravy ve městě Strážnice. Zároveň je zde i expozice obytné budovy vodního mlýna a pily, přenesených z okolní obce z pohoří Bílých Karpat. Největší atrakcí je Baťův vodní kanál, ve kterém byla nákladní doprava nahrazena rekreační plavbou. I zde však existuje potenciál na zlepšení služeb pro turisty

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PRINCIPLES AND PROCEDURES OF THE ARCHAEOLOGICAL EXPLORATION OF CHARCOAL PLATFORMS

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Abstract
Charcoal platforms are landforms that refer to the historical burning of charcoal in the charcoal kilns. Nowadays, it is possible to encounter these objects especially in forested environments, where they can be damaged not only by natural influences, but also by human activity and forest management. An archaeological field prospection was carried out in three selected areas of the Drahany Highlands (Czech Republic), which aimed to identify and document the relics of production platforms in the field and subsequently carry out archaeological field excavation of six selected objects. The aim of this paper is primarily to describe the archaeological principles and procedures of the actual excavation of the charcoal platforms. Not only the main methodological steps of excavation and documentation will be presented, but also the complete legislative framework of archaeological management. Emphasis is also placed on the issue of determining the cultural and historical value of chracoal platforms, their place in the issue of monument protection and nature and landscape protection as such.

Key words: forest, nature conservation, cultural heritage, archaeological excavation

Introduction

Over the last few years, Czech archaeology has made tremendous progress in relation to charcoal pile research. Objects that used to be on the periphery of mainstream research, and were of interest mainly to archaeologists focused on experimental and post-medieval archaeology, have now become representative representatives of human economic activity in forests. The growing interest can be attributed to the increasing number of research projects aimed at identifying previously unknown or neglected archaeological sites in forests that are intensively threatened by logging operations as a result of the extensive current bark beetle calamity. Charcoal platforms are defined as relics of charcoal piles that were used to produce charcoal in the past. In the terrain, they appear as circular or oval-shaped platforms buried in the hillside or laid in flat terrain. The identification of a platform on the plain is greatly facilitated if it is surrounded by a continuous mound of charcoal, clay, moure or other surface remains of the charcoal piles. Platforms vary in size and can range from 5 to 15 m in diameter (obr. 1; Bobek a kol. 2021).

Fig. 1: Relic of the charcoal platform

Between 2020 and 2022, 117 objects were discovered in the area of interest with a total area of 15 km^2 and interpreted as charcoal platforms. After the identification and documentation of the captured relics, the excavation of six selected representatives of these evidence of human economic activity in forests was proceeded. The main objectives of the paper are: 1) To present the main methodological steps of conducting archaeological research on charcoal platforms and its setting in the legislative framework. 2) To emphasize the heritage value of charcoal platforms with regard to nature conservation and cultural landscape.

Material and methods

Archaeological research can be defined as a systematic set of specialized professional activities ensuring the rescue, preservation and documentation of archaeological findings. The methodology of field archaeological charcoal platforms excavation consists of the practical principles and procedures for conducting archaeological excavations within the framework of general archaeological method and theory (Neustupný 1993). The aim of archaeological excavation is to obtain the most comprehensive information and documentation in the form of, most often, a complete excavation in the case of rescue archaeological research initiated by contemporary construction or other activities that threaten and destroy archaeological objects and finds. On the other hand, research conducted in an area with archaeological findings not otherwise threatened by archaeological finds is triggered by the need for archaeology as a scientific discipline, is determined by a defined research purpose and, on the contrary, must be conducted in such a way as not to unnecessarily damage the object under investigation. Preference is given to non-destructive and low-destructive methods in research, and only when necessary for the stated research objective is destructive research of limited scope chosen without unnecessarily disturbing the preserved relics. Archaeological research consists of a pre-excavation part (e.g. research, selection of probe location, visual survey), the actual excavation (probing, surface excavation) and a post-excavation part (digitization of field documentation, laboratory treatment of findings, their conservation, registration and preparation of a finding report). The method of conducting archaeological research depends on the nature of the site and the type of destructive research method chosen, but it is always true that fieldwork is irreversible and non-reproducible in its effect, because archaeological sources are inherently inexhaustible and non-renewable. The working procedure, the technique of excavation and the documentation taken must therefore be carried out as carefully as possible. It is important to monitor their interrelationships and relationships to the archaeological site. The means to record the so-called find circumstances is to make the documentation and description as objective as possible (Harris 1989). The products of destructive research are immovable artefacts (e.g. pits, ovens, walls), movable artefacts (ceramics, metal etc.), samples of ecofacts and natural objects, documentation of finds and their relationships, and records of finds. The final product of the field research is the report of the archaeological research (according to Act No. 20/1987 Coll.) and the publication of the research results (Neustupný 2007; Bureš 2014).

According to the current legislation of the Czech Republic, the so-called Act on the national heritage care (No. 20/1987 Coll.), archaeological research can only be carried out by the Archaeological Institute of the Academy of Sciences of the Czech Republic and so-called authorized organizations, i.e. organizations that have been granted a valid permit by the Ministry of Culture of the Czech Republic to carry out archaeological research and at the same time these authorized organizations have concluded an agreement with the Academy of Sciences of the Czech Republic on the scope and conditions of archaeological research. The Act on the national heritage care also regulates the elements of agreements on conducting research, ownership of findings, payment of the costs of conducting research, measures in case of breach of obligations, etc. The protection of archaeological heritage, including the spatial planning process, and the management of archaeological finds are also dealt with in the Convention for the Protection of the Archaeological Heritage of Europe (the so-called Malta Convention), which is part of the Czech legal order. If archaeological research is carried out on listed buildings and sites, it is necessary to discuss the research plan with the expert organisation of the state heritage protection (National Institute for the Protection and Conservation of Monuments and Sites) and obtain a positive opinion of the executive body of the state heritage protection (Bureš 2014).

On the basis of the above principles, archaeological research was also carried out on a total of six objects (charcoal platforms) as part of a dedicated project. During the pre-excavation phase, the research method chosen was a cut-through object. Furthermore, it was necessary to ensure all legislative steps resulting from Act on the national heritage care. As Mendel University in Brno is not among the authorised organisations, the archaeological research was carried out by the partner non-profit organisation Archaia Brno, z.ú., which meets all the requirements of the law. A structured application for an opinion on the research was sent to the Institute of Archaeology of the Academy of Sciences of the Czech Republic in Brno, which, in addition to the basic identification parameters of the applicant, contained information on the objectives and proposed method of research, the expected publication and other presentation of the research results, and the expected impact of the research results on the site in terms of archaeological conservation. The application must also include the

opinion of the relevant department of the National Institute for the Protection and Conservation of Monuments and Sites on the research plan. It is also a legal obligation to conclude an agreement with the landowner to carry out the archaeological research. It is the duty of every authorised organisation to notify the Institute of Archaeology of the commencement of archaeological research via the Archaeological Map of the Czech Republic application (https://amcr-info.aiscr.cz/). Submit a report on the results of the research – a report of the archaeological research to the Institute of Archaeology and, in the case of research on listed buildings and sites, also submit the finding report to the expert organisation of the National Institute for the Protection and Conservation of Monuments and Sites. In addition, publish a brief report on the work carried out in the next issue of the unreviewed part of the journal Přehled Výzkumů, published by the Institute of Archaeology of the Academy of Sciences of the Czech Republic in Brno.
The field excavation was carried out on pre-selected objects. The most appropriate form of excavation was a longitudinal probe half a metre wide, which ran from the approximate centre of the charcoal platform to its edge. The probe reached into the intact geology. The standards of fieldwork include the careful alignment of the trenches and their delineation with stakes and string. The excavation was carried out mechanically using spades, shovels and hoes in sequence according to the stratified layers. If they are recognizable, they can be distinguished from each other on the basis of color, material, and strength. All these parameters are recorded on the relevant stratigraphic unit form, which is part of the field documentation of the archaeological research. Care must be taken during the work to identify possible artefacts in the layers. These are labelled with the samples so that the probe, object and deposit from which they were recovered can be clearly identified. All work is documented photographically (Fig. 2) and also by drawing on millimetre paper at the appropriate scale, usually 1 : 20. After the work was completed and the appropriate documentation carried out, the site was backfilled and returned to its original state. The surroundings of the charcoal platforms were also examined with a metal detector.

Fig. 2: Photographic documentation of the excavation

Results

During 2020-2022, six charcoal platforms were explored. The excavation involved a team consisting of a lead archaeologist and approximately five fieldworkers who were mainly involved in manual excavation. Work on a single object took the team 8-10 h depending on the size of the probe undertaken, which varied according to the nature of the particular platform. Approximately twice the time then had to be invested in the evaluation of each of the objects investigated, the production of the relevant Report of the archaeological research and the subsequent basic publication. No archaeological artefacts could be identified in any of the probes undertaken and so mainly charcoal samples were collected for further analysis. Thus, the main archaeological results of the research can only be considered to be the documented stratigraphy in the individual probes, which, however, is very simple and does not allow to distinguish several chronological phases within one object. It was also a beneficial finding that in some cases it was possible to identify the edge of the charcoal platform, which was sharply defined at an angle close to ninety degrees. The results of the metal detector survey did not yield any information on artifacts that could be associated with working activities related to charcoal burning. In particular, metals of recent age (less than 50 years old) were identified on the charcoal platforms or in the immediate vicinity, i.e. within a maximum distance of 3 m from the edge of the feature. These included unspecified iron fragments and metal food and drink packaging.

Discussion

The contribution of archaeology to the study of charcoal platforms lies not only in the identification of objects in the field and the methodological provision of sampling, but also in the evaluation of the cultural and historical value of the charcoal platforms and in the eventual determination of their monument protection. Like a number of other archaeological sites in forests, former charcoal piles are directly threatened not only by natural influences, but above all by human management, and thus also become an integral part of nature conservation features. For this reason, it is necessary to accentuate and raise awareness of the importance of these monuments and to look for their possible use, for example in tourism.

The relief of the flat terrain, which is built into the gentle slopes, makes it easy to visit, even though they are otherwise very inconspicuous and are often visited unconsciously. The recent 'waste' found on the charcoal platforms is indisputable evidence that the area of the charcoal platforms may have been secondarily used, for example, as a resting place for forest workers, or anyone who was in the forest looking for a suitable place to relax. The fact that all the identified charcoal platforms were within easy reach of paths that are still widely used today is also favourable. All of these aspects, and of course a number of others, can be used to promote the relics of the charcoal piles and to design a possible tourist route that would guide visitors through the forest environment and offer them an overall insight into the landscape with the remains of the historic charcoal mining craft. The arguments put forward can then also be used from a nature conservation and conservation point of view. Due to the large number of platforms that survive in the forest it is impossible to consistently protect all of them. If, however, selected specimens were to become the subject of a designated hiking route (nature trail), it would be possible to subject at least them to thorough protection.

Conclusion

The article presented the procedures and principles of archaeological investigation of charcoal platforms on the example of six objects from the Drahany Highlands. The basic scheme outlined the steps preceding the actual field excavation as well as the generally applicable methodological principles of fieldwork. In particular, all the important factors arising from the Act on the national heritage care, which define who is entitled to carry out archaeological excavations and under what conditions, were emphasised. The course of the archaeological excavations carried out at the charcoal platforms was also described with an example of basic documentation. It turned out that the obtained archaeological data are not representative enough to compensate for the time-consuming method of excavation and the subsequent processing of all documentation into the required form. However, this statement does not in any way negate the fact that the charcoal platforms must be considered as valuable evidence of historical craftsmanship, which has its place in both heritage conservation and nature conservation.

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Souhrn

Článek prezentoval na příkladu šesti objektů z území Drahanské vrchoviny postupy a principy archeologického zkoumání zaniklých milířů. V základním schématu byly nastíněny kroky předcházející vlastnímu terénnímu odkryvu a také obecně platné metodické zásady realizace terénních prací. Akcentovány byly především všechny důležité faktory vyplývající z památkového zákona, které definují, kdo je oprávněn provádět archeologické výzkumy a za jakých podmínek. Popsán byl rovněž průběh realizovaných archeologických výzkumů uhlířských pracovišť s ukázkou základní

dokumentace. Ukázalo se, že získaná archeologická data nejsou natolik reprezentativní, aby dokázala vyrovnat časovou náročnost zvolené metody odkryvu a následné zpracování veškeré dokumentace do požadované podoby. Toto konstatování však v žádném případě nerozporuje fakt, že uhlířské plošiny je nutné považovat za cenný doklad historického řemesla, které má své místo jak v památkové péči, tak ochraně přírody.

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PRIORITIZATION OF NATURE CONSERVATION AND ANTHROPOGENIC ACTIVITIES: CASE OF ŠUMAVA NP

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Abstract
Sustainable development deals with environmental, societal and economic pillar. Regarding the spatial nature conservation within Central Europe, the environmental pillar has been threatened. Long lasting human pressure on landscape has created cultural landscape with only small fragments of close-to-nature habitats. Šumava National Park plays exceptional role, it is one of the largest protected and forested areas in the region. However, Šumava National Park administration has gone through various periods with different outcomes for its protection. Therefore, we applied prioritization concept to evaluate management of National Park and its zonation. We based it on objective data and statistical approaches. Our results were compared with data of anthropogenic structures and activities as built-up, recreational and developable areas. Somewhere, as we show in the article, problems between conservation priorities and human use of the area arises. By these analyses we stress the problem of sustainability in the most valuable protected natural areas of Central Europe, where also societal and economic interests are eminent.

Key words: Zonation, Management, Anthropogenic structures, Šumava National Park

Introduction
Šumava National Park was established to protect large areas of relatively natural environment in the Central Europe, which is otherwise strongly affected by human activities. Anthropogenic pressure resulting in habitat and biodiversity loss is present throughout the European landscape, therefore spatial nature protection should avoid these negative influences especially within the most valuable areas (Gordon et al., 2009; Di Minin, Moilanen, 2012; Moilanen, 2013; Pouzols et al., 2014; Romportl, 2017; Tscharntke et al., 2012).
In this article, we present Šumava National Park as a case for evaluating different aims of nature conservation and regional and local development, their spatial intersection respectively. First input is a layer of prioritization representing top-down approach and principle of national interest regarding nature conservation, second input represents bottom-up aims of local municipalities on social and economic development, which is depicted as built-up, recreational and developable areas.
Our aim was to analyse relationship between priorities of nature conservation and human-affected or potentially affected areas, because it can help in decision-making processes of permitting new anthropogenic activities and areas within national park.

Material and methods
We prepared prioritization of spatial nature protection of Šumava National Park. It is based on fifty habitat models showing potential habitat suitability for each of selected key and protected species. Majority of models were made in MaxEnt software (Philips et al., 2006) by using environmental variables characterizing area of Šumava National Park from geology towards anthropogenic activities and presence occurrence records only. In a few cases we have absence data too, thus we used GLM approach in R (R Core Team, 2018) to obtain models for these species. In addition to models, which show quality of environment from point of view of individual species, data from habitat mapping layers were used for description of habitats quality.
Prioritization was analysed by Zonation software (Moilanen et al., 2005), as inputs models and habitat mapping layers were used. This was done with resolution 10x10 m.
Layers of built-up and recreational areas was derived from topographic maps and aerial imageries capturing recent (2019) state. Developable areas were provided by regional authorities and was derived from spatial planning documents in similar recent period.
Result of prioritization was classified into ten zones according to level of priority, i.e. the most valuable 10% (100–90%) of area, the second 10% (90– 80%) of the area and so on. This layer was intersected in ArcGIS software (ESRI, 2020) with abovementioned layers to obtain their areas within the zones

according to prioritization. More precisely, we used data of recreation and developable areas and 100m and 500m buffer outside built-up areas as localities threatened by human activities.
To sum up, we statistically compared differences between areas of human-activities layers in each zone of prioritization (R software, Kolmogorov-Smirnov test, sig. level 0.05).

Results

Table 1 shows distribution of human-activities areas within ten zones of prioritization. We can see that in the zones with the lowest priority human activities is less present than in zones with mid-priority, in some cases human-activities layers are significantly present in the zones with higher priority, e.g. in case of developable areas. Furthermore, we counted difference between presence of human-activities areas within the 30% of the least and the most valuable areas. Results show significant difference with a larger area within the most valuable 30% of the Šumava National Park.
Fig. 1 and 2 are examples of valuable parts of open landscape affected by anthropogenic activities: Fig. 1 shows situation of developable areas in vicinity of Modrava and Filipova Huť and Fig. 2 is a ski slope in Strážný.

Tab. 1: Areas of human-activities layers within the zones of prioritization (1 = the lowest priority 10% of area, 10 = the highest priority 10% of area)

	Developable areas		**Recreational areas**		**Buffer 100m around built-up areas**		**Buffer 500m around built-up areas**	
Zone	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
1	0,16	0,08	0	0	16,09	1,49	365,46	5,01
2	2,83	1,46	0	0	40,43	3,74	665,53	9,11
3	19,96	10,28	0,36	1,47	69,14	6,40	729,78	9,99
4	21,93	11,30	0,86	3,52	128,30	11,87	890,18	12,19
5	33,54	17,27	1,69	6,92	208,77	19,32	1001,53	13,72
6	22,02	11,34	3,77	15,48	169,65	15,70	896,80	12,28
7	22,08	11,37	11,34	46,52	125,19	11,58	741,82	10,16
8	20,02	10,31	3,08	12,62	124,90	11,56	711,32	9,74
9	27,10	13,96	0,99	4,06	90,66	8,39	626,62	8,58
10	24,52	12,63	2,29	9,41	107,67	9,96	672,51	9,21

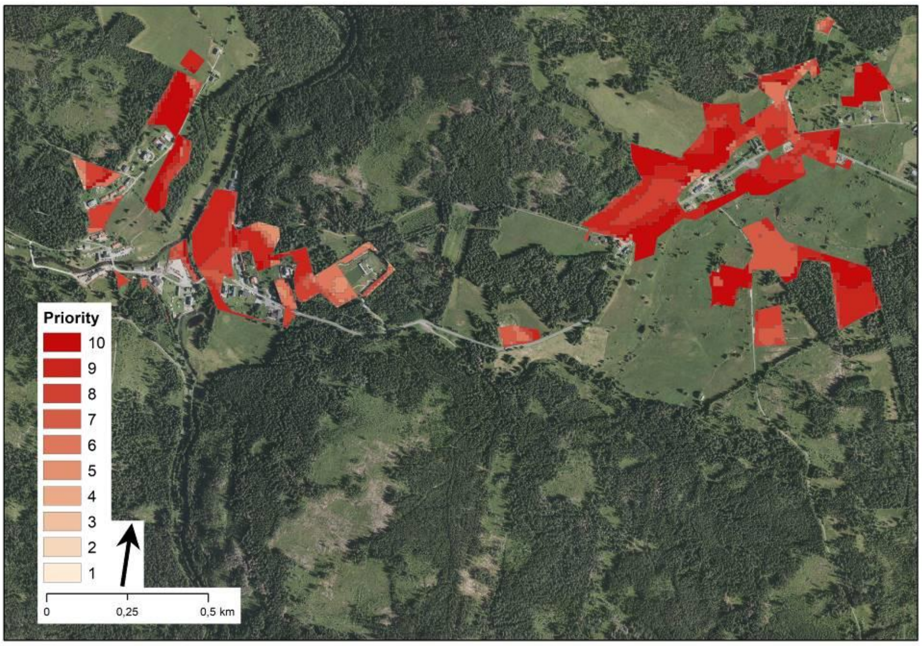

Fig. 1: Developable areas in vicinity of Modrava and Filipova Huť intersected with layer of prioritization

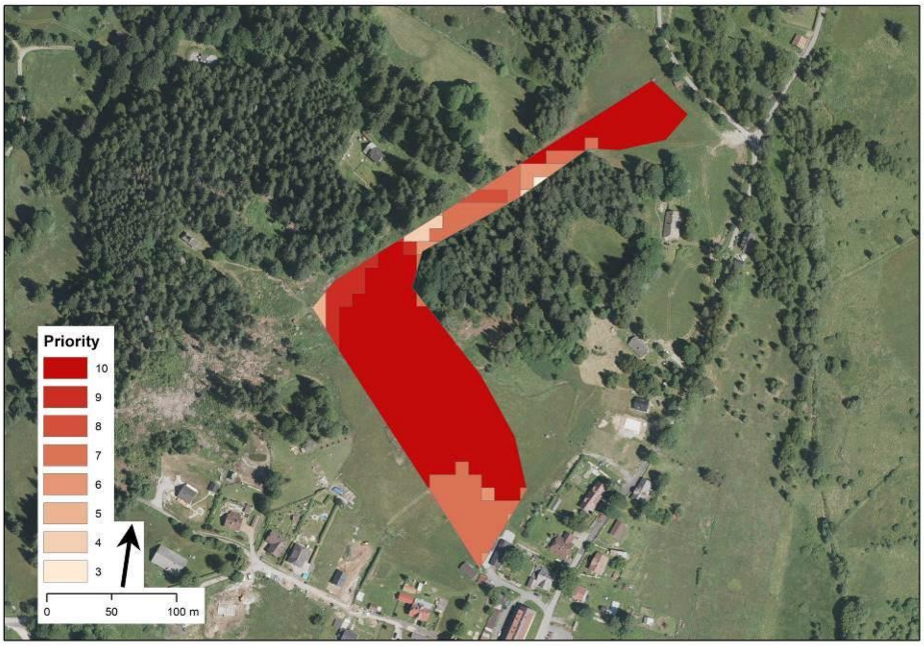

Fig. 2: Ski slope in Strážný intersected with layer of prioritization

Discussion

Central European landscape and nature is threatened by human activities; therefore, spatial nature protection is a tool for preventing from worsening condition of the most valuable pieces of landscape. Our evaluation of selected human activities in one of the largest and the most valuable protected areas in Czechia, the Šumava National Park, shows that anthropogenic structures and developable areas are present unevenly within zones of prioritization. They tended to be more present in the mid- and the most valuable zones.

Attractiveness of the nature in the most exclusive locations could be a reason for founding these areas, on the other hand, presence of structures like these lead to decline of values related to certain locality. Therefore, it is crucial to protect values by sufficient management of the area.

Conclusion

Despite the aim of the Šumava National Park to protect biodiversity and natural processes, human activities are present disproportionally largely in the priority zones regarding to our evaluation of natural values. We recommend to use this material for decision-making processes within the National Park.

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Souhrn

Náš příspěvek se zabývá dilematem mezi územní ochranou přírody a rozvojem předmětného území. Pro studium tohoto problému jsme si vybrali Národní park Šumava, jedno z největších ucelených chráněných území v rámci Česka i střední Evropy. Na území národního parku jsme aplikovali tzv. prioritizaci, která na základě dat popisující přírodní hodnotu prostředí prostřednictvím habitatových modelů klíčových a chráněných druhů a dat o kvalitě habitatů určuje prioritu pro územní ochranu. Takto vzniklou vrstvu jsme rozdělili do deseti stejně rozlehlých zón odstupňovaných podle priority ochrany od těch nejcennějších po těch nejméně cenných 10 % rozlohy Národního parku Šumava. Tato vrstva byla protnuta s vrstvami, které představují antropogenní tlak v území, konkrétně šlo o vrstvu zastavitelných ploch, rekreačních ploch a okolí zástavby s perimetrem 100 a 500 metrů. Díky tomuto protnutí bylo možné spočítat, jak je rozloha těchto vrstev distribuována v rámci zón podle priorit ochrany přírody. Z výsledků je patrné, že zmíněné vrstvy se ve větší míře nacházejí v zónách se střední a vyšší prioritou ochrany. Při srovnání nejméně a nejvíce prioritních 30 % území výsledky ukazují významný rozdíl s většími rozlohami ve 30 % nejvíce prioritního území. Ukazuje se tak, že v rámci Národního parku Šumava je antropogenní tlak disproporčně rozložen více do cennějších než méně cenných území. Takový závěr může být významným podkladem pro rozhodování a management území Národního parku, kde by přírodní procesy měly mít přednost před zájmy rozvoje území.

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PROBLEMS AND THREATS RELATED TO THE RECREATIONAL USE OF NATURAL PROTECTION AREAS IN CITIES

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Abstract
The development of cities and suburbanization causes absorption of natural habitats (protectected and not by low), antropopressure. Despite the EU's biodiversity policy, municipalities are under pressure to make these areas available for tourism and leisure.
According to Cieszewska [2008], areas with significant abiotic and / or biotic values are naturally valuable. These areas are characterized by high biodiversity, therefore they are subject to legal protection under the Act of April 16, 2004 on nature protection (Journal of Laws of 2020, item 55, i.e.) in local and supra-local form.
The aim of the paper is: 1) presentation of problems and threats related to the use of naturally valuable areas, 2) an indication of ways to prevent or limit their degradation. The research area concerns the province Mazovia, the oxbow lake of the Vistula river in the commune of Łomianki.
Despite the implementation of plans / programs for the protection and management of green resources, the areas of nature protection and naturally valuable areas are still exposed to strong anthropopressure.
Research shows that local areas of environment protection should be considered as a functional areas. The tasks of active protection of ecosystems should also be defined in the form of specific solutions for the management and sharing of them. Also, the valuation of ecosystem services in spatial planning will be important.

Key words: anthropropression to nature protection areas, active nature protection, management of green areas

Introduction

According to Cieszewska (2008), natural valuable ones are characterized by abiotic and / or biotic natural values. They are one move on the first and on the transformation. These areas are characterized by high biodiversity, hence they are subject to legal protection under the Act of April 16, 2004 on nature protection (Journal of Laws of 2020, item 55, i.e.) in the form of:

- supra-local: nature reserves, national parks, landscape parks, protected landscape areas, Natura 2000 areas
- local: ecological lands, documentation sites, nature and landscape complexes and natural monuments.

It is protected a) genetic diversity, allele variation in the gene pool, gene exchange and mutations; b) species diversity, species diversity and richness, equality, c) ecosystem diversity the diversity of ecosystems, the extent of the range of species, communities - structural and functional diversity.
Valuable forest communities, mid-field trees, wastelands, ancient trees and others are not covered by protection.
These areas, despite the implementation of protection plans and programs, are still exposed to strong anthropopressure. Especially in cities, they become available to residents. They have an educational and recreational function (Solarek K., 2020).
A number of threats to these areas are perceived. These are:

- Changes in climate and habitat conditions, abiotic and biotic damage due to unfavorable global and local changes,
- A protection zone running along the administrative border, along roads, instead of taking into account functional boundaries, no buffer zone, unfavorable changes in the immediate environment
- Indirect destruction - overexploitation, scaring animals
- Direct destruction, deliberate destruction, overexploitation due to the limited absorptive capacity of the land
- Unfavorable changes in the process of revitalization, renaturalization - planting plants, distorting the natural habitat
- Introduce invasive plants
- Conducting nursing treatments that deplete the habitat

- removing trees as part of measures to improve the safety of people and their property.

Badly understood tree care, including excessive sanitary cuts, reduction cuts in the event of a conflict with the terrain function is visible especially in the case of nature monuments (Rosłon-Szeryńska et al. 2017).

The research of Fortuna-Antoszkiewicz B., Łukaszkiewicz J. and Rosłon-Szeryńska E. (2019) conducted, among others, by in nature-protection areas in Warsaw (Natoliński Park, The Vistula riverside), they show a significant presence of invasive plants in the undergrowth, undergrowth and layer of trees in urbanized spaces, regardless of the availability of these areas. Research by Sikorski et al. (2014) shows that the ash-leaf maple penetrates the least into large willow stands and young poplar stands. Maple monocultures usually occupy small patches.

The aim of the paper is: 1) presentation of problems and threats related to the use of naturally valuable areas, 2) an indication of ways to prevent or limit their degradation. The authors present a case study. The research area concerns the province Mazovia, the oxbow lake of the Vistula river in the commune of Łomianki.

Material and methods

The problem was analyzed on the example of the Warsaw Protected Landscape Area in the commune of Łomianki. It covers the oxbow lake of the Vistula with a basin filled periodically with water and the dominance of riparian vegetation. The natural and landscape valorization of the area was presented. Potential threats to the protection of biodiversity and durability of the plantings in question were identified. Then, the principles of sustainable management of natural resources were indicated in order to minimize the problems. An important aspect is to maintain the natural character of the facility and use its potential to improve the microclimatic conditions of the neighboring areas (including reducing the heat island and improving air quality) and increasing water retention.

The research included:

- visual inspection of the area with photographic and audiovisual documentation, air raids over the area, using a drone,
- physiographic study, environmental monitoring and dendrological inventory with a description of the conservation status of plants and basic dendrometric measurements,
- valorization determining the state of preservation, type of damage, health condition of plants and their function as well as natural value in the field,
- indications for handling trees in connection with the planned creation of a new green area and renaturalization of this area.

Natural habitats, potential and real vegetation was determined according to the Matuszkiewicz's key (2001).

The health condition of the tree was determined based on the recognition of external symptoms of the disease or damage, using a qualitative assessment, where:

a) Good condition means trees with a natural habit and appearance resulting from the development in a given environment,

b) Medium condition - means the presence of damage, defects, local rot in the knot zone, of negligible importance for the statics of trees

c) Bad condition - means the presence of damage, defects, local rot in the area of knots, significant for the statics of trees or indicative of tree dieback.

Environmental valorization is defined on the valuation scale, where:

1 - it is a low natural value, invasive plant, not constituting a food base for birds;

2 - it is an average natural value, an invasive plant (but constituting a food base for animals or increasing soil fertility) or a native plant without significant ecological significance (not constituting a food base for animals);

3 - is a high natural value, a native plant that is a habitat of wild animals, including dead trees of native species.

Based on the analysis of all data, indications for tree management were presented.

Results

The area covered by the study is the Vistula oxbow lake and is a local depression of the land with a water basin with an area of 0.5 ha. The structure of this wooded area and the species composition refer to the poplar and willow riparian forests *(Salici-Populetum).* This area is under protection as the Warsaw Protected Landscape Area (WOChK) and lies in its normal zone. At a distance of 200 m to the east, the area is adjacent to the Fabryczny park created in the manor park at Fabryczny Lake. The lake with many oxbow lakes is part of a potential ecological corridor of local importance, running along the Struga Dziekanowska in the Vistula ice-marginal valley along with the lake system, including Lake

Fabryczny, Lake Kiełpińskie and Lake Dziekanowskie. About 600 m to the east are the boundaries of the special ecological protection zone of the WOChK. The main goal of establishing the Warsaw Protected Landscape Area (WOChK) is to protect valuable ecosystems and link them with the national system of protected areas. The areas which determine the biotic potential of the areas and the significant importance for the migration of animals, plants and fungi are covered with special ecological protection. The landscape surrounding the area is typical of the valley suburban areas. Among the wastelands, which until recently were cultivated for agriculture, residential buildings with small services are developing.
The landscape surrounding the area is typical of the valley suburban areas. There are multi-family and single-family buildings with small services in the vicinity of the study area.

Fig. 1: Viewing connection of the neighboring areas with the study area. Yellow arrows mean favorable views, red ones are unfavorable views, blue ones are neutral views. (photo, M. Brach).

Fig. 2: The natural connection of the study area with the Vistula valley and naturally valuable areas enables the migration of many animals, especially birds. The reed rushes in the local water basin are marked in blue (photo, M. Brach).

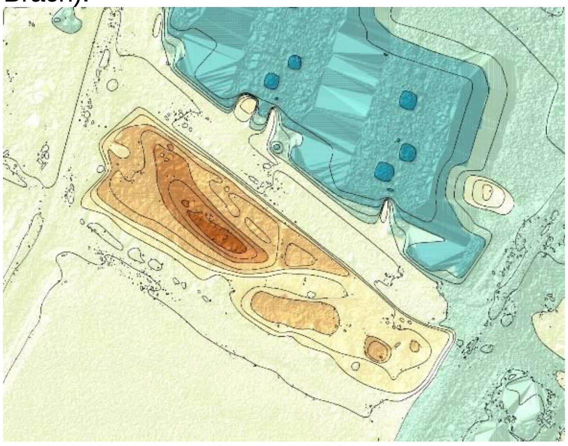

Fig. 3: Topographic features of the oxbow lake (GIS data, geoportal.pl)

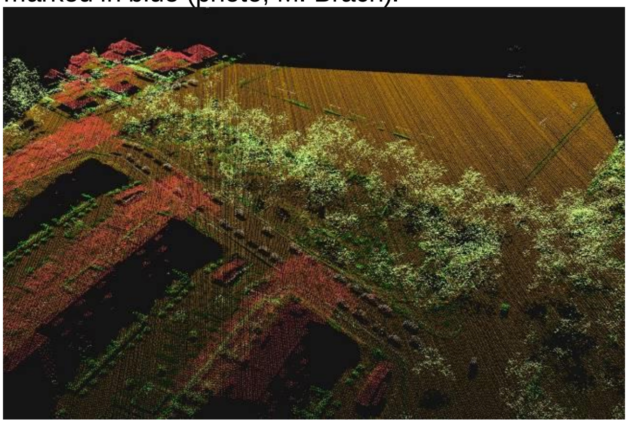

Fig. 4: Vertical structure of wooded area (M. Brach)

The oxbow lake has no surface water supply. It is a basin with a varied topography, periodically flooded in the north-west part. The difference in levels between the lowest point (with reed rushes in the central zone) and the highest point (on the northern border of the plot) is 4.5 meters.
The species composition includes species of trees and shrubs typical for poplar-willow, ash-alder riparian forests, oak-hornbeam forests and forest covers.
There were 187 lobes / groups / copies, including:
• single-species scrub communities or with the dominance of one species, undergrowth of shrubs and tree saplings - 12 patches / zones, each with an area of more than 100 m2.
• 44 groups and multi-stem forms of trees (including ash-leaved maple, small-leaved linden, cherry plum, white willow, black alder, common ash, elderberry, single-necked hawthorn, black dogwood and bird cherry.
• 131 individual trees, including: white willow, gray poplar, black alder, ash-leaved maple, small-leaved linden, common ash, black locust, and also: cherry plum (alga), single-necked hawthorn, pedunculate oak, warty birch, pear tree.

The structure of the vegetation in the area of the study is varied. In the eastern zone, it is compact, forested with a more or less rich multi-storey layout. In the western zone, it has a lobed character, where around the clearing with a water reservoir covered with rush, a community of dense shrubs and loose or dense surrounding trees is formed.
In the system, the oldest trees for valuation purposes are black alders, estimated to be> 50 years old. At the same time, these trees are in the worst condition due to the change in habitat conditions and the drying out of the land. The group of riparian trees - poplars, willows and ash trees are in the age range of 20-30 years. Later, small-leaved limes (due to the oak-hornbeam forests) and cherry plums - dragged and scattered by birds nesting in alders - came to the area. The health status of these plants is good. The last two decades have seen the expansion of the invasive ash-leaf maple and black locust. The average condition of the clones is average due to numerous deformations, tilt and drought, while the black locust are good. The table in the figure below shows the characteristics of dendloflora taking into account the process of changes in the habitat.

Tab. 1: Dendrochronological analysis of the main tree species growing in the study area

Teh most common tree species	**Number of trees**	**Average trunk circumference at. 130cm**	**Average condition**	**Average age range of trees (years)**
Alnus glutinosa	12	140	bad	>50
Salix alba	17	108	medium	30
Fraxinus excelsior	6	50	goood	20-30
Populus alba, P. X canescens	5	116	medium	20-30
Prunus cerasifera	9	35	good	20
Tillia cordata	27	43	good	20
Acer negundo	66	45	medium	<20
Robinia pseudoacacia	18	36	good	<20

The dendrochronolic analysis carried out shows that the oldest structure-forming trees (black alder) are withdrawing from the study area. Willow and poplar regeneration is limited. Lime and ash from the oak-hornbeam (riparian) habitats feel good in a given area and will constitute an important component of the species composition of tree stands. Cherry plum is associated with the presence of birds and will constitute a layer of undergrowth and thickets in the area of the study. Ash-leaf maples and black locust conquer the area expansively and compete with native species of trees and shrubs, while the black locust can play a positive role in the environment. It has allelopathic properties, positively ionizes the air, is a honey plant, and improves the nitrogen content of the soil.
The natural value and the occurrence of species forming a plant community were determined, divided into 1) trees, 2) shrubs and creepers, and 3) tree saplings. A valuation scale from 1 to 5 was used, where 1 is a low (negative) value and 5 is a very high (positive) value for a given criterion. The data is included in the table below. Plants that negatively affect the biodiversity of the habitat are marked in red. Plants that should be protected and need to be restored in the habitat are marked in green.
A threat to an area characterized by a high level of biodiversity may be its inept revitalization and management related to the removal of many plants, and the impoverishment of habitats by monoculture plantings.
An important factor reducing the value of riparian areas is their excessive trampling and uncontrolled use leading to degradation and synanthropization of the habitat. The areas of riparian forests and wet-loving thickets are not very resistant to trampling and have low absorption.
In the area of the study, the destruction of values by littering is visible. In the eastern part and on the outskirts, but also above the water basin, you can see wild garbage dumps. The proximity of roads and the "Orlik" sports complex is a nuisance due to noise emissions, which may not be conducive to rest in this place, and may also eliminate the most skittish birds from the habitat.

Tab. 2: Assessment of the natural value of dendroflora in the study area

list of the most common plants	Occurence on a scale of 1 (very rare) to 5 (very common)	Natural value on a scale of 1 (very low) to 5 (very high)
Shrubs and creepers		
Rubus fruticosa	4	5
Sambucus nigra	4	5
Euonymus europaeus	3	5
Cornus sanquinea	3	5
Crataegus monogyna	2	5
Rosa canina	1	5
Humulus lupulus	3	5
Parthenocissus quinquefolia	2	3
Tree saplings		
Acer negundo	5	1
Robinia pseudoacacia	5	2
Prunus avium	4	3
Alnus glutinosa	3	5
Prunus padus	2	5
Prunus avium	1	4
Juglans regia	2	3
Ulmus glabra, Acer pseudoplatanus	1	4
Quercus robur	1	4
Trees		
Acer negundo	5	1
Robinia pseudoacacia	5	2
Prunus cerasifera	4	3
Alnus glutinosa	3	5
Pyrus communis	2	4
Prunus avium	1	4
Populus x canescens	2	5
Fraxinus excelsior	3	5
Tilia cordata	4	5
Quercus robur	1	4

Discussion and Conclusion

The conducted nature analyzes and research allowed for the development of guidelines for the management plan for the existing tree cover and indications for the "Ptasia Oaza" green area development project in the commune of Łomianki. The great natural potential as well as phytotherapeutic and phytosanitary values of plants growing in the studied habitat have been noticed. The diversification of the area in terms of hydrogeology, topography, phytosociology and floristics allows for the creation of a space not only constituting a habitat of wild animals (including food and habitat for birds), but also performing a number of other services in the city's ecosystem, such as:

• regulation of the ecological conditions of the city by reducing noise, emission of volatile substances, air ionization;
• ability to carry out gas exchange in the atmospheric environment, modification of microclimatic conditions of the urban environment (leveling extreme temperatures and improving light conditions and air humidity);
• shaping ecological-biocenotic and hydrological relations (beneficial influence on soil water relations);
• phytosanitary and phytoremediation functions by reducing air dust and purifying water;
• health (phytoncides, phytotherapy) and educational functions (increasing environmental awareness, learning to respect nature).

An important assumption made in dealing with the existing greenery is:
a) preservation of the species composition of valuable plant communities, restoration of degraded and distorted spaces by the invasion of expansive plants (including ash-leaf maple and black locust) and due to the lack of water supply from the water system of the Struga Dziekanowska,
b) shaping and protection of habitats present in the area of fauna, with particular emphasis on birds.

For this reason, the following should be protected: dendroflora characteristic of potential natural habitats and trees with seeds and fruit that are food for animals, as well as dead trees, which are places of nesting and feeding for birds, as well as a thicket of saplings of trees and shrubs in the undergrowth of trees - which determines the existence of many timid birds. A dynamic model of landscaping should be applied, treating plant composition as a process, not a state.
Planned measures and actions towards the existing trees are of active and (in some places passive) habitat protection. Active protection applies to zones adjacent to the road and within the area of land development with an educational and recreational program. In these spaces, an important goal is a compromise between the good of nature, the preservation of biodiversity and the safety of people and property.
The conducted research shows that local nature protection areas in cities often occupy large areas.
Despite this, they are not sufficiently protected due to the lack of defined rules for their protection, the lack of lagging and the limited possibility of eliminating external threats, as well as the lack of the obligation to introduce arrangements for active protection of areas.
The problem is the limitation of the scope of local plan arrangements to referring to separate provisions. Therefore, local forms of nature protection should be treated as functional areas.
It is also necessary to define the tasks of active protection of ecosystems in the form of specific solutions for their management and making them available. The valuation of ecosystem services in spatial planning will also be important.
The methods of counteracting threats and destruction of naturally valuable areas include:
• conducting ongoing monitoring with an assessment of the reasons for the changes taking place,
• land valuation and land valuation
• educating the users of these areas, making them aware of ecosystem services
• comprehensive actions on a supra-local scale for the protection of naturally valuable areas
• legal regulations, development of management and protection models for naturally valuable areas
• promoting sustainable tourism with respect for nature and humility in the face of the potential risks of staying in the wild
• temporary or complete closing of areas at risk of destruction.

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Souhrn
Rozvoj měst a suburbanizace způsobuje pohlcování přírodních stanovišť (chráněných a ne nízkých), antropotlaky. Navzdory politice EU v oblasti biologické rozmanitosti jsou obce pod tlakem, aby tyto oblasti zpřístupnily pro cestovní ruch a volný čas.
Podle Cieszewské [2008] jsou přírodně cenná území s významnými abiotickými a/nebo biotickými hodnotami. Tato území se vyznačují vysokou biologickou rozmanitostí, proto podléhají právní ochraně podle zákona ze dne 16. dubna 2004 o ochraně přírody (Sb. zákonů z roku 2020, položka 55, tj.) v místní a nadmístní formě.
Cílem příspěvku je: 1) představení problémů a hrozeb spojených s využíváním přírodně cenných území, 2) naznačení způsobů, jak zabránit nebo omezit jejich degradaci. Oblast výzkumu se týká Mazovského vojvodství, volského jezera řeky Visly v gmině Łomianki.
Navzdory realizaci plánů/programů ochrany a managementu zelených zdrojů jsou území ochrany přírody a přírodně cenná území stále vystavena silnému antropotlaku.

Z výzkumu vyplývá, že místní oblasti ochrany přírody je třeba považovat za funkční plochy. Úkoly aktivní ochrany ekosystémů by měly být definovány i formou konkrétních řešení jejich správy a sdílení. Důležité bude také ocenění ekosystémových služeb v územním plánování.

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PUBLIC RECREATION IS AN ENVIRONMENTAL ASPECT AFFECTING NOT ONLY THE ENVIRONMENT

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Abstract
Optimal recreation should lead to the regeneration of the organism, which is conditioned by a retreat from everyday worries and work responsibilities. The most efficient and reliable way is to travel to places that are almost the opposite of everyday life. The diversity of requirements of individuals who are tired of physical or mental work logically implies the diversity of recreational areas. There are a large number of cultural and natural monuments, mountain resorts, spas and water areas. However, the increased concentration of tourists in these localities may be ambivalent.
A positive economic effect can be the reduction of unemployment and the development of local business in tourist attractions. These aspects lead to longer-term regional stability. The negative impact is mainly environmental pollution by carbon dioxide emissions. In some cases, there is also unwanted noise pollution, light smog and changes in local hydrogeology associated with unplanned development.
With the growing popularity of travel, the demands on the quality and quantity of not only holiday accommodation are growing, which has led to a sharp rise in property prices in this segment. The study maps how the environmental aspect of the attractiveness of a holiday or tourist destination affects the value of residential real estate.

Key words: Environment, tourism, tourist sites, economic impacts

Introduction
A typical tourist attraction of the South Moravian Region is the historic town of Znojmo, in the Czech Republic, where, in addition to publicly accessible monuments, other interesting cultural events take place in a few days. The number of accommodated visitors is recorded in the Czech Statistical Office database. This fact was used to create a statistical model.

Materials and methods
The basic and most important basis for evaluating the research goal are price data on realized sales of real estate with a residential function and statistical data from the public database of the Czech Statistical Office on the development of tourism.
As part of the research project, 5 cadastral areas in South Moravia were examined, which were evaluated as the most visited in terms of tourism. The city of Brno, with its specific market, area and population, was not included in the research. In this paper, only a partial part of the achieved results is presented.
A modern statistical method, dependence analysis, was used to evaluate the environmental aspect described above. The most important tools used in this analysis are correlation and regression analysis. The output of the correlation analysis is a correlation coefficient, which between the two variables indicates the degree of their mutual correlation. Pearson's correlation coefficient was used to evaluate the strength of the correlation.
Regression analysis is one of the most commonly used statistical methods that can examine the relationship between two variables. The output of the regression analysis is, among other things, the so-called P value, which indicates how significant the created statistical model is and the so-called Significance F, which expresses the statistical significance of the entire regression model and the suitability of the selected regression function. A simple linear regression was chosen to evaluate all sites.

Results
One of the localities that was investigated is the town of Znojmo in the South Moravian Region. The subject of the research was real estate with a residential function, specifically family houses and residential buildings. By remote access to the real estate cadastre, databases of all price data from cadastral areas were obtained for all registered periods (2014 - present), from which data on real estate with a residential function were subsequently analysed.

Subsequently, specific price data from the real estate cadastre were requested, which were processed into databases and assigned to the assessed real estate. Based on prices. data, cadastral maps and map portals, the agreed price per m^2 / year was determined according to the built-up area of buildings, storey of buildings and price data, which were evaluated on average in each year and each cadastral area.
In this way, the agreed price per m2 / year of built-up area of each property was determined. Average prices are clearly shown in Table 1. - Development of prices. At the time of the research, some data for 2021 were not yet available, for this reason the time series are only processed until 2020.

Tab. 1: Development of prices (Source: Own processing)

Price development in CZK / m^2 2014–2021								
c.t./ year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Znojmo	10 058	9 899	12 807	13 437	14 726	14 831	16 030	--------

The following graph also Fregular shows the development of prices.

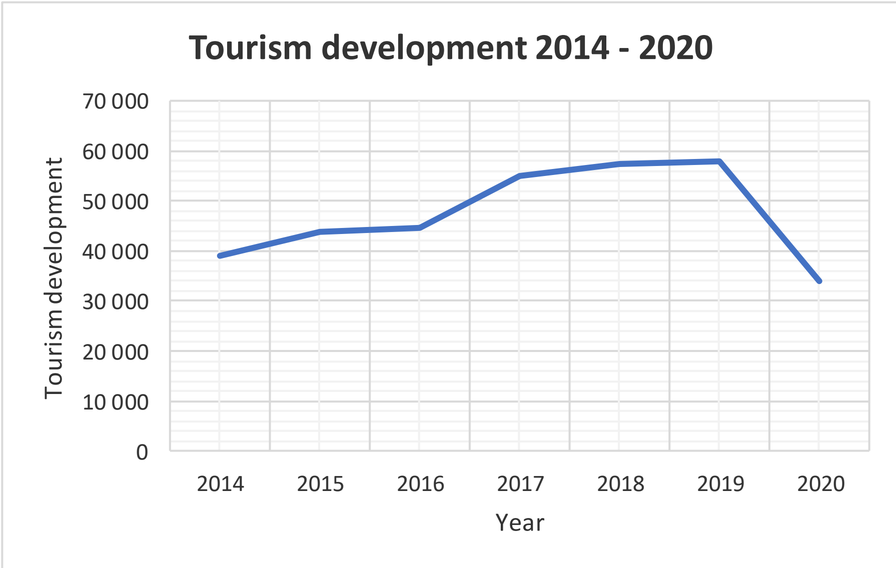
Graph. 1 Development of prices (Source: Own processing)

Statistical data from the public database of the Czech Statistical Office on the development of tourism (number of tourists who visited the site) are processed in the following table and graph.

Tab. 2: Tourism development (Source: Own processing)

Tourism development 2014–2021								
c.t./ year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Znojmo	39 076	43 873	44 706	54 993	57 434	57 911	33 956	--------

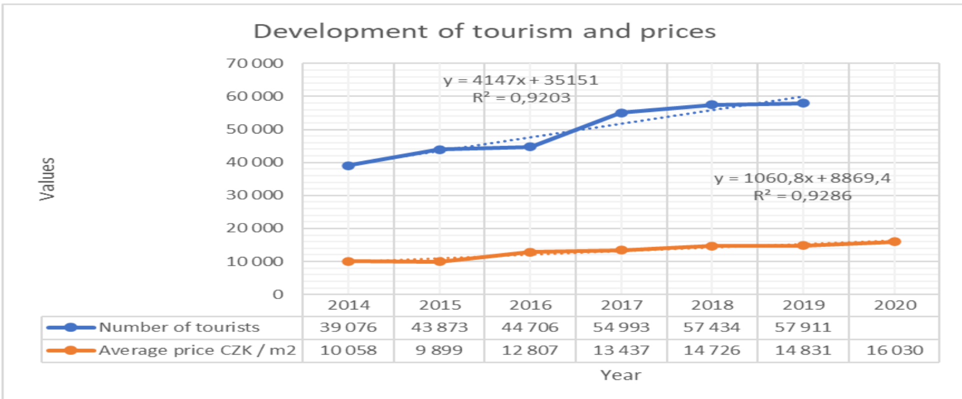
A statistically significant abnormality of the decrease in the number of visitors (tourists) in the years 2020–2021, caused by the covid pandemic, is not suitable for the model from the point of view of statistical assessment and would completely distort the results obtained in the regression analysis. For this reason, the total data were evaluated only in the period 2014–2019, inclusive. After the creation, analysis and processing of basic input data, these databases were tested by the statistical methods described above with the following results.



Graph. 2 Tourism development (Source: Own processing)

Location Znojmo

Znojmo is a city in the South Moravian Region, 65 km southwest of Brno and 80 km northwest of Vienna. 34,000 inhabitants live here. From the point of view of tourism, Znojmo Castle, Loucký Monastery and other former monasteries, Znojmo churches and town houses are especially sought after. Some monuments are also entered in the lists of cultural monuments of the Czech Republic. The following chart shows the development of tourism together with the price of real estate in the period under review (excluding the number of tourists 2020).



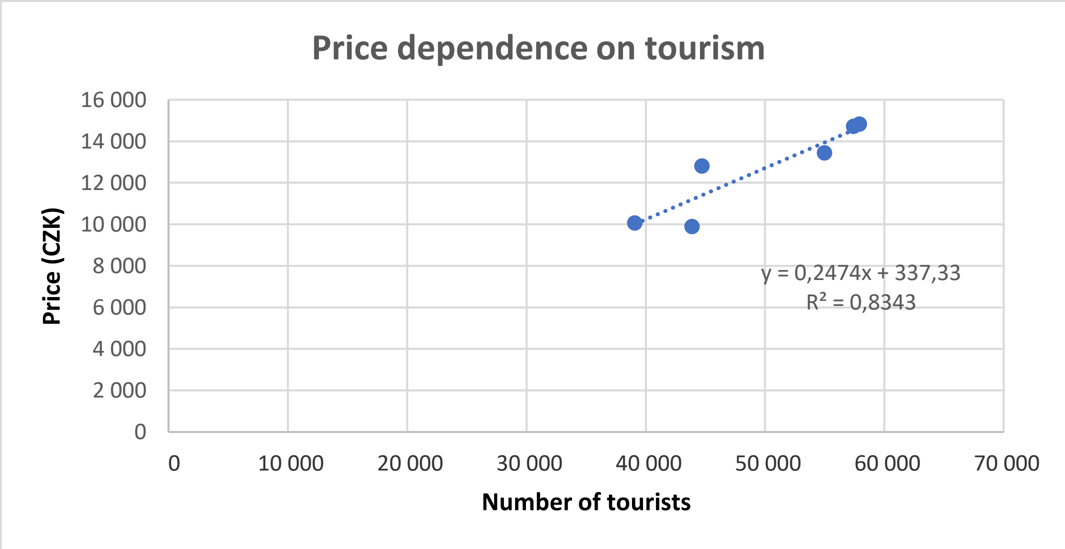
Graph. 3 Development of tourism and prices (Source: Own processing)

In the next step, a function for regression analysis was sought. The linear function was evaluated as the most suitable. The linear dependence of the price on tourism is clearly shown in the graph.

R^2 indicates the degree of explanation of the influence of tourism on the price of real estate = 83.43%. Subsequently, a correlation analysis was performed. Pearson's correlation coefficient was chosen for evaluation.

correlation coefficient (Reliability setpoint R) = 0.792 also indicates a strong, positive linear correlation. *Significance F* = 0.0109 is lower than the significance level 0.05, the linear function is appropriate, and the overall model is statistically significant.
The value of P = 0.01092 is lower than the value of *tStat* and the chosen level of significance α = 0.05 and proves the dependence of the price on tourism.
The coefficient of determination (Reliability value R) = 0.8343 indicates that the influence of tourism on the price of real estate is explained by the rate of 83.43%.
The standardized residues are less than 2 and their sum is equal to 0. *The value of P* is statistically significant.

At the level of significance α = 5% and the level of reliability 95%, the influence of tourism (number of tourists) on real estate prices in the cadastral area of Znojmo is proven.



Graph. 4 Price dependence on tourism (Source: Own processing)

Pearson correlation coefficient

	Total tourists	Average price
Total tourists	1	
Average price	**0,9134**	1

Fig. 1Pearson correlation coefficient (Source: Own processing)

Error! Not a valid link. Regression statistics capture the results of correlation and regression analysis.

Regression statistics	
Multiple R	**0,913402904**
Reliability value R	**0,834304866**
Reliability setpoint R	**0,792881082**
Mean value error	997,0047955
Observation	6

ANOVA

	Difference	*SS*	*MS*	*F*	***Significance F***
Regression	1	20020250,48	20020250,48	20,14072094	**0,010923887**
Residues	4	3976074,249	994018,5623		
Total	5	23996324,72			

	Coefficients	*Mean value error*	*t Stat*	***P value***	*Lower 95%*	*Top 95%*	*Lower 95.0%*	*Topí 95,0%*
Border	337,3270123	2768,337135	0,121851854	0,908892706	-7348,809075	8023,463	-7348,81	8023,463
Tourists	0,247432084	0,055133874	**4,487841457**	**0,010923887**	0,09435591	0,400508	0,094356	0,400508

Fig. 2 Regression statistics (Source: Own processing)

The following table shows the residues and probabilities.

RESIDUES PROBABILITY

Observation	Expected Average price CZK / m^2	Residues	Expected Average price CZK / m^2
1	10005,98312	51,58127114	0,057842866
2	11192,91482	1294,297907	-1,45141634
3	11399,02575	1408,0171	1,578940224
4	13944,35959	507,1286153	-0,568690373
5	14548,34131	177,6860887	0,199255899
6	14666,36641	164,1420621	0,184067725
	Sum of residues:	**0,00**	**0,00**

Percentile	Average price CZK / m^2
8,333333333	9898,616914
25	10057,56439
41,66666667	12807,04285
58,33333333	13437,23098
75	14726,0274
91,66666667	14830,50847

Fig. 3 Regression statistics - Residues (Source: Own processing)

A correlation coefficient (Multiple R) = 0.913 indicates a strong, positive linear correlation. An adjusted

Discussion

The expected assumption of the influence of tourism on the price of real estate in Znojmo was confirmed, however, for a correct evaluation and generalization it would be more conclusive long-term research. If it would be possible to include tourists not captured in the database of staying guests in the research, the dependence would probably be even more significant. Refinement would be possible using geolocation data from mobile operators, but this is only available to the public administration.

Conclusion

The benefits of local tourism are clear but rising residential property prices may also make housing less affordable for local residents. The fact is that since 2020, property prices have been rising steeply almost all over the Czech Republic, so it is important to thoroughly investigate the causes of the price rises and correctly demonstrate that they are caused by the tourist attraction of the location.

References

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Acknowledgement

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Souhrn

Studie mapuje, jak environmentální aspekt atraktivity rekreační či turistické destinace ovlivňuje nejen životní prostředí, ale i hodnotu rezidenčních nemovitostí (nejen rekreačních objektů), což dokládá statistické vyhodnocení za období let 2014 až 2019. Pozitivním ekonomickým vlivem mohou být v turisticky atraktivní lokalitě snížená nezaměstnanost a rozvoj místního podnikání. Nesledovaným aspektem je horší cenová dostupnost rezidenčních nemovitostí pro místní obyvatele.

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QUANTITATIVE VISITOR MONITORING RESULTS APPLICATION

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Abstract
The Czech Nature Conservation Agency collects visitor-monitoring data through automated counters since 2009. Contracting as well as data management have been centralised, harmonised, and made available for all employees as well as for partners. The profiles in protected areas are of various character, from roads to tiny paths with restricted access, from vehicles through cyclists to walkers and canoes.
Visitor monitoring data is valued source of information. Accurate data is utilised as an undisputable argument. Long-term profiles show overall trends in tourism and can detect changes e.g. during Covid-19 pandemic as well as before and after a lookout tower construction. Counters on paths with restricted access can help to evaluate effects of various measures. Oscillations within an average day, week as well as year can help planning visitor centre operating hours, ranger service, and construction works. Total and maximum numbers on trails help define necessary parameters of visitor infrastructure. Real numbers of vehicle traffic can evaluate the policy of issuing vehicle entry permits. Damages on nature can be compared with counter data to determine if visits are the cause.

Key words: automated counters, quantitative monitoring

Introduction
The Nature Conservation Agency of the Czech Republic (NCA) runs visitor monitoring using automated counters since 2009. As a state agency, NCA must cearly argument efectiveness of money spent. Review of visitor monitoring data values can inspire other subjects to start their own monitoring, too.

Materials and methods
Automated visitor counters are one of the methods used for visitor monitoring worldwide. Several producers offer their counters following a common pattern: detection of objects passing through a profile. Such a profile is usually placed across a trail, road or another type of corridor used by visitors to an area. Device properties (sensors, GSM data transmission, etc.) and data outputs can vary based on the needs of a customer.
NCA uses data from two contractors. Since 2009, methodology was subsequently improved to serve needs the best and to harmonise outputs between the contractors to allow evaluation of combined data. Counters monitor walkers, cyclers, motorised vehicles, and/or canoers inside protected areas managed by NCA. Basic interval is 1 hour. Data is downloaded manually four times a year and uploaded into a common internet based database (Eco-Visio). The database is accessed by NCA employees from all branches of the organisation located all around Czechia.
NCA publishes brief evaluation of visitor monitoring data annually, usually in May. Some results are published occassionally at conferences or in media on request.

Results
The highest number of monitored visitor profiles at NCA was reached in 2016: 107 profiles. In 2022, due to budget limitations, NCA runs only 49 profiles.
The data from visitor monitoring are basicly important to create **objective overall image of visitor movement** in the localities (along roads and elements of visitor infrastructure, at what time of day or night, how the traffic is distributed within a week or a year). According to the results, it is possible to predict periods of higher visitor use and plan various events accordingly (either positively - use the increased attendance for education, and negatively - send the nature guard to the right place at the right time, or suitable timing of measures). The results are also often used in negotiations with partners on land use. They are also very valuable for establishment of new protected areas. Authors of studies or academic works are often interested in visitor monitoring results. Data from long-term measurements are a necessary starting point for **research of the impact of visitor use** on subbjects of protection. If we monitor visitors, we are able to react relatively quickly and take measures in favor of nature protection and at the same time prevent damage to nature. Without visitor monitoring,

negative changes in the environment are being recorded after a longer period of time, and correction is then very costly, if not impossible.
The **long time series** of measurements at most sites shows a slight increase in visitor use. However, there are also locations with stable or even declining use. An example of a permanent increase is the northern access road to the top of Lysá hora in the Beskydy Protected Landscape Area (PLA), see Figure 1. Visitor monitoring there was launched back in 2009. For the first full year of the monitoring (2010), 59,000 passes were recorded. Numbers have been rising almost linearly since then, with the exception of 2017, when there was a temporary decline. By 2020, visitor numbers had already reached 205,000, which means 3.5 times with no indication of possible change. If continued, situation over the next 10 years with this trend is unacceptable to most people today.

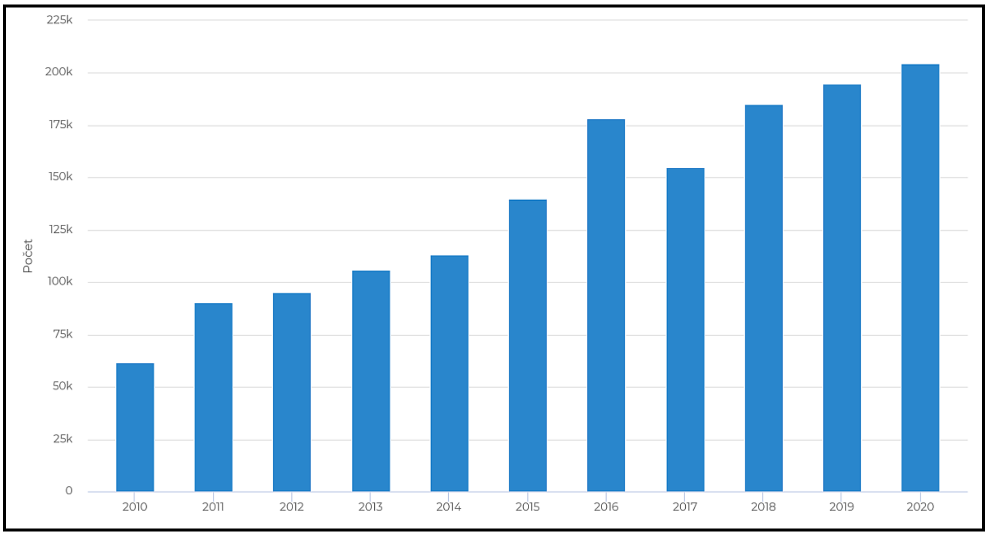

Fig. 10: Number of passes on one trail reaching the top of Lysá hora showing the trend in the period 2016–2020.

In the Křivoklátsko PLA, visitor monitoring started in 2010. Based on the data, a basic overview of the development of visitor use at profiles **in the considered National Park** over the last 10 years has been prepared for discussions with the mayors. Based on our data, we can seriously and demonstrably reject one of the mayors' arguments that there are too many tourists in the municipalities, because the number of visitors does not correspond to their concerns and there is only a slight increase in some localities. We can usually explain the reasons for the increase (eg new tourist infrastructure or, conversely, its damage, weather developments, pandemics, etc.). Municipalities, on the other hand, have usually no objective data about tourism intensity.
A study of the socio-economic impacts of discussed establishment of a nature reserves network or a PLA was compiled for the **negotiations on the protection** of the Soutok basin in South Moravia. Visitor monitoring data was one of the important inputs and thanks to them the study could bring significant results. Thus, we have not only a sophisticated estimate of the economic benefits of the current level of attendance in the area, where visitor use potentially increases the annual production of the regional economy by CZK 207 million. Additionally, we also know that conservation through the nature reserves network will attract more visitors and increase production by 19% and in the case of PLA even by 42%. It can be concluded that the category of NP proposed by the Government of the Czech Republic would increase the attendance even more, but this option was not the subject of consideration at the time of commissioning the study and therefore the study did not address it. Due to the fact that the study took place in a period strongly influenced by anti-pandemic measures, the visitor use of Soutok was compared with the changes in visitor use at nearby Pálava PLA, where the monitoring has been running for several years. And thanks to this, it was possible to estimate how much the current Covid-19 visitor use differed from the normal one.
Visitor monitoring provides important data on paths where **public access is currently prohibited** in national nature reserves (eg Kněhyně, Císařská rokle, Doutnáč). Thanks to this, we know how many people and when they most often violate the entry ban. We have also verified effectiveness of various measures to prevent entry. For example, the single placement of information signs at Kněhyně led to no change, only a thorough barrier from the cut branches helped later.
Thanks to the visitor monitoring at Radhošť and Praděd, we know not only walkers numbers but also **the number of passing cars**. So we know exactly to what extent car traffic corresponds to the

number of permits issued. The measured data not only help us in negotiating with real estate operators about the necessary regime, but also serves as an important guide in issuing permits in general.
NCA has long been criticized for admitting uncontrolled visitors to the Dog's-tooth-violet site in the Medník National Nature Monument (NNM). The movement of a large number of people around the site is said to lead to trampling and loss of individuals of this critically endangered plant. Counters found that the **claims of thousands of visitors were wrong**, the daily maximum at the time of flowering was 250 passes.
In the Drbákov - Albertovy skály National Nature Monument, where the locality is attractive for tourists with viewpoints and an educative path, the counter has shown a significant increase in visitor numbers in recent years (Covid-19). It is possible to prove a **direct connection between the increase in the number of visitors and the trampling** of various shortcuts, side paths, **and damage** to the visitor infrastructure. The data from the counter are an important basis for management of the marked trail network and planning the trail repair costs.
The counter in Kaňk NNM confirmed regular balanced attendance independent of dates, corresponding to short walks around the residence. The data is **essential for negotiations with** the Town Hall of Kutná Hora as **the owner** and the most important partner. Municipality contributes to the costs of site care. We have been striving for a suitable interpretation of this NNM for a long time, and the data show that it makes sense due to high traffic.
The counters in the Velký and Malý Blaník Nature Reserves (lookout tower, nature trail, forest as a subject of protection) also showed a significant increase in visitor use in recent years (Covid-19). The data is used for **negotiations with municipalities and forest owners** and is an important argument in negotiations on the nature trail, the operation of the lookout tower (pressures on electrification) and the opening of the peak for cyclists. We use the data when negotiating a "no-intervention" regime in parts of the nature reserve.
Due to the newly created climbing routes in Kobyla Nature Reserve (NR), the data show **a change in the visitor use in the area**. Awareness of the distribution of visitors during the day is valuable. With the help of data, it is possible to further correct visitor use and successfully **negotiate with representatives of the Czech Mountaineering Union**. The same applies to Tetínské skály NR, popular not only for climbers but also promoted by the municipality.
The counter by Kubrychtova bouda in Karlštejn NNR exceeds the original ideas about the number of people passing by. The data **confirm the idea to repair the chalet and set up an information point** here. Awareness of the distribution of visitors during the day, week and year for opening hours planning is valuable. Similarly, the famous viewpoint above Svatý Jan pod Skalou is confirmed by visitor monitoring as one of the most visited places in the Bohemian Karst PLA. The data will be used in a **sustainable tourism study**.
Visitor monitoring in selected caves in the Moravian Karst PLA shows higher values than expected. These findings will be the reason for **adjusting the regime** in cooperation with speleological organizations.
Thanks to counters on rivers used for canoeing (eg at the Ploučnice river in the Kokořínsko - Máchův kraj PLA or at the Morava river in the Litovelské Pomoraví PLA) we know not only **when the canoeing season begins and ends**, but also very precisely when the first eager people appear on the water and when the last boat really passed in a given year. We can, for example, check whether the destruction of clutches of eggs on the gravel alluvium have been caused by canoers or fishermen and take the right measures.
Long-term visitor monitoring on the trails in Králický Sněžník NNR not only shows us general trends, but also allows us to **identify the impacts of the construction of various visitor attractions** in Horní Morava village on visitor use. In the same way, we have documented the effects of the construction of the lookout tower on the Polish side of the peak, not only during the construction works, but also in the future after the start of regular operation. The **results can be used far beyond the borders** of the region, whose administration monitors traffic.

Discussion

The above list of visitor use data usefulness is just an example. Experience shows that visitor monitoring data can be very useful in many situations to answer current questions. On the contrary, for example, we do not have precise figures based on the rangers' claims about a dramatic increase in the number of visitors to suburban PLAs during antipandemic measures, because in 2020 no monitoring was run in the Czech Karst or the Moravian Karst or Poodří PLAs.
Automated counters are just one of the visitor monitoring methods. Much more accurate information on visitor use of a protected area could be obtained by a combination with other methods like mobile

phone signal providers data and visitor surveys. Unfortunately, state budget is limited and other partners show some attitude to support visitor monitoring very rarely.

Conclusion

This article claims to inspire as much organisations as possible to start with visitor monitoring in their areas of interest. NCA offers visitor monitoring data exchange to collaborate in sustainable visitor management based on reliable information.

Souhrn

Od roku 2009 sbírá AOPK ČR údaje o návštěvnosti vybraných lokalit ve své správě metodou automatických sčítačů. Sledují se jak nejzatíženější cesty, tak cesty u zranitelných cílů, uzavřené pěšiny v NPR, vrcholové cesty s občasným automobilovým provozem na zvláštní povolení, cyklostezky i vodácké trasy. V posledních cca pěti letech jde většinou o 50-100 současně sledovaných profilů. Zakázky na nákup dat a jejich základní vyhodnocení se soutěží formou rámcové dohody, máme dva tradiční dodavatele. Od roku 2018 oba dodavatelé nahrávají veškerá sebraná data do centrální internetové databáze Eco-Visio, která velmi usnadňuje sdílení dat a zároveň umožňuje vlastní základní analýzy.

Získané údaje podávají přehled nejen o celkové návštěvnosti lokalit. Z dat jsou zřejmé i oscilace v průběhu roku, týdne i dne (po hodinách). Na dlouhodobě sledovaných profilech je možné objektivně identifikovat trendy. Z dat jsou dobře patrné i výkyvy návštěvnosti, ať už jde o jednodenní hromadné akce nebo střednědobé vlivy např. u protipandemických opatření. Výsledky monitoringu jsou využívány pro plánování návštěvnické infrastruktury, služeb stráže přírody, povolování různých záměrů i projednávání strategií práce s návštěvníky. Zejména při diskuzích se starosty jsou údaje ze sčítačů důležitým podkladem, protože se v praxi ukazuje, že vnímání návštěvnosti je velmi subjektivní a na základě vlastních pocitů každá strana hodnotí situaci velmi odlišně.

Monitoring návštěvnosti pomocí automatických sčítačů je jen jednou z dostupných metod. Ideální je kombinace dat různých metod, například také zbytkových dat mobilních operátorů nebo dotazníkových šetření.

Cílem příspěvku je inspirovat další partnery k monitoringu návštěvnosti. AOPK ČR je jako státní organizace zcela závislá na možnostech státního rozpočtu. Vícezdrojové financování a vzájemné sdílení dat by umožnilo efektivní spolupráci na udržitelném managementu cestovního ruchu nejen v chráněných územích.

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RE-DESIGNING A RURAL PARK SQUARE AND CHURCHYARD IN POĽNÝ KESOV, SLOVAKIA

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Abstract
The Rural Green Space Design Studio is a subject in the master cycle in the Landscape Architecture study programme that focuses on the renewal and/or re-design of open spaces in rural settlements. The subject applies project-based learning and since rural landscapes belong to our main research domains at the Institute of Landscape Architecture, it also applies research-led teaching and research through design teaching. In recent years, this design studio has always been taught on direct assignments by rural municipalities, which has led to good and mutually enriching cooperation and exchange between the university and local governments. The task in 2020/2021 was to develop a design concept on the main square of the municipality of Poľný Kesov located in south-western Slovakia and the churchyard, which is in close vicinity to the square. Both, the square and the churchyard consist mainly of open green spaces, which were missing a general design concept. Within the design studio, we mapped, analysed, and evaluated the current situation of these central open spaces and developed three different design solutions, which are presented and interpreted in more detail in this paper.

Key words: countryside, green infrastructure, landscape architecture, open space, rural landscape

Introduction
An important challenge of contemporary landscape architecture in the Slovak countryside is restoration of public and special green and open spaces and an overall enhancement of the local green infrastructure (Tóth, Štěpánková and Feriancová, 2016). According to Tóth (2020), green infrastructure can be considered an important strategic concept and approach in planning and designing (rural) landscapes. Kuczman (2018) has tested and verified a wide range of landscape architectural strategies on applied research and design of rural landscapes. According to Kuczman and Feriancová (2019), it is very important to integrate regional specificities in landscape architectural works when designing open spaces in the countryside. An important part of evaluating greenery in public open spaces of rural settlements, as well as in open agricultural landscapes (Tóth, Kuczman and Feriancová, 2016) is represented by the inventory and evaluation of woody plants (Bechera and Kuczman, 2020), including fruit trees (Bihuňová et al., 2021). Rural landscapes and open spaces are highly important for sustainable tourism and recreation (Tóth et al., 2014; Bihuňová, 2019). The design assignments and challenges in rural landscapes can be highly variable, from designing memorial landscapes (Halajová et al., 2016), through re-designing environmental education centres (Tóth et al., 2018) and transforming central zones (Čibik et al., 2020), up to restoring historical sites and waterfronts (Čibik et al., 2019). Design can be also effectively integrated with research into “research by design” or “case study research” that has a high potential for landscape architecture design research in the context of the Slovak countryside (Tóth, 2020; Čibik and Štěpánková, 2020). One of the most recent tasks in the Rural Green Space Design Studio at the Institute of Landscape Architecture of SUA Nitra was to develop a design concept for the park square and churchyard in the historical centre of the rural settlement Poľný Kesov, located in southwestern Slovakia, in the Nitra District and Nitra Region (Tóth et al., 2021). This paper will present some of the design approaches and outcomes.

Material and methods
The assignment within the Rural Green Space Design Studio was to develop a design concept for the two most important open spaces in the centre of the municipality of Poľný Kesov (southwestern Slovakia, Danube Lowland, Nitra District, Nitra Region) – 1) the main square, which has the character of a park square with a prevalence of green spaces and woody plants, and 2) the churchyard / church garden, which in terms of users is a special green space, while from the point of view of accessibility and ownership, it is a public open space. The method consisted of two main parts – 1) analyses (wider relations, historical a., urban structure a., functional and spatial a., transport a., landscape a., green space a.), and 2) design (students worked in three design groups, which developed three different

design concepts – “Sunny Centre”, “Connections”, and “Water as Value and Identity”) (Tóth et al., 2021).

Results

Outcomes of the design studio were published as a design booklet (Tóth et al., 2021), presented and submitted to the municipality as a basic document for decision-making and discussions on the future of open spaces. Even the design of the cover page of the book was one of the assignments of the students (see figure 1).

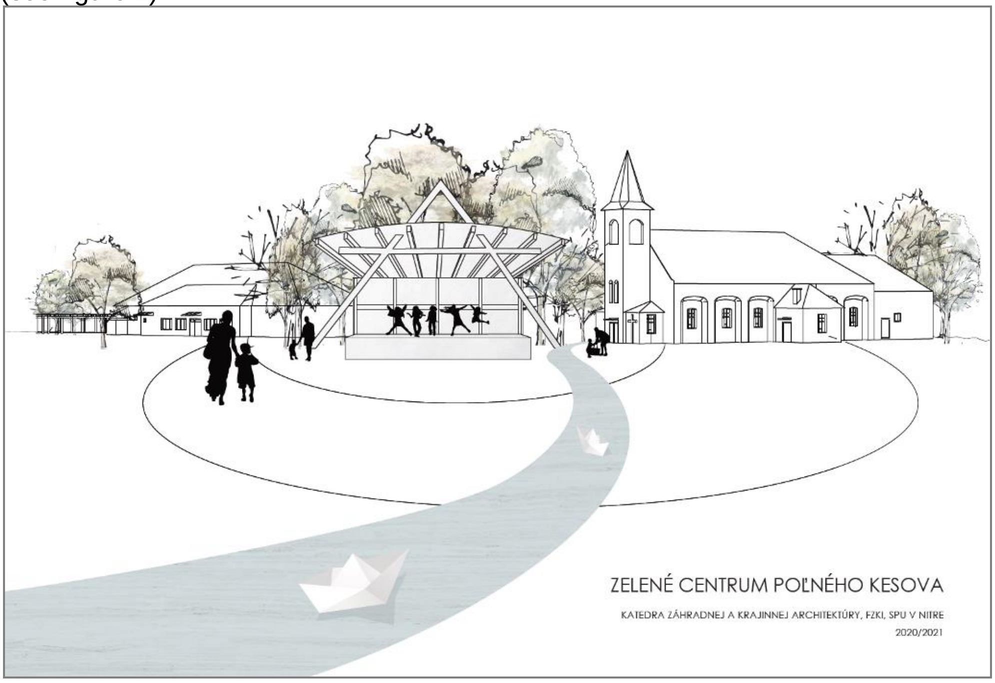

Fig. 1: The cover page of the design booklet designed by Andrea Zajacová is an abstract stylisation of the main landmarks of the village centre (Tóth et al., 2021, p. 1).

The main part of the design assignment was the park square, which is divided into two parts by the main road. This rural square is surrounded by the most important public buildings, including the mayor´s office and the cultural centre. The eastern part of the park square serves especially cultural and gathering functions. There is the cultural centre, a small square and an open-air podium. The western part of the square is linked to the mayor´s office and a new restaurant. In their design concept, students developed new pedestrian connections, a playground for children with dynamic terrain, an open-air gallery and an amphitheatre in front of the open-air podium (see figure 2).

The other open space, which was part of the design assignment, was the churchyard / church garden, which is owned by the municipality and is publicly accessible. The church used to be a distillery, which is reflected by its architecture. The main axis of the church continues towards the main road and ends in a baroque roadside cross from the 18th century made of sandstone. Students designed open-air Stations of the Cross in the churchyard and replaced some of the unsuitable woody plants. They designed perennial beds and new parking spaces. They suggest connecting the churchyard with the park square with an alley, see figure 3.

Fig. 2: One of the three design solutions developed for the park square by Anna Kulperová and Andrea Zajacová (Tóth et al., 2021, p. 64).

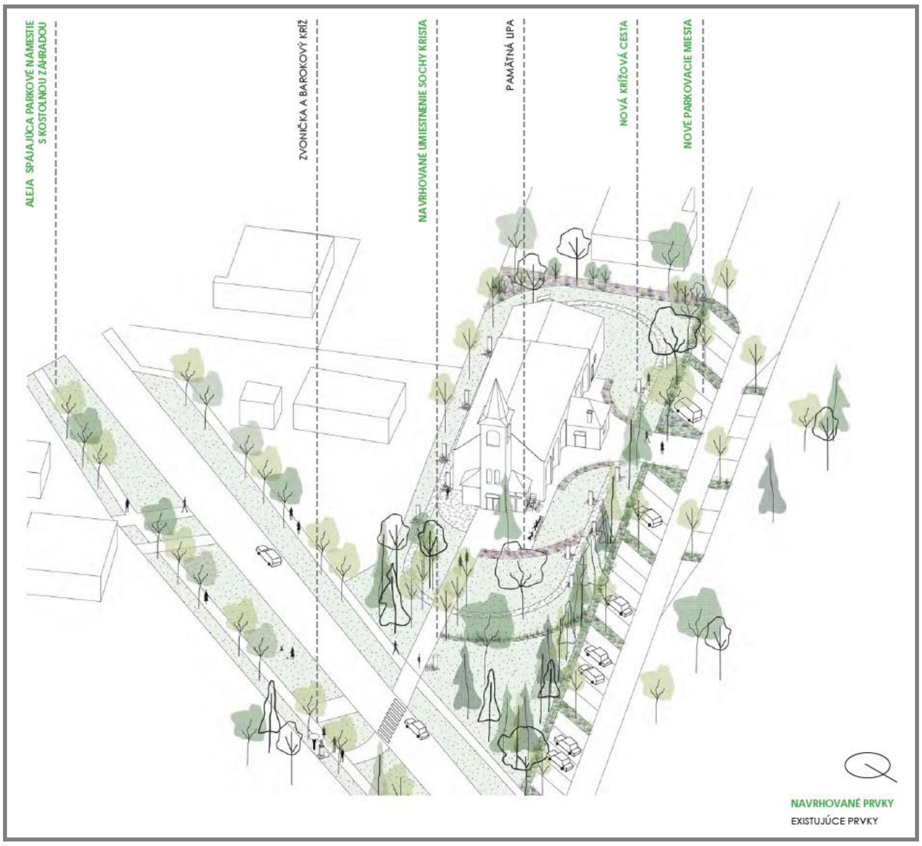

Fig. 3. Design of the churchyard / church garden by Anna Kulperová and Andrea Zajacová (Tóth et al., 2021, p. 71).

Discussion

All three design teams have integrated diverse elements of green infrastructure into their landscape architectural designs as suggested by Tóth, Štěpánková and Feriancová (2016). This project has been used as a case study in the long-term research by design teaching on rural open spaces and landscapes at the Institute of Landscape Architecture in Nitra (Tóth, 2020; Čibik and Štěpánková, 2020). The three design teams have managed to integrate regional specificities of the rural lowland landscape (Kuczman and Feriancová, 2019), while integrating also novel elements of open space design, inclusive design and nature-based solutions.

Conclusion

The presented landscape architectural project includes a set of analyses and three different design solutions for the park square and churchyard in the municipality of Poľný Kesov. Their results have been further elaborated into a design booklet (Tóth et al., 2021), which can be used by the municipality for enhancement of their central open spaces and develop the designs into more details and technical solutions. The high quality of the student design projects is reflected by the fact, that one of the student teams (presented in figures 2 and 3) succeeded in the Laurus 21 international competition, where they managed to get into the finale.

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Souhrn
Úkolem v roce 2020/2021 v ateliéru designu venkovské zeleně bylo vypracovat koncepci návrhu hlavního náměstí obce Poľný Kesov na jihozápadě Slovenska a kostelního dvora, který se nachází v těsné blízkosti náměstí. Náměstí i hřbitov tvoří převážně volné zelené plochy, kterým chyběla celková koncepce návrhu. V rámci designérského studia jsme zmapovali, analyzovali a vyhodnotili současný stav těchto centrálních otevřených prostranství a vypracovali tři různá návrhová řešení, která jsou v tomto článku podrobněji představena a interpretována.

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RECREATION AND BLACK GROUSE IN THE GIANT MOUNTAINS - WITH LOVE FOR NATURE TO THE EXTINCTION OF THE ICONIC SPECIES

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Abstract
The paper presents a study on the evaluation of a potentially suitable habitat for Black Grouse in the Giant Mountains. The modelling of suitable habitat using the traditional MAXENT method was extended by a detailed assessment of the impact of intensive recreation on the level of fragmentation of suitable habitat. The results showed that the degree of isolation of individual populations due to intensive recreational impact within the area leads to gradual extinction of particular subpopulations. Therefore, a much stricter form of visitor regulation in the region is urgently needed to save these populations from extincion.

Key words: Black Grouse, Giant Mountains, habitat suitability modelling, recreational impact

Introduction
The Black Grouse (*Tetrao tetrix*) is a highly endangered species whose numbers are constantly declining in the Czech Republic. Apart from the Ore and Šumava Mountains, the grouse is found in relatively higher numbers only in the Krkonoše and Jizera Mountains. Even here, however, there has been a steady decline in numbers in recent years, despite the fact, that these are relatively strictly protected areas.
In order to effectively protect the grouse and set up appropriate management, it is important to understand its habitat preferences, spatial requirements, critical limits and threatening factors. A widely used approach to such an assessment is habitat modelling, which enables a comprehensive assessment of the relationship between the occurrence of a species of interest and a suite of relevant environmental factors. The outputs of habitat models then include maps of potential distribution or an assessment of the suitability of habitats for the occurrence of the model species. These can then be confronted with background anthropogenic activities, spatial development data or management maps of forest and agricultural management. At the same time, they serve as a basis for defining sites that are key for the conservation and development of populations of the species of interest or for defining core areas as supporting elements of a possible ecological network.
The interconnected area of the Krkonoše National Park and the Jizera Mountains Protected Landscape Area represents an enormously exposed area where there is a significant concentration of disturbing human activities, especially in relation to recreational use of the environment. These activities very often penetrate into areas with a predominance of natural or near-natural biotopes. The current development of the use of the landscape and, in particular, the intensity of recreational use of the area brings with it a high degree of fragmentation by anthropogenic structures, which create significant barriers in terms of the permeability of the landscape. Together with the loss of suitable habitats (e.g. overgrowth of forest damaged formerly by air pollution), disturbance and fragmentation of grouse populations are critical factors for their long-term survival. Determination of the degree of habitat suitability, delineation of core areas of its current or potential range and determination of their spatial parameters thus constitute a useful basis for assessing the impacts of anthropogenic activities and also for planning measures within the framework of conservation management of the species.
The aim of this study was to characterize the gradient of environmental quality according to the suitability of habitats for sage grouse, to define core areas of suitable habitats in the Giant Mountains and the Jizera Mountains, and to express the degree of their fragmentation by disturbing factors of anthropogenic activities.

Materials and methods
MAXENT software (Phillips et al. 2006) was used in this study to predict potentially suitable habitat and assess habitat preferences of the species of interest. Maxent is one of the so-called machine learning methods, where the algorithm is based on the principle of maximizing entropy in geographic space or minimizing the relative entropy between two probability densities in environmental space,

one estimated from the presence data and the other determined from the entire area of interest (Elith et al. 2011). It works with georeferenced records of species occurrence, called presence data, and a set of predictors describing the environmental setting in the area of interest (Merow et al. 2013). The aim of the tool is to model the distribution of a species in a way that respects the distribution of predictor values across the area of interest as well as the species' preference for a particular range of predictor values (Elith et al. 2011).
The first step of the analysis is the processing of data on the occurrence of the species of interest, the second step is the preparation of documents describing relevant environmental factors and the final stage is the creation of the habitat model itself. Based on the map output, core habitat areas and stepping stones are then defined using expert knowledge of the spatial requirements of the Black Grouse, which can be further evaluated according to the quality of the habitats, interconnectivity or isolation, etc. Finally, the level of recreational impact on the area was evaluated to determine how it affects core areas of suitable habitat and the connectivity of grouse populations.
The input data on the occurrence of the grouse were compiled primarily from databases by the Krkonoše National Park Administration itself; furthermore, some data were compiled by the Administration of the Jizera Mountains Protected Landscape Area (CHKO Jizerské hory), which were supplemented with data from the Nature Conservation Finding Database (NDOP AOPK). The data were collected and evaluated from 1998 to the present, a total of 2461 records were processed in this way (Giant Mountains: n = 2151, Jizera Mountains: n = 310). All input data were standardized and "rarefied" before entering into the model to reduce spatial autocorrelation and prevent multiplication.
At the same time, input data describing relevant environmental factors were processed and evaluated. The input environmental variables included factors describing the basic abiotic gradients of the environment (altitude, slope, solar radiation), habitat factors (derived from the Consolidated Ecosystem Layer database – KVES, ©AOPK ČR & CzechGlobe), habitat mapping of the Karkonoski Park Narodowy and Sentinel 2 satellite image classification) and anthropogenic disturbance factors expressing the distance from built-up areas or roads. The source of the relief data was the pan-European digital elevation model EU-DEM 2; in the case of anthropogenic disturbance factors, the primary source was the Open Street Map (OSM) database, which was supplemented by national databases (e.g. ZABAGED). The most complicated was the preparation of a database on habitats or ecosystem types for the whole transboundary area with different availability of data. Here, the Consolidated Ecosystem Layer (KVES) was chosen as the basic database, which is available for the entire territory of the Czech Republic and thus covers the area of interest of the KRNAP and the Jizera Mountains Protected Landscape Area without any problems. For the Polish Karkonosze National Park, a habitat mapping layer was provided, which could be linked to the KVES layer thanks to the common coding of habitats. For the remaining territory on the Polish side, it was then necessary to classify and vectorise a cutout from the scene taken at the end of 2017. The merged layer resulting from the necessary generalization of subcategories distinguishes 20 habitat types (see Table 1).
The last step was a comprehensive assessment of the recreational load of the area. Based on a combination of census data, field monitoring and expert evaluation, a three-level scale of tourist intensity of tracks and roads was established. Each of these pathways was thus assigned a buffer expressing the level of disturbance according to the intensity of the recreation load.

Results & Discussion
The result of the habitat model shows on a scale of 0 - 100% the suitability of the environment for the species of interest. In addition, the MAXENT model generates a series of tabular and graphical results that aid in model interpretation. The habitat model shows the species' association with the upper parts of the mountains at the upper forest boundary, open forest stands with clearings, peat bogs and other natural treeless areas. It is also limited by the climatic conditions of the highest parts of the mountains. However, the area of potential occurrence, which is naturally structured by natural barriers (deep valleys, summits, etc.), is significantly threatened by fragmentation by anthropogenic structures - especially elements of the so-called hard recreational infrastructure, such as ski areas, routes for summer and winter traffic of service vehicles, very intensively used hiking and skiing trails, or cycling tracks. The results of the grouse habitat model show a significant influence of altitudinal gradient, habitat, solar radiation and distance to roads as well as distance to buildings. The histograms of the model show the importance of preferred habitats, especially in the following categories: alpine meadows, wetlands and bogs, peatlands, shrubs and heathland.

Tab. 1: Habitat classification

HABITAT			
1	water	11	dry lawns
2	wetlands and marshes	12	deciduous forests
3	peat bogs	13	mixed forests
4	sagebrush	14	coniferous forests
5	alpine meadows	15	quarries
6	heathland	16	arable land
7	rocks, scree	17	other agricultural areas
8	shrubs	18	urban green areas
9	mesophilic meadows	19	Urban areas and industry
10	meadows	20	transport networks

Based on the outputs of the habitat model, core areas of suitable habitat were defined throughout the model area, in the first phase without including the disturbance or barrier effect of infrastructure, development and other anthropogenic structures. However, the model constructed in this way present only a very limited assessment of the real impact of anthropogenic structures, especially the tracks and road network. Given the intensity of its use in both mountain ranges, it represents a crucial element that limits the functioning of the sub-populations of grouse within suitable habitat. Therefore, a "realistic" version of a graded assessment of the disturbance effects of the tracks & road network was developed - according to the intensity of use or traffic on tracks and roads, disturbance envelope zones were defined (buffer 50 m around low-use tracks & roads, 200 m for medium and high-use tracks & roads). The output is then a set of datasets and maps that allow an objective assessment of the level fragmentation / isolation of core areas of suitable black grouse habitat within the area of interest.
If we quantify the impact of the disturbance of anthropogenic elements on the extent and character of the distribution of core areas according to the above parameters (graded disturbance effect of 50-200m of tracks & roads according to the intensity of traffic on low-medium-high use roads), we find a substantial degradation of suitable habitats. Out of a total area of over 23.800 ha of suitable habitat, the undisturbed area of habitat is reduced to only 3.496 ha when the disturbance effect is included. Similarly, the spatial structure of the arrangement of isolated core area patches decreases significantly - while their number increases, the average patch size also decreases. This also increases the necessary migration distances between suitable habitats and reduces the overall connectivity of habitats and sub-populations of grouse.

Conclusion

Habitat models enable objective processing of large volumes of data on the occurrence of species of interest and relevant environmental variables. In addition to maps of potential species distributions, the models also result in graphical and tabular outputs that assess the influence of selected environmental factors and, in particular, the actual habitat preferences of the species under study. The map outputs are the basis for the delineation of core areas of actual and potential distribution of the species of interest and also serve as a key input for the assessment of connectivity of suitable habitats.
The results of the study represent both the different habitat preferences of grouse in the two mountain ranges assessed, but also the similar vulnerability of the populations to anthropogenic activities in the area. It is the regulation of the impact of disturbance, particularly in relation to recreational use of the area, that appears to be the most significant challenge for grouse conservation in the future. If such regulation fails in the next few years, the black grouse population in the region will most likely disappear.

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Shrnutí

Příspěvek představuje studii hodnocení potenciálně vhodného habitatu pro tetřívka obecného v Krkonoších. Modelování vhodného habitatu pomocí tradiční metody MAXENT bylo rozšířeno o detailní hodnocení vlivu intenzivní rekreace na míru fragmentace vhodného habitatu. Výsledky ukázaly, že míra izolovanosti jednotlivých populací vlivem intenzivní rekreační zátěže území vede k postupnému zániku dílčích populací. Pro záchranu těchto populací je proto nezbytně nutné mnohem striktnější forma regulace návštěvnosti v tomto území.

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RECREATIONAL POTENTIAL OF COMMON FACILITIES IN LAND CONSOLIDATION

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Abstract
As part of land consolidation, "common facilities" are designed and implemented, in this context are proposed measures to protect soil and water, to improve the ecological stability of the landscape and field roads that increase the permeability of area. Land consolidations are increasingly focused not only on the rational use of the land fund, but mainly on proposals for multifunctional measures, ensuring consistency between farmers, residents and visitors in the area. To popularize the hard work of designers, land offices and construction contractors, a competition for the best common facility called Living the Landscape is held every year. Through it, the implemented measures are evaluated and their polyfunctionality and contribution to the improvement of the landscape are appreciated. Just in the year 2020, 271 buildings were built as part of land consolidation, of which ecological (greenery) in the number of 33, water management in the number of 62, anti-erosion in the number of 18 and the most represented were field roads by the number of 158. The aim of the paper is to present several common facilities appreciated in previous years of competition, their purpose and importance for increasing the recreational potential of the area and its attractiveness.

Key words: Landscape, tourism, soil and water conservation, landscape permeability

Introduction
The Czech landscape has historically undergone a complex development, given by the power, political and economic influences, especially in the twentieth century due to drastic changes in the way of farming on agricultural land. The legacy of this process is the disturbed landscape, unable to fully ensure its ecosystem functions (Sklenička et al. 2014). The way to remedy this situation is not easy or short. Restoring landscape functions requires a comprehensive approach, based on both knowledge of historical contexts and modern approaches to landscape creation and protection, while respecting land ownership rights. Land consolidation is an important tool for applying these principles and achieving a balanced state of the landscape, including its ecological, economic and social functions. As part of land consolidation, "common facilities" are designed and implemented, which form the framework in landscaping, in this context are proposed measures to protect soil and water, to improve the ecological stability of the landscape and, finally, a network of roads to increase permeability of the area. The term "common facility" can be imagined, for example, like field roads, water reservoirs, grassy broadchannels, or planted elements of greenery (Papoušek, 2011).
Land consolidations are more and more focused not only on the rational use of the land fund, but mainly on proposals for multifunctional measures, ensuring consistency between farmers, residents and visitors to the area (Janečková et al.2017). To popularize the difficult work of designers, land offices and suppliers, a competition for the best common facility called “Living the Landscape” is held every year. Through it, the implemented measures are evaluated and their polyfunctionality and contribution to the improvement of the landscape are appreciated. Last year alone, 271 building structures were implemented as part of landscaping, of which ecological (greenery) in the number of 33, water management in the number of 62, anti-erosion in the number of 18 and field roads were represented by the number 158. (SPU CR)
Key words: Landscape; tourism; soil and water protection; landscape permeability

Material and methods
The main goal of the competition is to acquaint the widest professional and laic public with the scope and level of implementation of common facilities proposed in land consolidation and thus contribute to increasing the prestige of the field. The competition supports projects that, by their nature, meet the requirements for a comprehensive landscape solution or part thereof (SLA CR).
Common facilities are evaluated in two categories:
1. Green and transport infrastructure (Ecological network elements, field roads)
2. Landscape creation and protection (anti-erosion and water management measures)

The aim of the paper is to present several winning common facilities, their purpose and importance increasing the recreational potential of the area and its attractiveness. They are:
• educational trails and pools in cadastral area Růžová (district Děčín),
• windbreak in cadastral area Vrbovec (district Znojmo),
• local biocentre in cadastral area Čejč (Hodonín District),
• wine routes in cadastral area Mikulov (district Břeclav).

Nature trails and pools in cadastral area Růžová

It is a set of consecutive common facilities implemented based on the results of complex land consolidation in cadastral area Růžová. With the construction of the main field road and the side field road, stable field roads with farming slips were built from dangerous muddy access to agricultural land. As these backbone roads crossed the landscape across the tourist site, the village used them for sightseeing tours and supplemented with furniture and educational panels. Planted pears and apple trees form the Fruit Trail, the Health Trail encourages walks with beautiful views. Small pools have attracted water-loving animals and helped increase biodiversity. The project returned natural water areas to the landscape and increased biodiversity, improved water management conditions and at the same time increased the overall ecological stability in the affected locality (Fig. 1., 2.).

Fig. 1: Landscape before the construction

Fig. 2: Pools with the field road

Shelterbelt in cadastral area Vrbovec

The project is based on the common interest of the Municipality of Vrbovec and the owners of the affected lands to actively strengthen the protection of the municipality from wind erosion, reduce dust in the village and strengthen the functionality of selected Ecological network components by restoring ecosystems and subsequently developing their functionality (Fig.3.,4.). The selection of woody plants for planting was made so that it corresponded as much as possible to the potential natural vegetation in the solved locality. Znojmo is one of the driest areas in the Czech Republic. A hydrogel was used on the plant roots when planting the plants. In addition to the planting itself, the implementation also included a three- year aftercare.

Fig. 3: Area before construction

Fig. 4: Shelterbelt after planting

Local biocentre in cadastral area Čejč

The project of restoring the water area in the landscape originated in places where, based on the first written mention from 1464, Lake Čejčské was located. The water in it was brackish (half-salty) and there were salt marshes in the vicinity. However, it probably already existed in the Holocene. It disappeared through human activity between 1823 and 1824 through targeted drying. The last of its local remains were devastated by the "economy leaders" through a thorough amelioration after the year 1965. The new intention was to sensitively revitalize this area. A local biocentre of a combined type was created on the partially wetted soil area, one of the last, which was used for many years due to its remote location for a black dump, looking unfriendly into the surroundings (Fig.5.). It is a creation of a multifunctional measure in the form of 2 shallow, drying ponds and one with a constant water surface, including numerous plantings of deciduous trees and shrubs. The littoral zone around the water area provides a natural place for the development of wetland vegetation, waterfowl and amphibians. Through the implementation of the project, natural water areas were returned to the landscape and biodiversity and ecological stability were significantly increased (Fig.46.). The overall measure thus fulfils an anti-erosion, soil protection, ecological, aesthetic and recreational function. The efforts made gave rise to an important water management, eco-stabilizing and landscape-creating element with societal significance, which further follows the bio corridor of the Čejčský potok floodplain.

Fig. 5: Area before creation the bio-center

Fig. 6: Local bio-center Čejč

Wine routes in cadastral area Mikulov

This is the construction of two field roads in the protection zone of the Pálava Protected Landscape Area in the locality of Holly hill (Svatý kopeček). A compromise solution was chosen to strengthen the roads, which would meet the requirements of the AOPK. The construction was carried out in the form of paving made of quarry stone laid on a sheet pile. The performed method of consolidation will allow partial infiltration of water in order to prevent its rapid outflow. Paved roads make agricultural and forest land accessible and at the same time they are widely used by local citizens and tourists for walks around the Holy Hill (Fig. 7.,8.,9.).

Fig. 7: The original road

Fig. 8: New field road

Fig. 9: Detail of the road

Conclusion

All these common facilities are just a small example of the results of land consolidations in the Czech and Moravian landscape. They serve both residents and farmers and visitors, sensitively combine the needs of protection and rational use of agricultural land, protection of water, nature and landscape and are aimed at aesthetic and recreational function and contribute to the restoration of the picturesque character of our landscape.

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Souhrn

Pozemkové úpravy se stále více soustřeďují nejen na racionální využití půdního fondu, ale hlavně na návrhy multifunkčních opatření, zajišťujících soulad mezi hospodáři, obyvateli i návštěvníky řešeného území. Státní pozemkový úřad každoročně oceňuje nejlepší realizovaná společná zařízení nejen z hlediska technického (kvalita a provedení staveb), ale zejména také pro jejich polyfunkčnost a přínos pro zvelebení krajiny. Jen v loňském roce bylo realizováno v rámci pozemkových úprav 271 stavebních objektů, z nich ekologická (zeleň) v počtu 33, vodohospodářská v počtu 62, protierozní v počtu 18 a nejvíce byly zastoupeny polní cesty počtem 158 (SPU CR). Cílem příspěvku je představit několik vítězných společných zařízení, jejich účel a význam zvyšující rekreační potenciál území a jeho

atraktivitu. Jsou to: Naučné stezky tůně v k.ú. Růžová v okrese Děčín, Větrolam v k.ú. Vrbovec v okrese Znojmo, a Vinařské cesty v k.ú. Mikulov v okrese Břeclav.

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REDUCING THE VISUAL IMPACT OF PLASTICULTURE ON RURAL LANDSCAPES BY A SUSTAINABLE MANAGEMENT OF AGRICULTURAL PLASTICS

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Abstract

The use of plastics in agriculture represents one of the main factors having a major impact on the environmental sustainability of the agricultural sector. The effectiveness, economy and versatility of using different plastic polymers has made these products widespread in highly profitable agricultural activities (orchards and horticulture). However, their incorrect management can determine serious environmental impacts, mainly connected to large quantities of post-consume plastic waste. Another problem is linked to the visual impact that these large clusters can have on the surrounding rural landscape. Indeed, the aesthetic quality of these territories may be reduced, with negative impacts on the surrounding areas - often characterized by a fragile environment and a marked tourist vocation - whose perception is difficult to quantify and evaluate. In this paper, a GIS-based methodology has been implemented, to perform a visual impact assessment, by applying it to the case study of the agri-food district of “Metapontino” (Basilicata Region - Southern Italy). GIS tools, besides allowing complex spatial analysis, revealed as a planning instrument that can be used by public authority also to activate suitable strategies for mitigating the visual impact of plastics on rural landscape, so as to contribute to reducing the plastic footprint of agriculture.

Key words: Landscape protection, Protected crops, Plastic covers, GIS, tourism impacts

Introduction

Agriculture has been one of the sectors in which technological innovation has been constantly researched, in order to improve land productivity and make agricultural work easier. One of these innovations has concerned the introduction of different plastic polymers which are used in different phases of the production cycles (Djakhdane K. et al., 2016). The most evident example is that of greenhouses and tunnels. However, in addition to the benefits, the use of plastics in agriculture causes numerous negative impacts on the environment, such as those related with the mismanagement of large amounts of post-consumer materials, with possible release of macro-, micro- and nano-plastics in agricultural soil, surface and deep water, air, crops, etc., as well as a heavy impact on the sustainability of agricultural productions (Scarascia-Mugnozza et al., 2008; Picuno C., et al., 2019). In addition to these impacts, it should be noted that these wide continuous surfaces covered with plastics, greatly reduce the visual quality of rural landscapes. This is extremely evident in some areas of the Mediterranean (Espí et al., 2006; Nanna et al., 2018). Obviously, the visual quality of the landscape is very important in areas with a marked tourist appeal for public recreation which, in some cases, coincide with areas with a strong agricultural vocation. Visibility analysis, in particular, is increasingly being implemented by landscape planners in effective decision support systems that deal with the best possible land patterning, as well as in assessing the visual impact of given landscape elements (Rogge et al., 2008). In southern Italy, there are several cases; the one analyzed in this work is referred to the agri-food district of “Metapontino” (Basilicata Region), in which the increase of agricultural plastics (in addition to the environmental impact on the various protected areas present) represents a problem for the aesthetic quality of the landscape. In this paper, a methodology to assess the visual impact of plastic agricultural surfaces is presented, by using a GIS methodology (Statuto et al., 2019) reproducible and exportable in other territorial contexts as a simple and rapid application, as well as modular, on the basis of the appropriate level of detail. In addition, the ease of use and calibration of the methodology also makes it a spatial tool for decision support, because it allows to process information useful to the public decision maker to plan interventions for mitigating the visual impact.

Material and methods

The study area is represented by the boundaries of the municipality of “Policoro” (Basilicata Region - Southern Italy); it covers almost 6800 hectares (Fig.1). It is one of the most important municipalities of the “Metapontino” agro-alimentary district, since there is a strong presence of quality fruit and vegetable cultivations. This, determines an important presence of different types of agricultural plastics

(Fig.2) as well. Indeed, almost 30 percent of the greenhouse crops in the entire Basilicata region are located there.
A previous study (Cillis et al., 2022) showed that in 2017 the Agricultural Plastic Surface (APS) in the municipality of Policoro amounted to about 461 hectares.

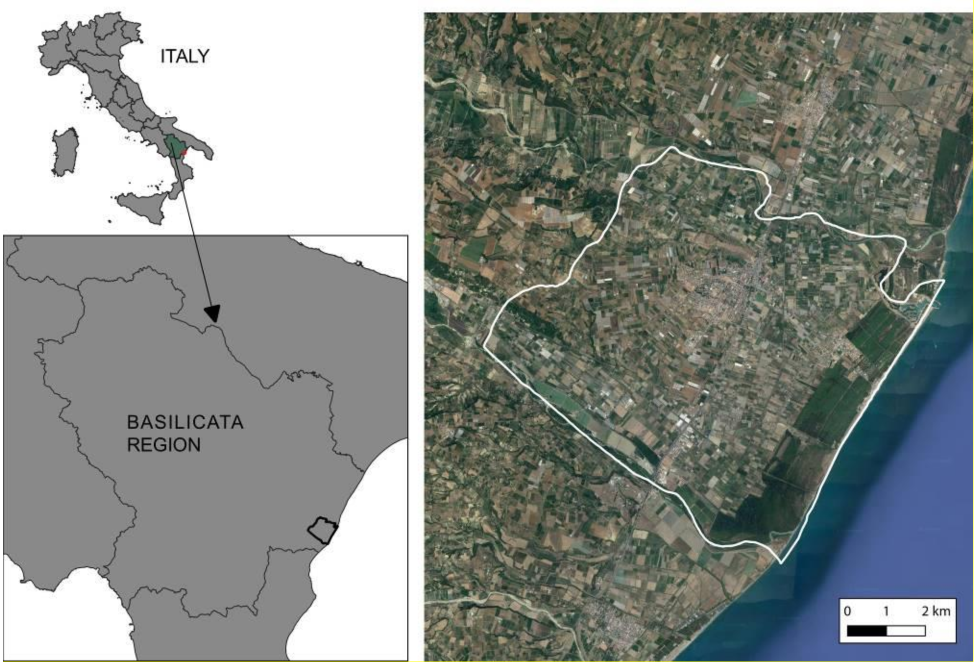

Fig. 1: Location of study area in Italy and Basilicata Region.

This is an important area for public recreation, as it overlooks the Ionian Sea, so during summer period it attracts many tourists. Moreover, the coast and part of the surrounding area is a very important site of natural interest, protected by the Natura2000 network of the European Community.
The first part of the work was to create a dataset of Agricultural Plastic Surfaces (APS) within the study area. Using an integrated approach between manual digitization of orthophotos and semi-automated classification of Sentinel-2 satellite imagery, all plastic surfaces detected in year 2017 (Cillis et al., 2022) have been mapped.


Fig. 2: Example of agricultural plastic used in study area.

Subsequently, in order to evaluate the visual impact of the plastic covers on landscape, the main access roads to areas with the greatest tourist flow have been selected based on the free *OpenStreetMap* database, so as to identify the most important tourist facilities. This information layer in vector polyline format was divided into points on the basis of vertices, since the visibility analysis is based on points. The other fundamental information layer is represented by the Digital Terrain Model (DTM), which has information about the altitude of each point of the territory (Fig.3). For a better analysis and in consideration of the level of detail required for this type of planning actions, a Digital Surface Model (DSM) with a resolution of 5 meters was chosen. This high-resolution DSM allows to detect also street trees or other type of visual barrier in a more accurate way than the DTM, which

represents only the topographic plan. These layers, within the specific QGIS plugin for Viewshed Analysis (Čučković 2016) allowed to perform the visibility analysis by making a cumulative raster. The parameters set concerned the height of the observer (1.5 meters, imagining the height of the view from the car) and the radius of analysis (1000 meters from each vertex). The result is a raster map, in which each pixel is associated with the cumulative value of the viewpoints. The higher the value, the more it means that that area is better visible from the network.
All operations have been carried out with an open-source Geographical Information System (GIS), *i.e.*: the QGIS software, which allows, with some specific plugins, to perform these operations in a subsequent way (Statuto et al., 2019).

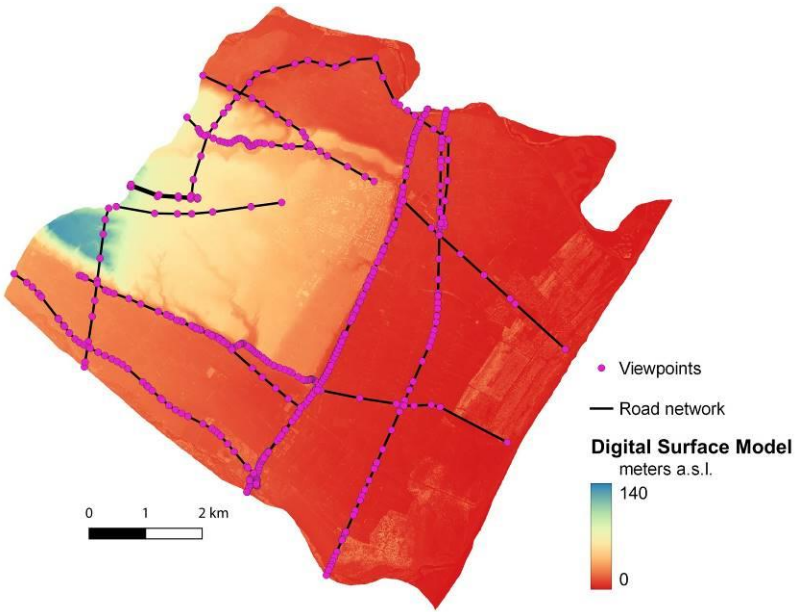

Fig. 3: Information layers used in viewshed analysis.

Results and Discussion
GIS tools are fundamental to deal with all issues related to landscape (Cillis et al., 2021). In fact, the GIS approach has allowed to test a simple methodology, which is at the same time fundamental for planning rural landscape in areas with a strong tourist vocation, but that at the same time present different types of elements linked to agricultural activity, that may reduce their aesthetic quality. The final map (Fig.4 - Left) shows the areas where there is greater visibility, imagining that the observers are along the main access road to the tourist destinations. This elaboration is easily usable as a tool to support planning activities, because it allows to identify the areas potentially having the best visibility from the road, then possibly put in place strategies to mitigate the visual impact. In fact, in the case of the visual impact of agricultural plastics, a visual overlay can be made between APS and the visibility map to identify critical areas, where agricultural plastics are most visible. In this case study, we concluded that APS are visible almost everywhere from the road network, with few clusters where there is a anyway major overlap (Fig. 4 – Right).

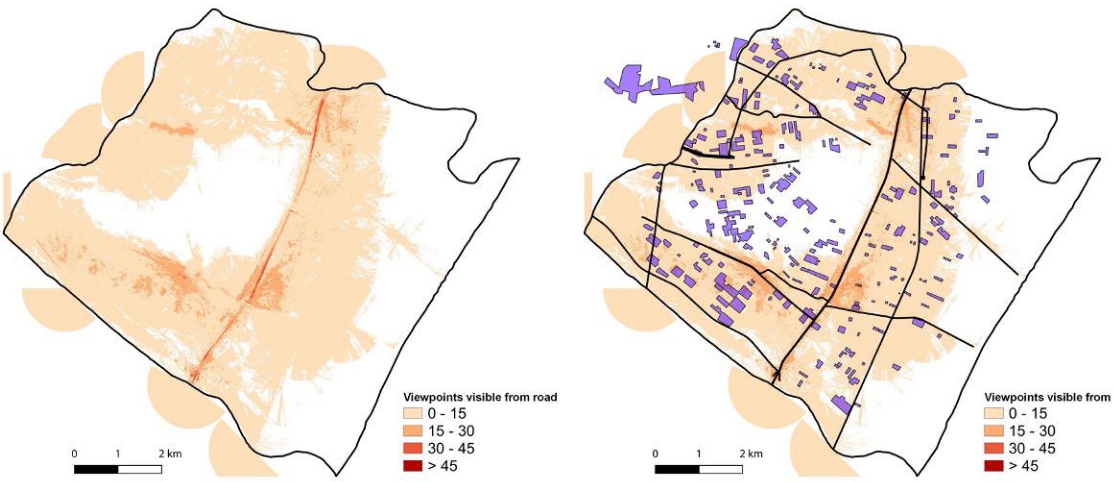

Fig. 4: Viewshed analysis map result (left) and with APS overlay (right).

In this study, the application was limited to a well-defined administrative area, without considering the surrounding areas that still have agricultural plastics. In addition, the greater the level of resolution of the DSM, the greater the reliability of the analysis, so having LIDAR flights available would certainly represent a fundamental support for the application of this methodology. In addition, thanks to GIS, the DSM can be modified to imagine the creation, for example, of a hedge, whose effect limiting the visual impact could be tested.

Conclusion

The use, management and disposal of plastics in agriculture is one of the most important issues dealt with by the European Community. Alongside the fundamental aspect of environmental impact due to incorrect disposal of plastic waste, there is also the issue on how these plastics impact on the visual quality of the landscape. Indeed, there is a risk of an excessive and concentrated diffusion in some areas with a serious negative visual impact. This problem is evident as many of these areas are those with the greatest tourist appeal for public recreation. So, the use of GIS and visibility analysis allows, thanks to the possibility to manipulate geodata in an immediate way, to make an assessment of this problem, as well as to test actions aimed to mitigate the visual impact.

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Souhrn
V tomto článku byla pomocí aplikace GIS zavedena metodika hodnocení vizuálního dopadu zemědělských plastů (skleníků, tunelů atd.) v oblasti se silným turistickým využitím v jižní Itálii (zemědělsko-potravinářská oblast "Metapontino" - region Basilicata). Plasty v zemědělství, kromě toho, že představují ekologický problém, pokud se s nimi řádně nehospodaří a nelikvidují se, jsou také negativním faktorem ovlivňujícím estetickou kvalitu a vnímání venkovské krajiny. Proto je nezbytné, aby veřejní činitelé a plánovači prováděli opatření schopná zmírnit vizuální dopady, zejména v oblastech se silným turistickým zaměřením. Jednoduchým a účinným nástrojem k dosažení tohoto cíle je analýza pohledových polí v prostředí GIS s otevřeným zdrojovým kódem. Pomocí několika vrstev informací, které lze snadno implementovat a podle potřeby upravovat, lze totiž identifikovat oblasti s lepší viditelností z hlavních silnic. Tyto informace mohou být nápomocny projektantům, kteří mohou zvolit nejlepší strategie ke snížení negativního vizuálního vlivu zejména v turistických oblastech.

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REGULAR ECO-MONITORING OF NEWLY OPENED SANDPITS – REQUIRED BY NATURE PROTECTION AND WELCOMED BY NATURE

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Abstract

The article presents the results of the case study which has been conducted in the area of the newly opened sandpit Spytihněv, lokalita Jih, operated by Cemex, a.s. The study has been focused on regular eco-monitoring of defined animal species and their sites with the basic aim of their protection and un-influencing by the sand mining respectively. The eco-monitoring was primarily required by the territorial nature protection authority and conditioned the opening of the sandpit and one of its aims is the potential future recreational purpose of the locality too. On the site of the miner, the eco-monitoring was understood as a tool potentially supporting nature by the sandpit in general. There are a methodology and the results obtained from the first year of monitoring presented within the article. Even though at the time of sandpit opening, there had been no reference to the appearance of target species directly at the locality, in connection with some specific mining works some of them began to be observed at the locality.

Key words: Eco-monitoring, Sandpits, Spytihněv, lokalita Jih

Introduction

The case study presented in the following article combines aspects of nature protection in the newly opened sand pit in combination with future recreational (educational) land use. The purpose of reclamation of the area after its extraction is to create aquatic ecosystems and ecosystems connected to it, which will be inhabited, if possible, by original plant communities and animal species. The site will then be used as a recreational and educational in order to show the public the possibilities of a positive impact of gravel mining on the landscape. To this end, the miner's cooperation with the nature conservation authority is necessary, as is systematic e-monitoring, so that in the event of a threat to the target species or their habitats, it is possible to react immediately to this fact. Eco-monitoring is then carried out by an independent university workplace after the target species have been defined by a nature conservation authority, the setting of mining work has been defined by the miner and the method of subsequent use of the excavated area has been defined by both above in cooperation with local stakeholders. Aspects of the sustainability of land management (e.g. Brus et al. 2020) and landscape aesthetics were also taken into account (Deutscher 2014).

Material and methods

The location of the case study is the newly opened mining area Jih II Štěrkovna Spytihněv and its immediate surroundings, which gave the presumption of influencing the consequences of opening a new deposit. The boundaries of the locality were chosen to form a logical whole and the locality was bounded by significant dominants, which may form, for example, migration barriers, landmarks, etc. for the monitored species.

The locality is located between the villages of Topolná and Napajedla in the cadastral area of Napajedla and near the cadastral area Spytihněv and Topolná. The area for eco-monitoring has an area of about 45 ha and outside the own mining area it is arable land. Its northern border is formed by the access road from the village of Topolná and Napajedla. The eastern border is formed by a draw, which separates the field from the Burava stream. The southern border copies the field with the adjacent fallow deer park and RKS Topolná. The western border is formed by a road, which is bordered to about half of it by a shrubbery, which then ends and the road leads to the already mentioned road and separates the monitored area from the neighboring field. The whole area has logical and well-defined boundaries in the field (see fig 1).

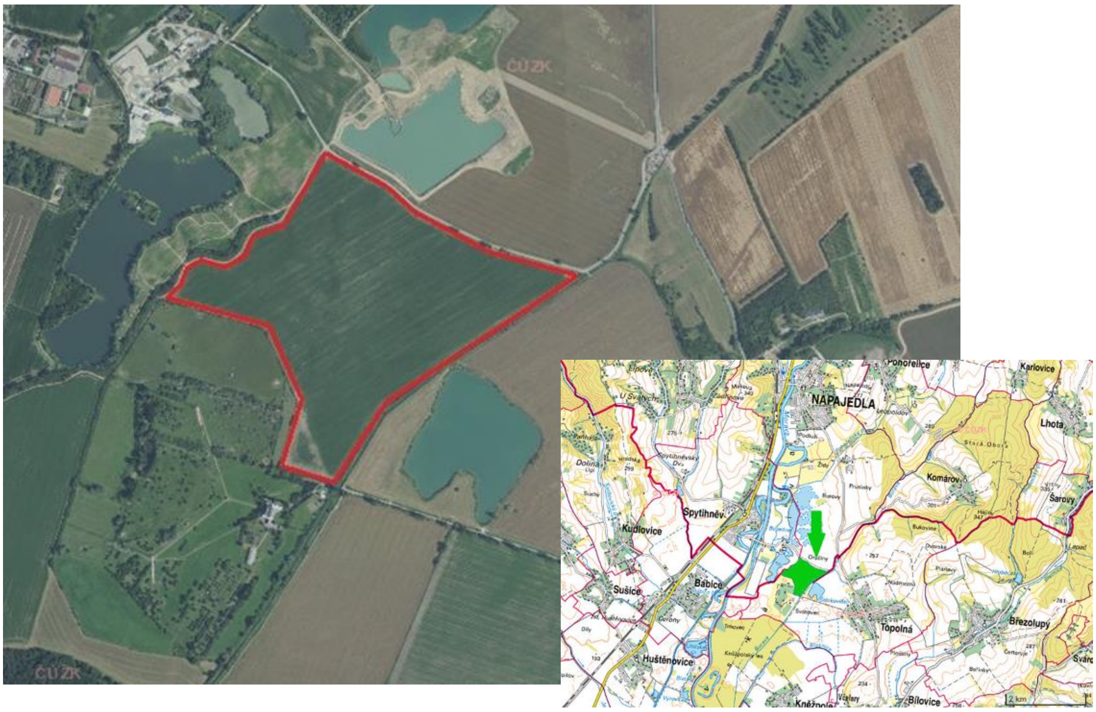

Fig. 1: Borders of the locality and its location

The following target species were selected by the nature conservation authority for eco-monitoring (their bionomy was taken from Bejček 2009, Pavelka 2000, Pokorný 2002 and Řehák 2011):

- Bumblebee (*Bombus sp.*) - Specially protected species according to Decree No. 395/1992 Coll. in protection category - endangered.
- *Oxythyrea funesta* - Specially protected species according to Decree No. 395/1992 Coll. in protection category - endangered.
- *Pelophylax ridibundus* - Specially protected species according to Decree No. 395/1992 Coll. in protection category - critically endangered.
- Field Quail (*Coturnix coturnix*) - Specially protected species according to Decree No. 395/1992 Coll. in the protection category - highly endangered.
- Moth (*Circus pygargus*) - Specially protected species according to Decree No. 395/1992 Coll. in the protection category - highly endangered.

Eco-monitoring took place systematically in the period from April to September 2021. The systematic eco-supervision was preceded by a tour of the site with a representative of the contracting authority in March 2021 and ended with a final tour at the turn of October and November.
Systematic eco-surveillance took place through day trips around the site on a monthly frequency. All potential occurrences of selected species such as borders, road edges, draws, water areas, and wetlands were monitored. Furthermore, the places inside the solved area (field) were monitored, where the occurrence of the nest of both floodplain and quail, or even the bumblebee, would be possible. In particular, residence signs and sound expressions were sought. In the case of the *Oxythyrea funesta*, it was crucial to thoroughly inspect all the flowering plants on which it occurs most frequently. The Common Frog was searched exclusively for wet habitats, in the vicinity of mining and emerging water areas, and in pools in rutted tracks. All findings were recorded in a field notebook, in which data related to the occurrence of the monitored species were recorded, i.e., date, time, outdoor temperature, weather, and the occurrence of all animals, resp. there in the case of monitored and their manifestations. During each visit to the site, photographs were taken of the growing mined water area and its surroundings.

Results

The results of the case study are as follow:
1. Records from regular monthly appointments (an example is given below)
2. Overall assessment of the situation and proposal of measures for a) solution of possible conflict situations and b) for strengthening the potential of occurrence of target species so that these localities will soon occupy and thus fulfill the goal of future recreational-educational use of the locality

Example of minutes from regular monthly appointments:
Eco-monitoring 30.8.2021

- 14 ° C, overcast
- Mined water surface noticeable of larger dimensions
- Animals moving in the monitored area:
- honeybee, cabbage white butterfly, green frog (see fig. 2), magpie, hare
- Grain (sown wheat) already cut, rotating hops bear fruit
- On the eastern border of the monitored area, next to the field road, the occurrence of the green jumper in puddles on ruts
- Occurrence of solved species: NO

Fig. 2: Green frog (*Pelophylax esculentus*), 30.8.2022

Overall assessment of the situation and proposal of measures
Bumblebee (*Bombus sp*.) - The nests of the species were not confirmed in the solved area and only individuals were seen in the spring and summer, when they flew on the flowers of plants around the road edge, draw and at the edge of the field in the bush. Bumblebees used the area only as a food habitat.
Oxythyrea funesta - This species of goldfinch was not seen in the area.
Pelophylax ridibundus - Its occurrence has not yet been confirmed on the created mined area. One individual Green Frog (*Pelophylax esculentus*) was found in observation 30.8.
Field Quail (*Coturnix coturnix*) - No occurrence of this species was recorded in the monitored area.
Circus pygargus - No nesting or residence of this species was recorded in the monitored area.

Discussion and conclusion
According to the results for the entire monitored period, the course of mining and its impact on the surrounding habitats can be stated as minimal for selected endangered animal species. The permanent occurrence of the bumblebee (*Bombus sp*.) and *Pelophylax ridibundus* has not been confirmed in the selected area and the mining has not disturbed their natural environment for the movement, reproduction, or food. The presence of the bumblebee (*Bombus sp*.) in the locality was only to ensure food, but no signs of residence were seen. The occurrence of *Oxythyrea funesta, Coturnix coturnix* and *Circus pygargus* has not been recorded both permanently and intermittently.
The occurrence of other animals in the studied area is also small. There are quite common species, in minimum or expected numbers (roe deer, hare).

Recommended measures for minimizing the impacts of mining opening on the occurring animals and strengthening the possibility of their occurrence at the site so that the goals of potential recreational and educational use of the site are met:

- use exclusively defined routes and existing routes to move equipment

- do not disturb resting and feeding places for animals - borders, road edges, draws, ditches, shrubs, trees
- in case of finding any of the mentioned protected species - immediately ensure their protection against the adverse effects of mining (marking of nests, calm during the nesting period, etc.)
- prevent the release of oil substances and other chemicals into the environment (habitat)
- after the completion of harvesting - planting of trees near the water surface in accordance with the reclamation plan

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Souhrn

Článek prezentuje výsledky případové studie, která byla provedena v areálu nově otevřené pískovny Spytihněv, lokalita Jih, provozované společností Cemex, as. Studie byla zaměřena na pravidelný ekomonitoring definovaných druhů živočichů a jejich lokalit se základním cílem jejich ochrany a minimalizací jejich ovlivnění těžbou štěrkopísku. Ekomonitoring byl primárně požadován územním orgánem ochrany přírody a podmínil zprovoznění pískovny a jedním z jeho cílů je i potenciální budoucí rekreační účel lokality. Účel budoucího využití lokality totiž má být rekreačně-edukativní v tom smyslu, že lokalita má ukázat možný pozitivní vliv těžby štěrkopísků v území (mimo obecné negativní dopady). Na místě těžaře byl ekomonitoring chápán zejména jako nástroj potenciálně podporující přírodu u pískovny obecně. V článku je uvedena metodika a výsledky získané z prvního roku monitorování. Výsledky získané v tomto období ukazují, že těžba štěrkopísku na lokalitě výrazně neovlivňuje výskyt cílových druhů, ale na druhou stranu v prvním roce realizace těžby ani výrazně nevytváří podmínky pro jejich výskyt. Studie tedy předkládá návrhy opatření, která by mohla vést k podpoře výskytu cílových druhů, a tak k naplnění budoucího účelu využití lokality – ochrany přírody a edukace.

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RESTORATION OF SMALL RIVER TO INCREASE THE RECREATIONAL AND TOURIST POTENTIAL OF RURAL AREA

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Abstract
The study is focused on increasing the recreational and tourist potential of the rural part of the western Slovak village Vrbovce. The Teplica River, flowing through the village, has been inappropriately regulated neglecting the river ecosystem and currently provides very few opportunities for recreational use. The study was also initiated by the efforts to improve the ecological condition of the river by implementing restoration measures including the use of the stream potential for the aesthetic creation of public space.
The proposal for a scenario is described to achieve a highly positive effect with relatively low financial resources. In this locality, there is an old unused millrace, which is in very poor condition and full of waste material. Its restoration and connection to the regulated main riverbed will create a side arm and a valuable variable microhabitat will be obtained in the aquatic environment as a counterweight to the monotonous regulated reach. The re-connection of the millrace will provide an important microhabitat for the biota, especially in the summer period of minimum flows. This measure together with the revitalisation and replenishment of the existing greenery and the design of the nature trail will significantly increase the attractiveness of the area for recreation and tourism development.

Key words: Public space, millrace, rural greenery, river regulation, Teplica

Introduction
With the gradual historical economic expansion, people concentrated their activities and the development of settlements in the floodplains of rivers - river inundation areas with sufficient water sources, especially for the development of agriculture. In the first phase, the settlements were secured against floods passively - they were built on elevated places, but with an increasing number of inhabitants, it was necessary to start with the active protection, so the stream regulation activities began. By regulating the streams, people gradually ensured the flood protection of their settlements, while neglecting the ecological function of the river network, which is an important biocorridor and artery of life in the landscape, especially the rural space. Over time, the rivers and streams were perceived mainly as a threat, therefore their regulation was performed mainly from by the means of flood protection. The most widely used tool of the stream regulation was to change the morphology of the originally naturally fragmented riverbeds to such an extent that a monotonous environment was created, and such a habitat became almost uninhabitable for aquatic animals and even plants. Massive technical and, unfortunately, often inappropriate stream regulations have significant negative effects on river landscape ecosystems, with an obvious spill-over into the rural and urban environment.
Moreover, these river regulations are designed to support the quick outflow of the water from the upper river basin thus negatively influencing the water balance (Rončák et al., 2019) and soil Moisture Regime (Rončák et al., 2021). Furthermore, the river regulation is usually reflected in a significant reduction in the attractiveness of the surrounding area and public space for recreation and leisure activities.
The Teplica riverbed is such an example and this study is aimed at the efforts to increase the ecological, recreational and tourist potential of its inundation area.
In previous research (Výleta et al., 2019), we assessed the ecological stability of the whole cadastral area of the village of Vrbovce in both historical and current contexts using similar methods to Ivan et al. (2014) and Valent et al. (2016). From the analysis of land use from the history to the present, there is a tendency for the arable land to decline and to increase the vegetation and grassland areas. Landscape-ecological stability calculations in various mapping periods suggest that the current landscape is much closer to its natural state than it was during the historical periods. Different types of functional utilization of the area have been recorded in the area, mainly arable land, meadows and forest areas are dominant. The actual level of ecological stability is relatively favourable, it reaches a moderate level (2.80), however, several negative phenomena have been recorded in the territory,

which have a negative impact on biodiversity and ecological stability of the country. The results of the analysis suggest that there is a potential for improving its ecological stability.

Material and methods

Teplica as a left tributary of the Morava River flows through two countries – Czech Republic and Slovakia and it crosses the SK-CZ border in rkm 26,2 in the cadastre of the western Slovak village Vrbovce (Fig. 1). Outside the built-up area, there is mostly agricultural land on both banks in the inundation area.

The riverbed of the upper reach of the river Teplica (rkm 18,0 - 32,0) was heavily modified in the in the last century with a straight path and a prismatic cross-section creating a monotonous habitat within the entire section of the river regulation. In recent years, the river restoration was performed in the upstream river reaches in the Czech part of the river (above rkm 26,0) thus creating the favourable environment for the instream biota. On the contrary, the Slovak part of the river remains heavily regulated providing a good potential for further downstream river restoration.

The waters of Teplica are significantly eutrophic. This is mainly due to the high content of organic matter in the stream, which comes from sewage, agricultural activities, and other unidentified sources of pollution. One of the causes of eutrophication is the total absence of riparian vegetation. In this part, the watercourse is directly exposed to sunlight, which also has a negative effect on the quality of the water in the stream. As a first step, it is therefore necessary to improve the quality of the water in the stream - to build a sewerage network connected to a wastewater treatment plant and to apply various erosion-control measures reducing the income of nutrients into the stream.

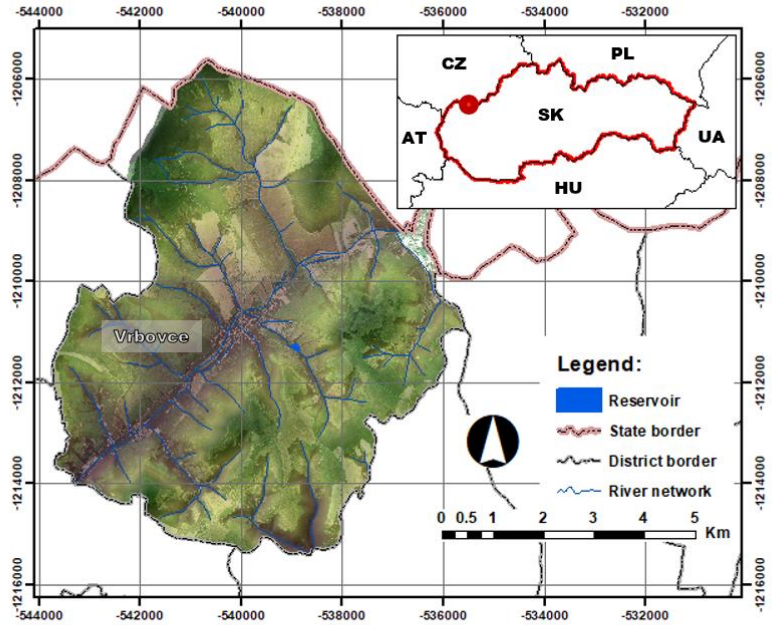

Fig. 1: Position of the cadastral area of village Vrbovce in Slovakia

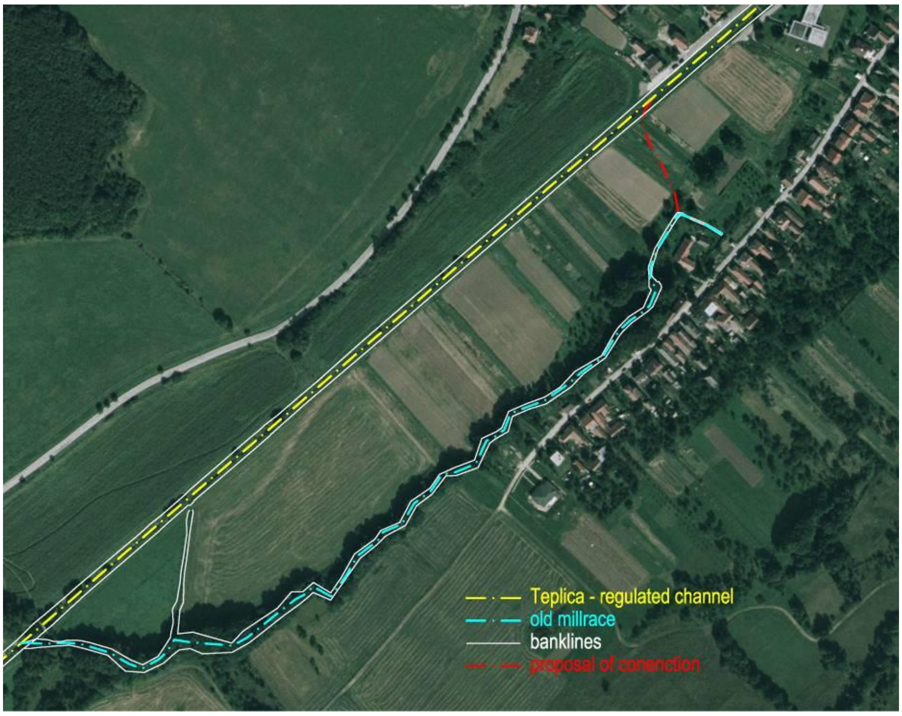

Fig. 2: Scheme of the restoration proposal

To increase the channel variability of the regulated stream, the best step is to recreate the original meanders along with implementing changes in the longitudinal profile. In this locality, there is an old unused millrace, which is in poor condition, full of waste material and heavily eutrophicated (Fig. 3). By its restoration and connection to the regulated main riverbed a side arm will be created (Fig. 2, Fig. 4) and a valuable variable microhabitat will be obtained in the aquatic environment as a counterweight to the monotonous regulated reach.


Fig. 3: Waste dumps with eutrophicated millrace and rendering of the design


Fig. 4: Current state of the area and rendering of the connection design

Fig. 5: Current state of Teplica and proposal of the riparian vegetation

Riparian vegetation by autochthonous tree species (Fig. 5) was also proposed to create a local greenery along the river.

The basic input for the study was a topographic and elevation plan of the current state - digital terrain model (DTM) created by the study's authors from several data sources in Autocad Civil3D software. The basis was the database of geodetic survey points provided by Slovak Water-management Enterprise, and own detailed geodetic survey in the wider vicinity of the riverbed and millrace, carried out by the team of the study's authors. Highly precise geodetic GNSS instrument and total station were used for detailed elevation and topography surveying. Elevation data in the inundation area were taken from a DTM created using LiDAR aerial laser scanning. The DHI Mike21FM 2D hydrodynamic model of unsteady flow was used to simulate the water flow in a locality.

Results and discussion

Outputs of the hydrodynamic model (Fig. 6) show that to recreate a full flowing side arm of the river no significant interventions are required in the millrace, only local cleaning by light mechanisms so that obstacles to the flowing water are removed. Straightening of the path and any efforts to model the prismatic profile are undesirable - the revitalized millrace must be left as natural as possible.

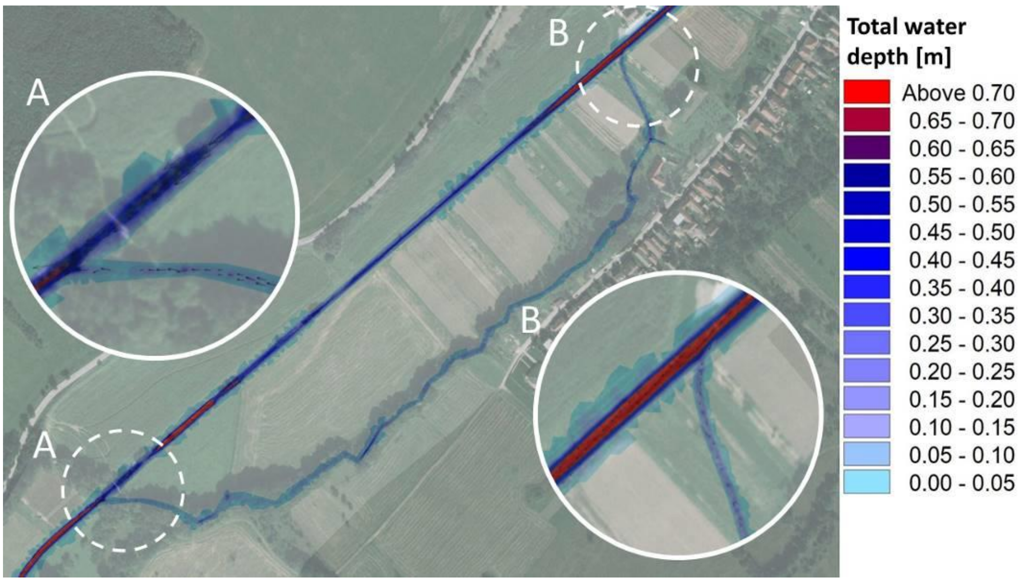

Fig. 6: Outputs of the hydrodynamic model

This measure together with design of the riparian vegetation along Teplica and design of the nature trail will significantly increase the attractiveness of the area for recreation and tourism development. Furthermore, the millrace restoration and revitalisation of the whole area will contribute to drought management by water retention in the landscape (Šurda et al., 2020) and will support the adaptation to microclimate change (Vasilaki et al., 2017).

Conclusion

The area around the millrace is currently in very poor condition and serves local citizens as a waste dump and septic (Fig. 3), where sewage is discharged from individual houses. Waste dump removal together with the construction of a sewage network or responsible individual sewage management is a prerequisite for the successful restoration of Teplica and the millrace. The connection of the millrace will be the first step towards the revitalization of the whole area, where the flowing water is expected to bring life to the locality and the measures were designed to use the flow potential for aesthetic formation of public space and increase the attractiveness of the area for recreation and tourism development.

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Souhrn

Studie je zaměřena na zvýšení rekreačního a turistického potenciálu zastavěné části západoslovenské obce Vrbovce. Řeka Teplica protékající intravilánem byla v minulosti z přírodního a estetického hlediska nevhodně upravena a v současnosti poskytuje jen málo příležitostí k rekreačnímu využití. Článek popisuje navrhovaný scénář, který může dosáhnout vysoce pozitivního efektu z hlediska rekreačního využití, ale také z hlediska zlepšení ekologického stavu lokality realizací revitalizačních opatření za relativně nízké náklady. V lokalitě se nachází starý nepoužívaný mlýnský násep, který je zanedbaný, plný odpadního materiálu a stojatá voda v něm je eutrofizovaná. Jeho napojení na upravené koryto Teplice vytvoří levobřežní rameno a poskytne cenný variabilní mikrostanoviště ve vodním prostředí jako protiváhu monotónnímu upravenému úseku. Propojení nábřeží bude prvním krokem k revitalizaci celého území, kde se očekává, že propojení oživí celou lokalitu a součástí opatření je využití potenciálu potoka pro estetické dotvoření veřejného prostoru a zvýšení atraktivity území pro rozvoj rekreace a cestovního ruchu.

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SCENARIOS FOR OPEN SPACE CONVERSION FROM AN EXHIBITION GROUND TO A SUSTAINABLE MULTIFUNCTIONAL URBAN PARK

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Abstract
It is not usual that in a strictly urbanised environment in the immediate vicinity of a regional capital centre, a large number of open spaces with a huge potential for future recreational use are concentrated in one place. The largest Slovak exhibition centre Agrokomplex, which at national level ranks among the most important trade fair and exhibition companies, has a long tradition in organising various events. Unfortunately, the current state does not meet the requirements of existing or potential users. Over time, its primary function has slowly faded, which has left behind spaces available for change. The article focuses on the potential use of the area in changing conditions through the perspective of diverse ideas, scenarios and solutions developed within three design studios. Following the methodology of Research by Design (Deming & Swaffield, 2011) (van den Brink, 2017) the paper identifies the main approaches and key principles to a complex renewal of the site. All designed interventions were proposed while considering various possibilities of creating an open multifunctional part of the surrounding residential complex and adjacent locations with the predominance of recreational and leisure activities. The results provide three different design scenarios with various approaches to introducing multi-layered functions into non-functional spaces.

Key words: landscape architecture, urban design, urban environment, open space, research by design, social interaction

Introduction
Exhibition grounds as semi-public spaces represent an important part of the urban structure and contemporary landscape architecture. Unfortunately, they often remain forgotten compared to more significant public open spaces such as parks, squares, streets, or riverfronts. As they are usually privately owned areas, the problem is the lack of interest of the private sector, incompetence, and unclear management strategy, leading to an untapped potential. Due to their size and diversity of premises, they form an important space within the urban environment (Castello & Prochnow, 2021). From this point of view, exhibition centres stand for extraordinary objects, where commercial function may not be the only one, but much rather every exhibition ground needs to be designed as a sustainable multifunctional part (Marques et al., 2020) of the urban fabric, which leads to fostering the relationship between humans and their environment (Tóth et al., 2018). In 2020, the Institute of Landscape Architecture at the Slovak University of Agriculture in Nitra (SUA), in collaboration with the University of Natural Resources and Life Sciences, Vienna (BOKU) elaborated several possible scenarios for the Agrokomplex exhibition centre, located in Nitra, (Western Slovakia), as a publicly accessible open space. The assignments were developed by students within the international workshop "Global Design Studio", which has been established at BOKU since 2007 and takes place in a different city and country every year. Due to the COVID-19 pandemic situation and the resulting travel restrictions, the workshop was held online. During this time, other groups of students worked on proposals within the two design studios, where they primarily focused on a larger scale and scope of the area.

Materials and methods
The object of design was the Agrokomplex exhibition centre located in the city of Nitra (Slovakia) on the right side of the Nitra River close to the housing estates Chrenová I. and Chrenová II. It offers trade fair and exhibition services focused mainly on the economy and agriculture and is one of the largest and most recognised exhibition areas in Slovakia. The main goal of the company is to increase the quality of exhibitions and its internationalisation. The exhibition serves communication purposes for both professional and non-professional visitors, for creating international relations and gaining new potential customers for exhibitors. From this point of view, Agrokomplex takes over mainly a commercial function. The whole complex has an area of 143 ha of which 63 ha are green areas, 20 ha paved areas and 6 ha form water bodies. The site also includes an amphitheatre, which hosts various

cultural events throughout the year. The area is fenced without the possibility of entering outside the exhibition season. The overall area has seven entrances.

For the future development of the selected area, three main topics were chosen: “Foodscape”, “Water and Drought” and “Renewable Energies”. The design process began with the small introductions to selected topics and online presentation of the current state of the complex prepared by lecturers from Institute of Landscape Architecture in Nitra after completing on-site field mapping. Due to the pandemic situation, it was not possible to carry out any other field work or descriptive strategies such as observation, secondary description, complex description, inventory of woody plants and collection of site-specific data. For this reason, it was necessary to consult the analytical part with the locals on a regular basis. Based on the summarised information, the positives and negatives of the solved area were examined. According to the collected data, the goals, directions, and visions of the qualitative development of the space within each topic were subsequently set. In its conclusion, the work links aspects of qualitative and quantitative research and focuses on the practical use of data. The last phase of the design process was focused on a comprehensive evaluation of the researched issues and formulation of conclusions, characterisation of potential and preparation of a set of recommendations for planning practice, which creates the basis for the management of Agrokomplex and which shapes its starting points and quality development goals (Čibik & Štěpánková, 2021). The intensive workshop ended with presentations to an international jury with lecturers from Vienna and Nitra.

Results

The results of the design studios consist of three complex design concepts applied for the whole area as well as several detailed landscape-architectural proposals applied only to selected parts of the space. Each of the present outputs contains expected changes on the global level over a period of 30 years, to which students try to respond with their proposal. Some of these designs is therefore very conceptual and perhaps utopian (Aidnik, 2020), but the aim was to motivate participants of the workshop to think about possible scenarios.

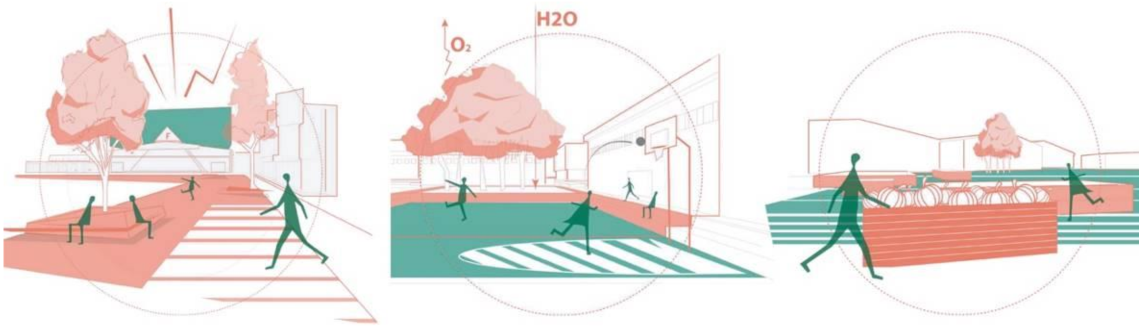

Fig. 1: Visualisations. From the left “central loop”, “small squares” and “collective gardens”. Source: Global Design Studio, Nitra (Ilic Djordje, 2020)

Various scenarios

Design proposals within selected topics contains several interesting ideas. The first presented scenario (Fig. 1) counts with the possibility of building a so-called “Utopia” station as a background for the new route that was created as a central loop through the neighbourhood connecting the surrounding housing estates. This object offers several functions including the restaurant, where one of the most important functions is the presentation of vertical farming. The system of corridors and pedestrian routes (Fig. 2) is also interesting. Along some of them are situated collective gardens, where production of food is main activity that is supposed to happen here. Food production also appeared in various forms in the peripheral parts of the complex.

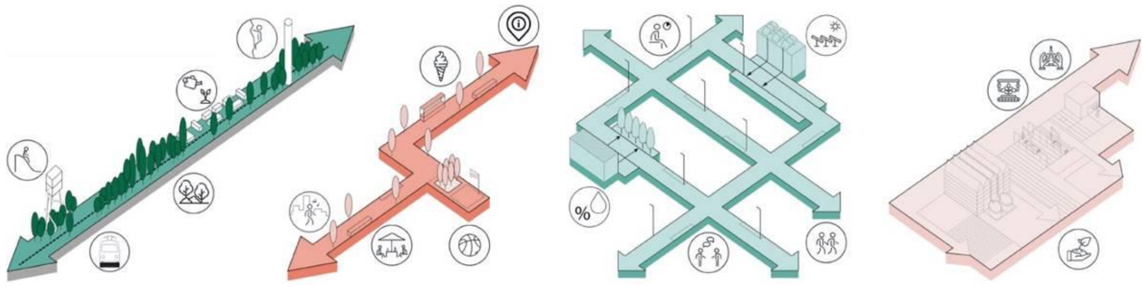

Fig. 2: Schemes of the main axes. “green corridor” , “transport network”, “production corridor”. Source: Global Design Studio, Nitra (Ilic Djordje, 2020)

Another scenario includes in its proposal mostly community gardens, temporary markets, and pop-up stores, but also aquaponic lake in the central part of the area, and educational or demonstration gardens. In their proposal, students developed a functional zoning of the complex, which divides the space into several small areas: service, production and community gardens, recreation, production and research and production, and agriculture. The third scenario brings to the area a central square, with a stream flowing through it that visually connects the entire complex (Fig. 3). Participants of the workshop also divided the area into several zones regarding to its functions. To these spaces, they added new elements such as edible parks, rooftop horticulture, or floating horticulture. Another group of students within the “Water and Drought” topic came up with the idea of collecting stormwater from the surroundings, where the water from the city will be guided with a drainage system and will be collected and filtrated in water ponds. An important aspect in their design is also the connection between the green areas by creating a green infrastructure linking the city and the complex.

Fig. 3. Site plan of the landscape architectural design developed by student. Source: Global Design Studio, Nitra (Alessandro dalla Libera, 2020)

Conclusion

The exhibition ground is a significant element of the urban landscape. Due to its size and character, it markedly influences the development of the surrounding environment and its physical integration in the city helps economic growth, increases social activities, creates a cultural and social background, connects people's communities (Lukas-Sithole, 2020), and changes the overall appearance, image, and characteristics of its immediate surroundings. Based on this fact, a strategic intention was set, namely, to connect the Agrokomplex exhibition centre with urban structures with the intention of preserving the idea of a sustainable multifunctional part of the urban environment. The goal was to prepare several scenarios of possible future use of the area. The different scenarios serve for the company management and municipality as a useful material for the future development of the area and the possibilities of its use. From the scientific perspective, Global Design Studio and two other design studios focused on this topic, provided a great opportunity to implement scientific research methods such as Research by Design and Case Study Research. It was also important to examine the relations between exhibition ground and the city in terms of physical, social, economic, and cultural-social dimensions to find out what role the exhibition centre plays in the urban area and how it can serve as a publicly accessible open space without compromising the integrity and privacy of company, and what criteria should determine the design of an ideal exhibition ground.

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Souhrn

Výstaviště jako poloveřejná prostranství představují důležitou součást urbanistické struktury a současné krajinářské architektury. Článek prezentuje různé případové studie, nápady, přístupy a řešení vyvinuté studenty v rámci tří designových studií aplikované na výstaviště Agrokomplex v Nitře,

které vzešly ze spolupráce mezi Ústavem krajinářské architektury Slovenské zemědělské univerzity v Nitře a Univerzitou přírodních zdrojů a přírodních věd, Vídeň. Pro budoucí rozvoj této oblasti byly vypracovány scénáře na různé témata, přičemž se do návrhového procesu implementovali vědeckovýzkumné metody “Research by Design“ (Hauberg, 2011) a “Case Study Research“.

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SIGNIFICANT TREES WITH GREAT INFLUENCE FOR LANDSCAPE UTILIZATION IN POHANSKO DISTRICT

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Abstract
In Central Europe, trees are one of the basic units of the landscape structure and form an irreplaceable part of it. They also play a similar role in biodiversity maintenance. Biodiversity of an ecosystem is a very important property for both, the stability of the ecosystem and "the landscape utilization". NAKI II project (2018–2022; FFWT MENDELU) is focused on the evaluation of woody plants' importance for organisms associated with woody plants biodiversity in the Pohansko district, e.g. wood fungi and saproxylic insects. This part of the Czech Republic has a crucial effect on the biodiversity of the whole central Europe region and can be very important for recreation and tourism. The negative finding of the project is the very bad health status and reduced perspective of the most biological value trees. There have not been created conservation management or arboriculture care with no stabilization or prospective improvement of trees on locality. This fact strongly threatens the further biodiversity stability of this ecosystem and also significantly reduces the possibilities of this locality used by the general public. The project can be considered as a base of arboriculture management creation on solved locality, which can also implicate further higher attractiveness of Pohansko for tourism and recreation, not only biodiversity maintaining.

Key words: Biodiversity, magnificent Trees, South Moravia, ecological stability, saproxylic insects, NAKI II project, wood fungi, arboriculture management, recreation and tourism

Introduction

In the conditions of Central Europe, tree species are one of the basic units of the landscape structure and form an irreplaceable part of it (Ritter 2011). They also play a similar role in biodiversity maintaining in the landscape (Siitonen and Thomas 2015, Jonsell 2012). From the beginning of their presence on the locality, specific habitats have been created on woody plants, where the activity and development of saproxylic organism, i.e. habitat or nutritionally bound species of organism on wood in various stages of decomposition, takes place. These animals have adapted so much to the development in these habitats that without their existence they cannot prosper or exist in the landscape (Zumr et al. 2021). These habitats are, for example, completely closed or partially closed cavities in branches, wood cracks, thicker stumps of dry branches with bark, dead wood mass on a still-living tree, dead root mass in the contact with soil substrate etc. (Jurc et al. 2008). It is clear that these habitats are most often found on old trees, which indeed have the most fundamental and irreplaceable role in maintaining of biodiversity. Therefore, it is important to maintain the optimal number of tree species in all stages of physiological age so that it is possible to count in optimal number of habitats, or with the optimal number of old trees in the longer time period (Miklín et al. 2017). One of the most important parts of the Czech Republic with the occurrence of mentioned types of trees and bound invertebrate and fungal fauna is the Pohansko area (see fig 1.), where selected trees were monitored intensively in one-time period with the aim to build an inventory of species and create a basis for processing of arboricultural care for the most biologically value trees (2018–2022; FFWT MENDELU). This arboristic management and the connected information will be supported the possibilities of developing both the maintenance of biodiversity in the most biologically valuable areas of the republic and the possibility of making this area more attractive to the public and thus increase rate for tourism and recreation.

Materials and methods

From 2018 to 2022, the NAKI II project is solved at the FFWT MENDELU. This project is focused, among other things, on evaluation of the importance of these woody plants for the biodiversity of organisms associated with woody plants, such as wood fungi and saproxylic insects (insects attached to dead wood). As part of the terrain research, a visual survey of significant trees listed in the database ArcGEO was carried out. A total of 781 trees were measured and observed during project research period (2018-2021). The survey period was selected individually according to the location of the tree and according to the taxon in order to conduct the survey in the best possible time in terms of the formation of wood fungi and the occurrence of saproxylic organisms.

Results

On average, from two to four permanent-bound organisms (wood fungi, saproxylic insects etc.) and two other occasional-bound organisms (date birds, airplanes etc.) were found on each of the observed trees. Compared to commonly occurring mature trees, these are very high numbers.

A less positive finding from our surveys is the very poor current health status of most trees and thus a significantly reduced tree perspective (see fig 2.). On investigated trees, there were no conservation management or arboricultural care with stabilization or perspective improvement objects observed. Thus, no attempt was made to prolong the existence of these trees in the habitat. Due to the absence of these managements, most trees are overgrown with fast-growing trees, dying and rapidly decaying. From 781 evaluated trees, almost half of the individuals were already dead (see fig 3.), a quarter were dying and only a quarter of the trees could be described as promising. At the same time, the absence of substitute tree species of similar dimensions, which could ensure the continuity of currently occurring species and habitats of organisms with a connection to trees were not presence.

Discussion

To put it very simply, bigger the tree has higher habitat presence potential, but also tree vitality, health status, tree taxon and the environment in which the tree grows play a crucial role in biodiversity significance (Buse et al. 2009). The species richness of insects and wood fungi as the best known and the most species rich groups of organisms with a strong bound to woody plants is influenced not only by the condition of woody plants, but also by their number and location in the observed area (Krása 2015, Miklín et al. 2017). The investigated locality belongs to the areas with the richest species biodiversity of insects, but also other groups of organisms (Miklín 2017). There are many reasons which maintain this fact, but the temperature and humidity conditions as well as the character of the woody complexes will be crucial - there are forests and non-forest complexes of very diverse vegetation with the local character of the original hard or soft floodplain. One of the important factors that contributes to the high species richness of common and specially protected organisms in the surveyed locality is clearly the presence of a large number of old oaks (Krása 2015). These woody plants (oaks (*Quercus*, L., 1753)) are usually of the greatest importance for diversity, mainly due to the quality of the wood and their longevity. Along with oaks, there are other tree taxon (*Salix* L., *Populus* L., *Tilia* L., *Acer* L., etc.), which can provide habitats for activity of large numbers of tree bounded species (Miklín et al. 2017). On the trees are among the fungi these represents *Inonotus* sp., *Phellinus* sp., *Trametes*, *Armillaria* sp., *Ganoderma* sp. etc. (Miklín et al. 2017). The insects were represented by the longhorn beetles (Cerambycidae), beauties (Buprestidae), woodpeck-ers (Elateridae), scarabs (Scarabaeidae) and others (Buse et al. 2009). The existing significant trees occurring at the confluence of the Morava and Dyje rivers are very valuable from the point of view of the biodiversity (the count of the bounded organisms) (Miklín et al. 2017). At the same time, however, these are trees that are currently dying out very quickly (see above). This can lead to a loss of diversity, especially in the case of specially protected organisms, which will not be able to find new habitats after the disintegration of tree habitats on today's large trees. One way, what we can mitigate the negative effects of the current situation is to start intensively caring for the surviving important trees in this area (Ritter 2011, Krása 2015). The stabilization of trees by arboricultural care (ties, supports, small local reductions, etc.) prevent their total disintegration and immediate degradation of most biologically valuable habitats. With arboristic care is possible to achieve a significant extension of biologically value trees existence in the locality and this gain the time needed to grow a new generation of trees, which can ensure the continuity of populations occurring in this area (Grove 2002).

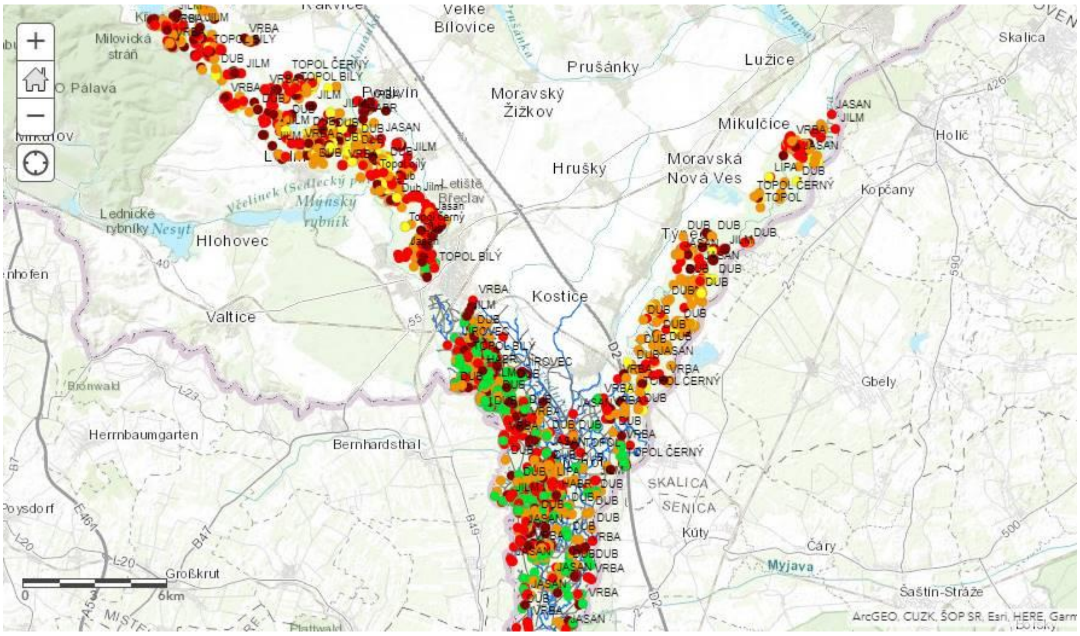

Fig. 1: Tree location map

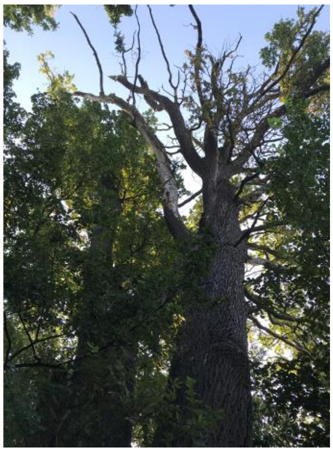
Fig. 2: Biologically valuable oak (*Quercus robur*) with a reduced perspective


Fig. 3: Dead large oak (*Quercus robur*) – the supply of habitats for saproxylic species will gradually decrease

Conclusion

The assumption that these are very important trees for biodiversity maintain was confirmed by our research. Despite the fact that the surveys were conducted only once in the concrete sea-son, a very high species diversity was found. The recognition of one of the forms of large-scale nature protection would certainly help the mentioned care and of course the tourism attractiveness. There is a long-standing discussion about the need to protect the local exceptional biodiversity, in which some adjustments have already been made in the way of forest management. However, in the context of the drought of recent years and the deteriorating condition of old oaks, further measures need to be taken and, above all, action taken quickly. The situation could be helped by the current government's program statement approved at the beginning of January this year, which promises to expand the area of large-scale protected areas and specifically states the Soutok National Park announcement.

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Souhrn

Tento příspěvek popisuje výsledky terénního průzkumu mohutných a biotopově hodnotných stromů nacházejících se na území soutoku řek Moravy a Dyje. Tento průzkum probíhal v letech 2018 až 2022 a bylo v rámci něj prozkoumáno 781 významných dřevin nacházejících se v této oblasti. Na zkoumaných stromech byla potvrzena významně vyšší diverzita zvláště chráněných či ohrožených organismů s vazbou na dřeviny než u běžně se vyskytujících stromů. Zároveň byl ale pozorován velmi špatný zdravotní stav a perspektiva většiny stromů. Z velké části se jedná o odumírající či zcela odumřelé stormy.

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SMALL RESERVOIRS AS ELEMENTS INCREASING THE ATTRACTIVENESS AND ATTENDANCE OF THE AREA

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Abstract
The issue of climate change, especially drought and water scarcity, has been comprehensively addressed in recent years by several inter-ministerial strategic documents, all of which mention Land consolidation as one of the important and consiredable tools for addressing this issue.
Within the framework of land consolidation, it is possible to implement a number of measures that have a positive impact especially on the landscape structure, increase its biodiversity and aesthetics and thus also increase the attractiveness of the area for recreational and sports activities. Building local water management measures is an important part not only of drought prevention and adaptation measures, but also makes it possible to increase the functionality of the area for residents and visitors. One of the examples of building a multi-purpose reservoir is a small reservoir in the cadastre of the village Křepice (district Břeclav). It is a landscape-forming complex of measures -water reservoir with a field road, which will be used, among other things, for recreational purposes as a cycle path, then continuing to the neighbouring area. Velké Němčice. This will not only spread up the network of cycle paths and improve the permeability of the area, but also create a rest and relaxation zone near the reservoir.

Key words: tourism; reservoir; recreation; drought; land consolidation

Introduction

Water fulfills a number of production and non-production functions in the cultural landscape. Because water areas and streams have always been one of the most important landscape elements, they have been significantly influenced by man throughout history. Understanding the main drivers influencing historical changes in the development of water features in the landscape can help to understand and better protect the landscape and the environment. The Czech Republic has been facing a long-term absence of precipitation since about 2015. In recent years, this precipitation deficit has manifested itself almost every year during the spring and summer, when the effect of high temperatures added to the absence of precipitation. These phenomena result in a decrease of water in the landscape. Kvítek (2017) states that water scarcity in the extreme is a global problem. Water retention in the landscape means natural or artificial, temporary retention of water in the landscape. The current world situation (including the Czech Republic) requires that appropriate measures be taken to retain water in the landscape, which will slow down surface runoff and promote water infiltration in the landscape (Lancaster, 2006). The elimination of possible risks can be solved in the process of complex land consolidation, where appropriate measures are implemented within the solution of water management measures during the design of the plan of common facilities (PCF). Measures to catch run-off water and its harmless drainage from surfaces consist mainly of catch ditches or broadway channels. In many cases, field roads designed with ditches within landscaping can serve as a device for interrupting surface runoff and harmless drainage (Papoušek, 2011). Water management facilities, which may also be of landscaping or flood protection, are modifications or revitalization of small watercourses, small reservoirs, wetlands, ponds, dry reservoirs or polders (Němec, Pražáková, 2018). In particular, the design and construction of small reservoirs is currently gaining prominence, with the aim of accumulating and retaining water in the landscape and strengthening its retention capacity.

Materials and methods

For the purposes of this article was selected a locality of Křepice u Hustopečí with ongoing complex land consolidation process. This village is in the Southern Moravia in the Czech Republic.

This village is located north of Hustopeče municipality. The total area of the cadastral area is 671.88 ha. Agricultural land covers a total area of 554.17 ha, the remaining 117.70 ha is non-agricultural land.

In the solved locality there are production and above-average production agricultural lands. The area of interest is shown in Fig. 1.

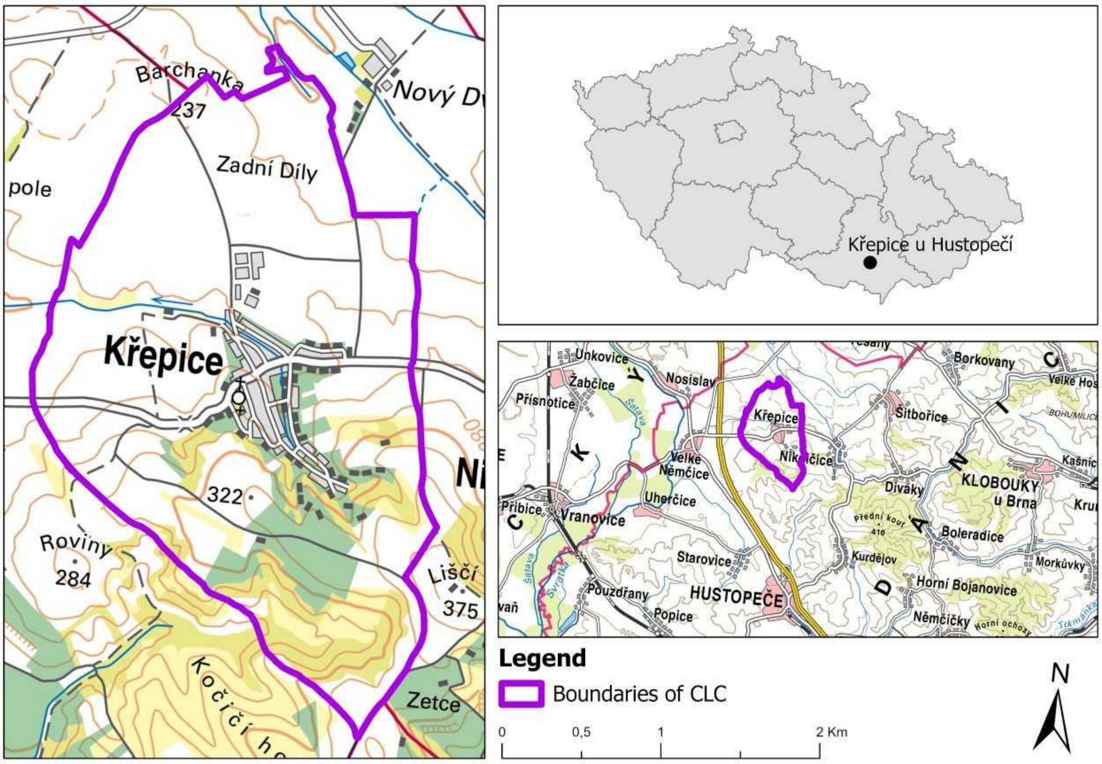

Fig. 1: Area of Křepice

The following measures have been proposed as part of the plan of common land consolidation facilities

- Elements of erosion control – elimination of row crops (171.27 ha), grassing (106.21 ha), technical elements (2x windbreaks, 2x ditch),
- Elements of transport infrastructure – 3x roads to reconstuction, 9x unpaved roads,
- Ecological network – a total 94.70 ha biocentres, biocorridors, interaction elements,
- Water management facilities – water reservoir (Fig.2).

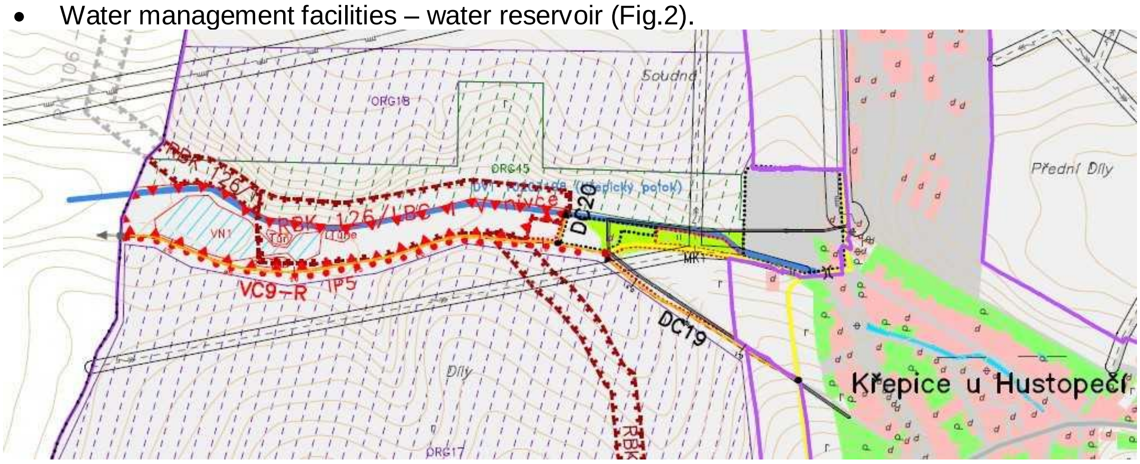

Fig. 2: Part of plan of common facilities with water reservoir

For the purposes of this article, one newly designed water reservoir selected and assessed, which is situated in a wet area around the watercourse.

Results and Discussion

As part of the ongoing land consolidation, small reservoir, including a system of pools, were designed to retain water in the landscape. The water reservoir is located on the right side of the Křepický stream. The proposed reservoir is in the outskirts of the village Křepice near Hustopeče. It is located northwest of the urban area in the designed local biocentre LBC1. It is a landscaping reservoir that will improve biodiversity and water conditions in the area. The water reservoir is not considered as a dry polder, but as a polder with a fixed water level. The water level can be affected by torrential rain or droughts. A sedimentation space is designed in front of the reservoir itself, which will be used to settle the impurities from the stream. Greening in the form of autochthonous tree species and plants will be designed in the vicinity of the reservoir. (Fig.3)

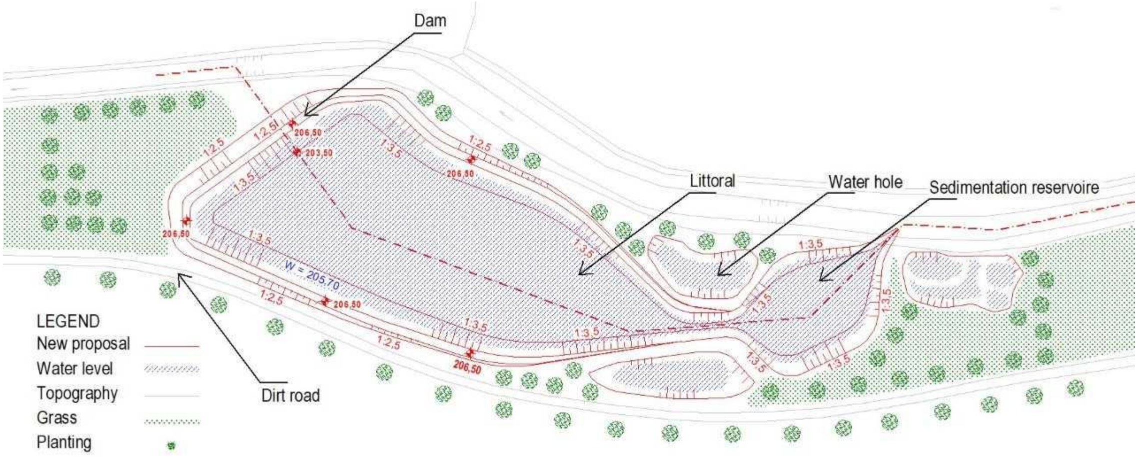

Fig. 3: Situation of designed reservoir

The width of the dam top is designed at 3 m nothoroughable. The elevation of the dam top is 206.5 m above sea level. The slopes were chosen in form 1.3.5 on the upstream side and the air slope was set at 1: 2.5. The water level should be at a height of 205.7 m.a.s. and the maximum water depth should reach 2.2 m. The discovery of water in the reservoir should reach 12,891 m^3, the water area will expand to 9,930 m^2 and the total area of the reservoir, including the accompanying ponds and greenery, will reach 4.5 ha. The design of this water reservoir was prepared based on a topographic and elevation survey of the current state using Atlas DMT design software (Fig.4).

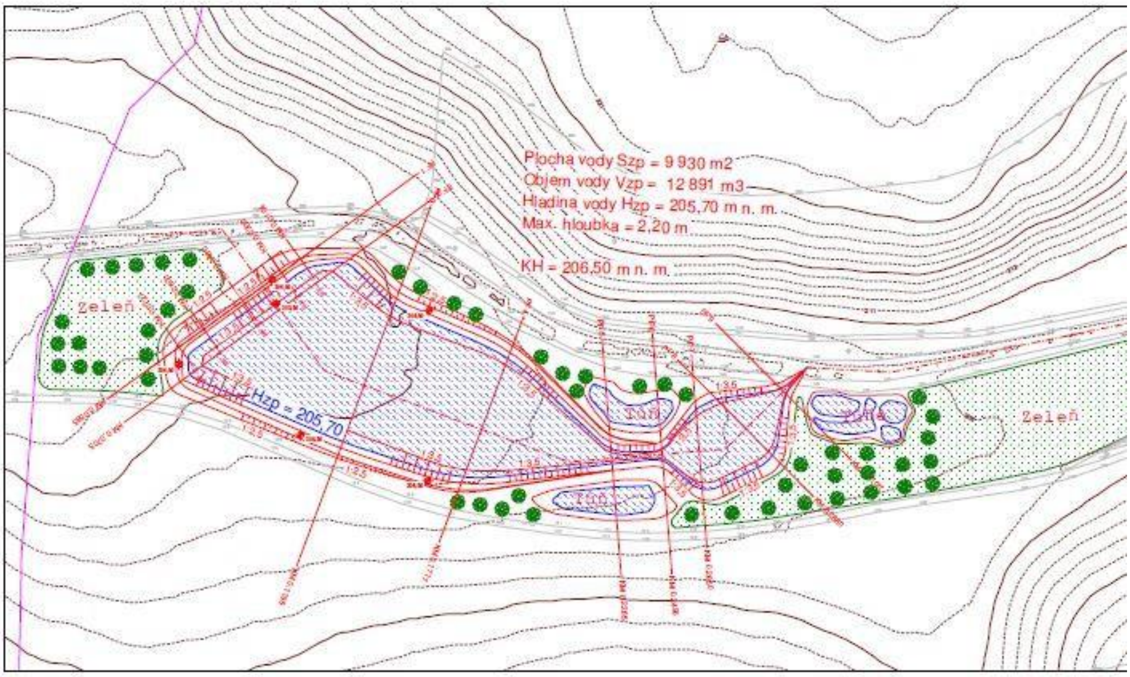

Fig. 4: Project of planned reservoir

A paved road is designed around the water reservoir, which will serve as a bike path to connect the villages of Křepice and Velké Němčice and thus lead bicycle traffic off the main road (Fig. 5).

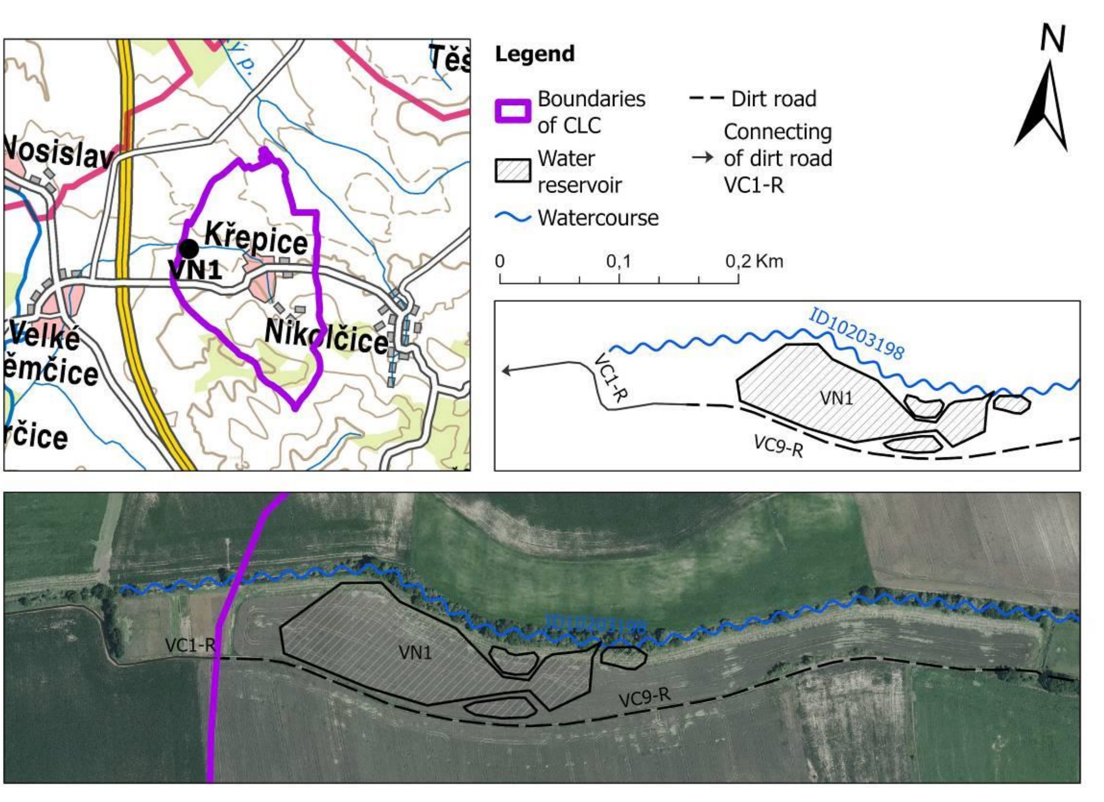

Fig. 5: The bike path around the reservoir and connection to the neighbour area

Conclusion

The village of Křepice lies in a rugged area. Most of the development lies at the foot of steep agricultural slopes with slopes above 10% and in the valley between them. Arable land organized into large land blocks unsuitable for stabilizing the water regime of the locality predominates in the area use of the area. The current situation needs to be supported by a smaller landscape structure, organizational and agrotechnical measures on arable land and a system of technical measures within the framework of land consolidation. Particularly, technical measures can permanently change the character of the landscape. The designed reservoir, accompanied by a system of environmental measures and a sensitively designed road network, will serve locals and visitors as an important place to relax, make walking and cycling more enjoyable between neighboring villages and support tourist development.

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Souhrn

V rámci pozemkových úprav je možné realizovat řadu opatření, která mají pozitivní dopad zejména na strukturu krajiny, zvyšují její biodiverzitu a estetiku a tím také zvyšují atraktivitu území pro rekreační a

sportovní aktivity. Budování místních vodohospodářských opatření je důležitou součástí nejen prevence sucha a adaptačních opatření, ale umožňuje i zvýšení funkčnosti území pro obyvatele i návštěvníky. Jedním z příkladů výstavby víceúčelové nádrže je malá nádrž v katastru obce Křepice (okres Břeclav). Jedná se o krajinotvorný komplex opatření -vodní nádrž s polní cestou, která bude sloužit mj. k rekreačním účelům jako cyklostezka, dále pokračující do sousedního území. Velké Němčice. Tím dojde nejen k rozšíření sítě cyklostezek a zlepšení prostupnosti území, ale také k vytvoření odpočinkové a relaxační zóny v blízkosti nádrže.

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SOIL AND WATER CONSERVATION MEASURES CAN CONTRIBUTE TO ENHANCEMENT OF LANDSCAPE QUALITY IN THE LITENČICKÁ UPLAND

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Abstract

Since 2019, the quality of soil and water as two basic environment components has been monitored in the southern foothills of the Litenčická Upland. The research focuses on the transport of nutrients (nitrogen and phosphorus) and pesticides in the Uhřický Pond basin. The article presents partial results of monitoring. The project aim is to create a design of comprehensive measures to reduce erosion, leaching of potentially hazardous substances, for protection of soil and water, which will also be close to nature. If implemented, the measures will contribute to increasing ecological stability and aesthetics of the landscape in this area and thus enhance its recreation attractivity.

Key words: Rural countryside, nitrogen, phosphorus, pesticides, measures

Introduction

Litenčická Upland is located in the South Moravian Region, southeast of Vyškov. It is interwoven with a network of hiking trails, forest and field roads suitable for cycling. It is partially covered by forests, but its foothills are intensively used for agriculture. The whole hilly area has its own charm, but it is not a mass recreation destination and therefore tourists can undisturbedly enjoy the distant views, rugged landscape, picturesque villages hiding interesting monuments and bathing ponds.

Catchment of the Uhřický Pond was chosen as one from 3 experimental areas for research of transport processes of nutrients and pesticides in the system soil – water. This area is very intensively exploited for farming and the soils are fertile but due to erosion degraded. To ensure consistently high yields, farmers supply fertilizers (mostly artificial) and plant protection products to the soil. These matters are transported by water erosion and leaching through soil profiles to the surface water bodies and affect water quality.

Material and methods

Uhřický Pond is located on the stream of Hvězdlička, between the villages Milonice and Uhřice in the Vyškov region. The Hvězdlička Stream, as well as its right-hand tributary Pavlovický Stream, springs in the Litenčická Uplands. The pond basin covers 2570 ha. The highest peak of the basin is Klín (443 m a.s.l.), the dam of the pond is located at a height of 255 m a.s.l. Long undulated slopes, mostly ploughed, are typical for the terrain relief. The average slope of the basin reaches 5.3° (Sáňka et al. 2021).

The geological substrate of the catchment is formed by Neogene rocks: clay, sand, gravel, sandstone or conglomerates. They are often covered with loess or loess clay. Soil types of Chernozems and Luvisols have developed on them, which are often degraded due to declination and intensive farming. Along the streams, there are fluvial soils on calcareous alluvial deposits.

More than half of the catchment area is ploughed, namely 1414 ha (= 55%). Mainly cereals, corn, sunflower, beet and potatoes are grown on arable land. Permanent grasslands are located only on 38 ha. 37% of the catchment area (953 ha) is covered by forests.

In the Uhřický Pond catchment (Fig. 1), 2 transects on sloping blocks of arable land were selected. One above the inlet of the pond (US1) and the other in the central part of the basin (US2). Mixed soil samples were taken monthly from the slope top (infiltration section), the slope middle (transport section) and the slope heel (accumulation section). Furthermore, samples of bottom sediments were taken from the stream (UB2) and from the pond (UB1). Surface water samples (U1 - U4) were also taken monthly, 3 from streams and 1 from the pond (Fig. 1). In the 2019 - 2021, overall 78 samples of soil, 26 samples of sediment and 83 samples of surface water were here taken and analyzed.

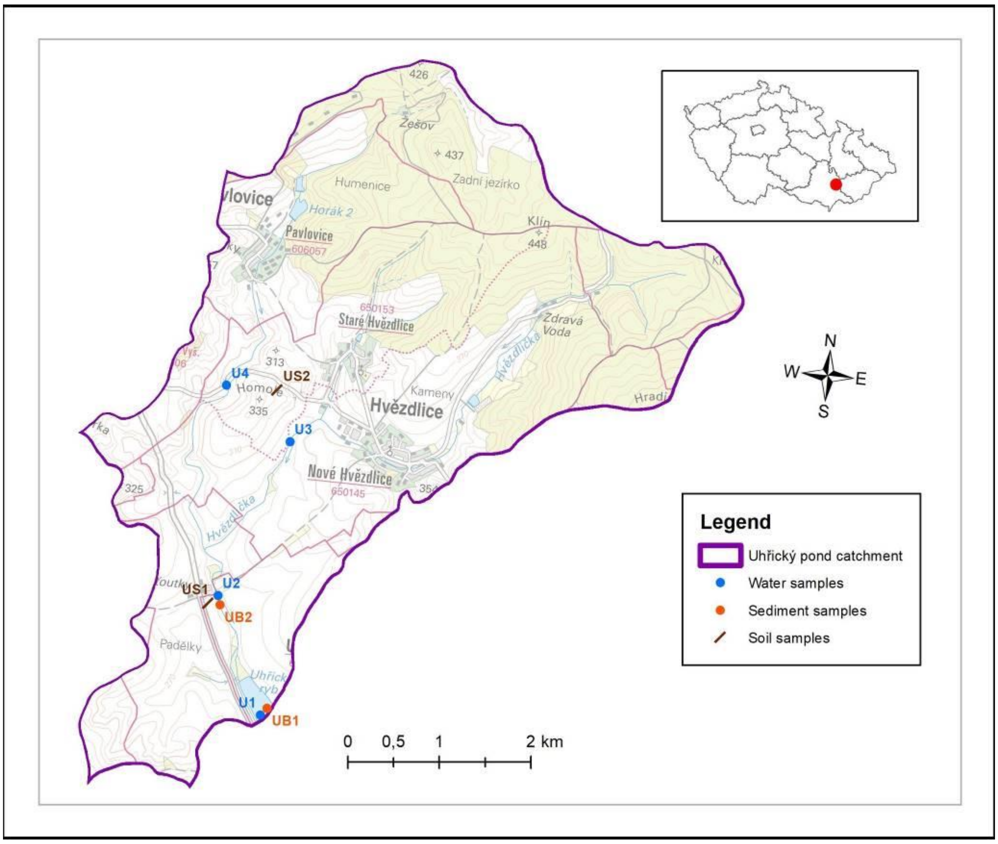

Fig. 1: Catchment of the Uhřický Pond and monitored places

Results and discussion

Soils at the Litenčická Uplands slopes are relatively quality and fertile. In taken samples of soils approximate concentration of Ntot reached 2.30 g/kg and Ptot 0.96 g/kg (2019-2021). Fig. 2 demonstrates marked tendency of nitrogen accumulation in the slope heels, the tendency for phosphorus is less evident. Nevertheless both nutrients are transported from arable land to water bodies with erosion and washing processes (e.g. Krasa et al. 2019; Dupas et al. 2020). Higher concentrations of Ntot (3.10 g/kg) and Ptot (1.31 g/kg) in bottom sediments than in soils (Fig. 2) prove this fact. Of course, municipal wastes have an important share in sediments pollution (Konečná et al. 2017).

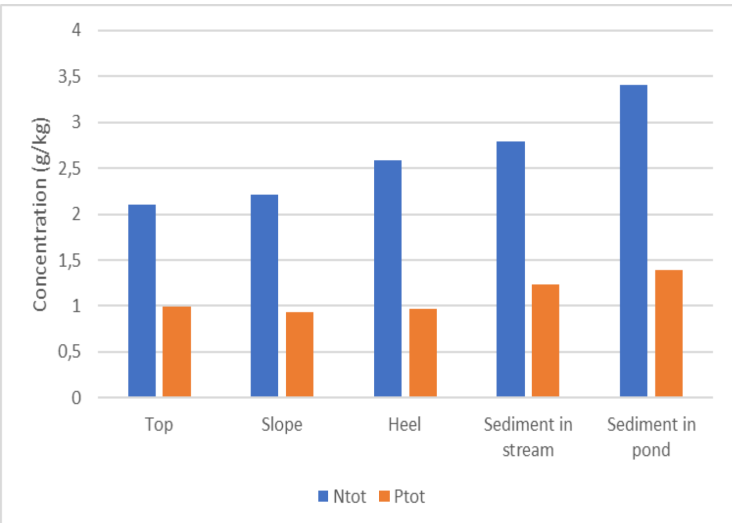

Fig. 2: Nutrients content in soils and sediments

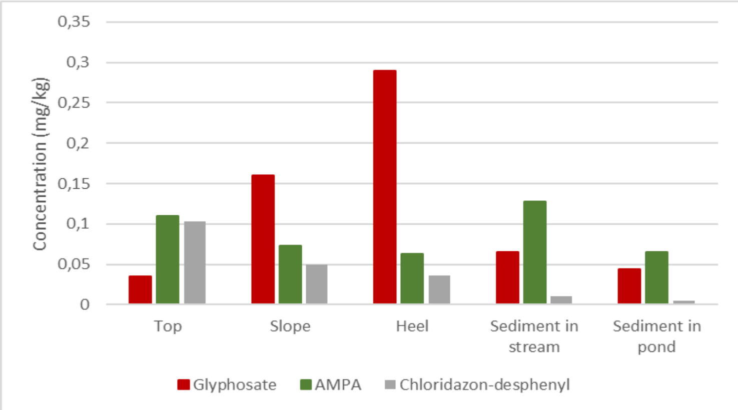

Fig. 3: Pesticides content in soils and sediments

From about 300 analysed pesticide matters, following 3 were identified in almost all samples of soil and sediment: glyphosate, AMPA and chloridazon-desphenyl. The finding corresponds with spectrum of plant protective preparations used in this area. Glyphosate appears in soil in average concentration 0.16 mg/kg. It is transported down slope and accumulates in the heels (Fig. 3) likewise nutrients. During time glyphosate degrades, its metabolite AMPA (av. 0.08 mg/kg in soil) originates. The AMPA concentrations in sediments are higher than glyphosate. Chloridazon-desphenyl (av. 0.06 mg/kg in soil) is an irrelevant metabolite of chloridazon. Average contents of monitored matters in sediments were: glyphosate 0.01, AMPA 0.10, chloridazon-desphenyl 0.05 mg/kg (Fig. 3). Zajíček et al. (2018) confirm our finding that parent pesticide compounds occur in more rate usually in soils and their metabolites in water bodies.

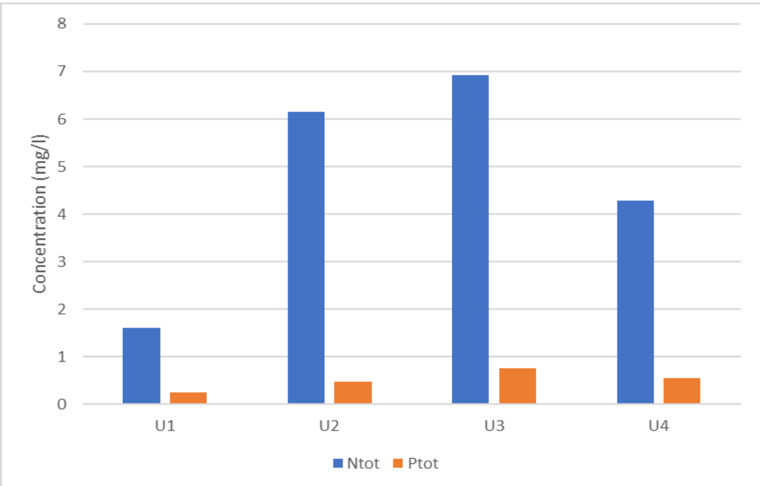

Fig. 4: Nutrients content in surface water

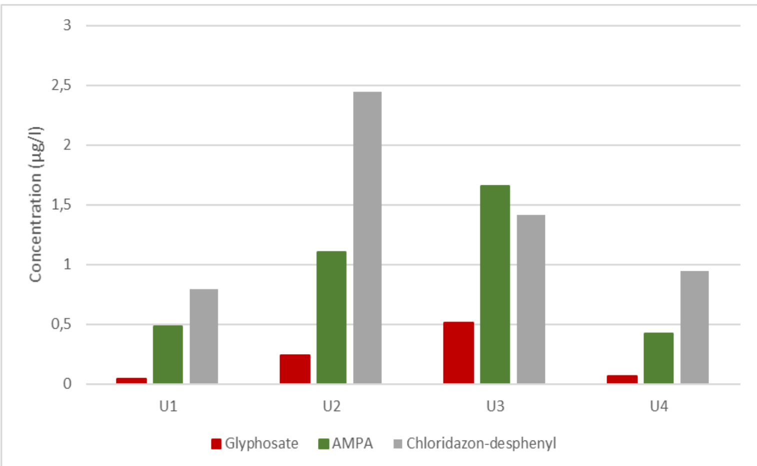

Fig. 5: Pesticides content in surface water

Concentrations of Ntot (av. 4.75 mg/l) and Ptot (av. 0.50 mg/l) in surface waters are different on sampling site (Fig. 1 and 4). The lowest are in pond (U1: Ntot 1.61 mg/l, Ptot 0.25 mg/l). Water quality in streams (namely U2, U3) is affected by near settlement.
Pesticide load in surface waters keeps similar pattern (Fig. 5), water in pond is cleaner than in streams. Main water contaminant is chloridazon-desphenyl (av. 1.43 µg/l). AMPA occurs in average concentration of 0.80 µg/l and its parent matter glyphosate of 0.22 µg/l. Limit for pesticides in drinking water is 0.1 µg/l (Halešová et al. 2021).
With an aim to improve water quality and minimize soil degradation, a complex system of measures will be designed for the Uhřický Pond catchment. The measures will restrict surface erosion and decelerate transport nutrients and risk matters to water bodies. Following types of measures will be systematically located in the arable land:

- Protective agrotechnologies (seeding to mulch or stable, catch crops, …).
- Sheet and belt grassing.
- Grassed hedges, contour furrows or ditches.

Along some protective measures with permanent character (grassing, line elements) new roads and paths with tourist resting and view points can be designed. So, there is a real potential to increase the landscape patency. Design of grassing and bio-technological measures involves accompanying greenery. It is apparent from Fig. 6 and 7, that the landscape of studied catchment is visually nice shaped but thanks to large blocks of arable land rather monotonic.

Fig. 6: View at south-east part of the catchment

The landscape needs more green elements, lines and nests of trees and bushes. Design of soil and water conservation measures can help to solve this situation. It will be prepared as a study utilizable in process of land consolidation, which represent the main tool for implementation for environmental measures in countryside in the CR (Konečná et al. 2017).
Development of environmentally sound agriculture is one of fundamental conditions for development of rural tourism (Hájek 2002). Support and implementation of polyfunctional measures for soil and water conservation is important also for sustainable exploitation and development of rural landscape.

Fig. 7: View at north-west part of the catchment

Conclusion

The project aim is to create a design of comprehensive measures to reduce erosion, leaching of potentially hazardous substances, for protection of soil and water, which will also be close to nature. If implemented, the measures will contribute to increasing ecological stability and aesthetics of the landscape in this area, also to its better patency. More greenery, roads and tourist resting points extend potentially recreation attractivity of the area.

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Souhrn

Od roku 2019 je na jižních svazích Litenčické pahorkatiny sledována kvalita půdy a vody jako dvou základních složek životního prostředí. Výzkum je zaměřen na transport živin (N a P) a pesticidů v povodí Uhřického rybníka. Prokázalo se, že problémem povodí jsou erozní procesy na půdě a intenzivní vstupy živin a potenciálně rizikových látek do vodních útvarů. Cílem projektu je vytvořit návrh komplexních opatření ke snížení eroze, vyplavování látek ze zemědělských půd, pro ochranu půdy a vody, které budou zároveň přírodě blízké. Opatření v případě realizace přispějí ke zvýšení ekologické stability a estetiky krajiny v této oblasti a zvýší tak její rekreační atraktivitu.

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SOIL CHEMISTRY UNDERPINS THE LEGACY OF CHARCOAL HEARTHS: EXPLORING POTENTIAL BASIS FOR EDUCATIONAL MATERIALS

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Abstract
Charcoal production hearths are significant cultural landscape features and convey profound anthropogenic effects on soil properties. Whereas pyrolysis causes irreversible changes in the wood chemical structure, charcoal production residues alter underlying soil environment (stratigraphy and chemical composition). The most substantial changes consist in increased stable forms of organic carbon concentrations, which gain unique nutrient properties (nitrogen content augmentation to the detriment of metals bound in ashes and mineral soil) over centuries.
This contribution compares the elemental composition (C, N, P, K, Ca, Mg, S and Fe) of relict hearth layers and their total stocks to neighbouring forest soil. The hearth soil layers were predominately C and N enriched while depleted of Ca, Mg, P and Fe. Total hearth carbon stock exceeded that of forest soil more than twice. Total sulphur content, however lower in upper soil layers, was also higher in the hearths. Hearths can be perceived as meaningful hotspots of long-term carbon storage. The heritage of charcoal production in forestry should be well communicated to public because of (1) high number and density of hearths in Central European landscape, as well as (2) their ecosystem stability protection and stable carbon sequestration potentials.

Key words: carbon sink, environmental education, soil, nutrient stock, elemental analysis

Introduction
Charcoal production hearths are important geomorphic features of Central European cultural landscape. Charcoal production was conducted for centuries and has considerably affected forest stands in terms of their fragmentation, composition and edatope (Hirsch et al. 2017; Raab et al. 2019).
Due to their high density and differentiation from surrounding soil, ecological and environmental importance of the hearths might be more accented within scientific as well as laic public in such forms as are shown at URL [1; 2; 3]. Beside tourist and historical charisma of hearths, we would like to show their ecological importance, which could be assigned in the tourist trails as well.
Remains of charcoal mounds not only possess pedoarchaeological significance but also represent hotspots of different soil properties (Borchard et al. 2014) due to high temperatures and enrichments (ash, tar, biochar etc.) during pyrolysis (Knicker 2011). As a result of charring and site preparation (landscaping by creating a production platform) in the topsoil, there was blending of soil masses, changes in soil stratigraphy and concentration of individual elements (Hirsch et al. 2017).
Soil chemical composition shifts caused by charcoal production have been addressed in several studies: focusing on volumetric characteristics (Mikan, Abrams 1995), content of C, P, K and other elements (Young et al. 1996).
The outcomes of the treatises sometimes differ on the site significance of hearths. Some of them mention the defavorization effect on the soil environment, or rather on vegetation. Charcoal hearths have a differentiated impact on the concentration of various elements (Mikan, Abrams 1995; Young et al. 1996). Beside site evaluation of hearths, a few studies focus on the overall nutrient stock.
The aim of his study was to compare chemical properties of charcoal hearths with surrounding forest soil. As we believe, the results could be used as a handout for a trail information board to underline hearths importance not only due to historical legacy but also due to environmental significance. The legacy effects and cultural heritage of traditional land use practices in forestry fully deserve general public awareness emphasizing balanced carbon budget and natural renewable resources.
Focusing on element contents (C, N, P, K, Ca, Mg, S and Fe) to the soil depth of 40 cm, we assumed that the content of organic carbon increases in hearth soils and in this connection also the organic matter of bound nitrogen and phosphorus.

Material and Methods
Forest stands situated 10-30 km east and north of Brno (Czech Republic) between the north latitude coordinates of 49°13´N; 16°40´E and 49°26´N; 16°50´E were chosen as the area of interest. The altitude of the area is from 390 to 590 m a.s.l. The area is characterized by topographical

fragmentation. The study area was divided into three 5 × 5 km squares (northern, central and southern). Within the study area we detected and verified 116 hearths from which we selected 6 for sampling and analysis (2 per each square). Hearts were last used ca. 150 years ago according to historical records.
Sedimentary rocks (graywacke, slope loam) predominated in the S and N squares and an admixture of granodiorite and paragneiss predominated in the central square. The rocks of the geological subsoil are recovered by differentially thick loess loam (30–60 cm). Eutric Cambisols (IUSS Working Group WRB 2014) predominate from the soils, altering rarely with Haplic Luvisols.
The samples were collected both from the hearths and from the soil probes excavated near the hearths at distance of 10-15 m following the contour line. The thickness of the individual horizons was detected and samples were taken as undisturbed (82 in total; 2 repetitions per horizon) for bulk density assessment and mixed (46 in total; 1 per horizon) for chemical analysis.
Bulk density (ρ_d) was determined as the weight of 1 cm^3 of the intact sample dried to the constant weight (105°C). Total carbon (TC), total nitrogen (N), and total sulphur (S) were assessed using elemental analysis for the samples sieved through a 2 mm sieve and milled to a maximum particle size of 0.25 mm. Determination was performed with the application of Vario Macro cube analyzer, Elementar, Germany, burning the dry sample at 1125°C and weighing 100 mg ±5 mg. Determination of P, Ca, Mg, K and Fe was carried out after total mineralisation of the sample sieved through a 2 mm sieve by microwave decomposition in hydrofluoric (HF) and nitric (HNO_3) acids in a wet process by means of FAAS.
The amount of the individual elements was calculated for each horizon according to ρ_d as a weight per area of 1 m^2. The amount of the element was converted to the fixed depth of 0-10; 10-20; 20-30 and 30-40 cm according to the thickness of the horizons both separately and cumulatively to determine the total stock at the depth of 0-40 cm. The results were expressed for both the individual horizons and fixed depths by the average values of the element content with standard deviations. Data were evaluated to compare element contents in the hearths and the soil using two-factor parametric ANOVA at α= 0,05.

Results

The humus (H) horizons (Table 1) indicated the lowest and similar thickness. The organomineral (A) horizons evinced similar thickness, but the substantial differences of soil stratigraphy lied on presence of Azp horizon leading to deeper position of mineral horizons in hearths. Bulk density increased with augmenting depth (min. 0.46 g cm^{-3} at the H horizons; max. more than 1.5 g cm^{-3} at the mineral horizons). Humification decreased with the increasing depth. The organomineral Ah horizons were significantly more humic in the hearths, which also demonstrated high TC content at a considerable depth down to 15-20 cm.

Tab. 1: Thickness, bulk density and total carbon concentration in genetical horizons separately for hearths and surrounding soils.

sampl. site	hor.	n	thickness [cm]		ρd [g cm^{-3}]		TC [%]	
			$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
hearth	**H**	6	2.8	1.7	0.46	0.12	33.1	11.4
	Ah	4	5.5	2.1	0.85	0.19	18.9	8.6
	Azp	6	11.5	5.1	0.73	0.06	21.7	8.5
	Bzp	6	11.8	10.4	1.31	0.33	1.6	1.8
	C	5	-	-	1.58	0.14	0.6	0.3
soil	**H**	2	2.5	0.6	0.64	0.02	35.4	4.3
	Ah	5	6.0	1.0	1.01	0.14	5.1	2.3
	E	2	9.5	2.1	1.55	0.08	0.7	0.6
	B	8	13.5	3.1	1.38	0.23	0.9	0.2
	BC	2	-	-	1.45	0.03	0.3	0.2

The soils were significantly richer in TC and also in N especially in the organomineral horizons (Table 2) in the hearths. There was the higher stock of N in the forest soil and it was more than doubled in the organic H horizon. The P content was comparable in the humus horizons, but significantly higher in the mineral horizons of the forest soil. The same trend was observed for K, Ca, Mg and F. The sulphur content was generally higher at mineral horizons of the hearths. When converted to the fixed depths, the C-stock in the hearths was more than twofold and the stock of N, K and S was slightly higher (Table 3; Fig. 1). At the same time, there was a sudden increase in the stock of Con the soil surface of the hearths while the mineral horizont indicated a stock comparable to the forest soil. On the contrary, there was a higher stock of P, Ca, Mg and Fe in the mineral horizons of the forest soil. The sulphur content was lower in the organic horizons of the hearths, but higher in the overall depth of 0–40 cm due to its enhanced content in the mineral horizons. Overall, the Fe content was higher in the forest soil.

Tab. 2: Element stocks in genetical horizons separately for hearths and surrounding soils.

sampl. site	Hor	TC [kg m^{-2}]		N [g m^{-2}]		P		K		Ca		Mg		S		Fe	
		x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd
hearth	**H**	4.3	3.2	163	121	26	17	97	69	21	12	107	77	13	9	27	17
	Ah	7.9	1.2	209	80	151	138	212	146	174	150	720	486	14	8	151	138
	Azp	17.3	7.4	368	155	242	129	646	491	247	133	1263	533	18	14	242	129
	Bzp	1.6	1.4	93	33	226	222	993	640	789	432	2682	1367	10	8	226	222
	C	1.4	0.9	117	34	462	227	1299	819	1243	504	4507	1298	34	59	462	227
soil	**H**	5.8	1.9	240	66	31	6	83	24	25	4	110	31	25	7	31	7
	Ah	3.0	1.4	145	56	173	32	344	183	200	86	1240	605	17	9	173	32
	E	1.0	0.0	87	28	454	168	1509	336	973	289	2661	1209	4	2	454	168
	B	1.4	0.9	110	39	447	302	1264	1136	952	568	3454	1154	10	7	447	302
	BC	0.7	0.7	75	31	186	186	1055	908	1113	224	5517	3561	5	5	186	185

Tab. 3: Element stocks in the fixed depths and in the total thickness of 0–40 cm separately for the hearths and the surrounding soils.

sampl site	Hl. [cm]	TC		N		P		K [kg m^{-2}]		Ca		Mg		S		Fe	
		x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd
hearth	**0-10**	12.3	4.0	0.37	0.11	0.21	0.07	0.49	0.21	0.24	0.11	1.09	0.35	0.028	0.01	1.42	0.64
	10-20	9.4	6.9	0.23	0.13	0.24	0.08	0.64	0.33	0.38	0.24	1.56	0.36	0.016	0.01	2.17	1.42
	20-30	2.4	2.5	0.10	0.05	0.22	0.09	0.91	0.48	0.74	0.39	2.58	0.74	0.018	0.02	3.33	1.37
	30-40	0.8	0.5	0.07	0.01	0.36	0.17	0.11	0.64	0.79	0.21	2.86	0.82	0.020	0.03	4.10	0.68
	0-40	27.0	11.6	0.78	0.29	0.93	0.20	2.89	1.19	2.15	0.83	8.05	1.34	0.07	0.07	10.71	3.85
soil	**0-10**	10.7	4.2	0.40	0.08	0.21	0.07	0.54	0.30	0.29	0.15	1.63	0.77	0.038	0.01	1.84	0.90
	10-20	3.1	4.5	0.07	0.07	0.23	0.19	0.80	0.45	0.62	0.23	2.58	0.66	0.007	0.00	3.38	1.58
	20-30	0.8	0.4	0.07	0.02	0.34	0.20	1.00	0.63	0.76	0.29	2.93	0.66	0.006	0.00	4.40	1.77
	30-40	0.7	0.4	0.07	0.02	0.30	0.18	0.92	0.74	0.97	0.44	2.99	0.63	0.006	0.00	5.47	2.42
	0-40	11.6	3.1	0.61	0.14	1.17	0.55	2.23	2.23	2.58	1.12	10.14	1.94	0.06	0.02	15.21	6.61

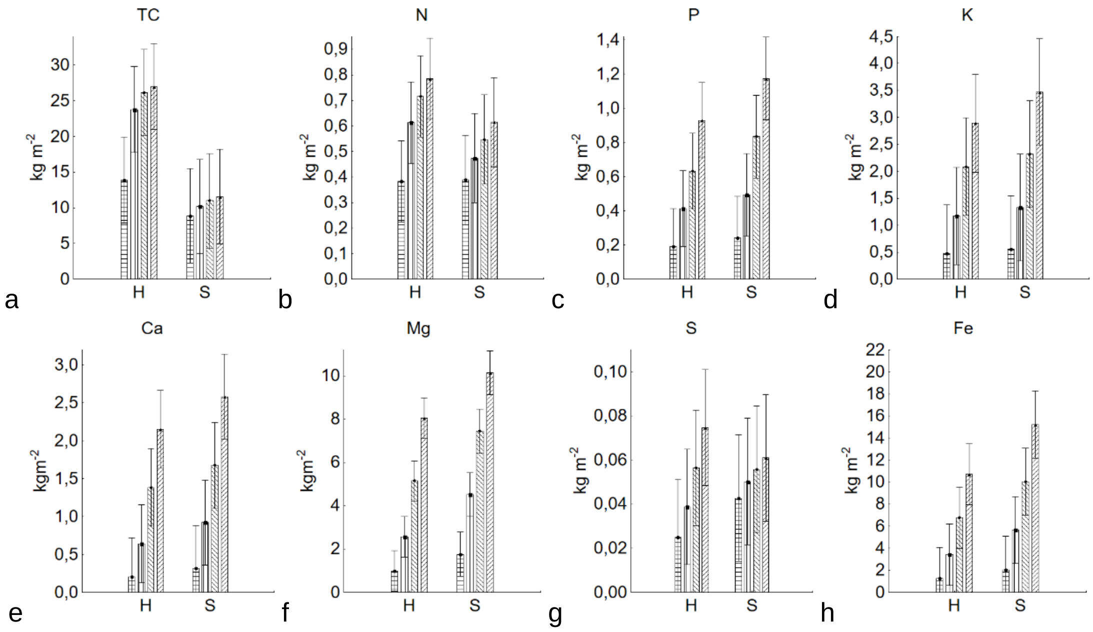

Fig. 1: The cumulative element contents in the fixed depths in the soil of the hearth and the surrounding forest. (H – hearth; S – forest soil; 0-10 cm; 10-20 cm; 20-30 cm; 30-40 cm).

Discussion

The soils of charcoal hearths were classified according to WRB as Spolic Technosol (Humic, Thaptotransportic) over Cambisol by the authors(Hirsch et al. 2017). The related terrain modifications generally result in higher thickness of horizons by modifying the site into the plateau and leaving the part of pyrolytically decomposed biomass or imperfect cleaning of the hearth site.

In our work, similarly to the study by Borchard et al. (2014), bulk density was significantly lower in the hearth, moreover in the greater depth than in the surrounding soil (Table 1). In the cited work (Hirsch et al. 2017), the authors found out the overall lower concentration of organic carbon. Charcoal hearth appears to be an important landscape element for organic carbon in terms of long-term carbon stock in the stabilized form (Knicker 2011; Schmidt & Noack 2000). Nevertheless, the cited authors also highlighted the significant influence of management following charring and hearth age (cf. Hardy et al. 2017). The key time limit for the concentration of N was estimated to be 150 years (Raab et al. 2019) when the nitrogen content, as a result of charring completely volatilized, increases by binding to the organic matter and redeveloped soil biota.

The sulphur content was not assessed as significantly different from the surrounding soil in the similar works (Raab et al. 2019). In our work, the total sulphur stock was comparable, but with a completely various depth distribution (Table 3).

Alterations in the concentrations of other elements were also reported to be diverse in other works in comparison with the surrounding soil, under the influence of such factors as age or more precisely time since the last use of the hearth, the repetitive character of its use, comparative chemistry of the surrounding soil or rather the soil type (Borchard et al. 2014; Mikan and Abrams 1995; Young et al. 1996).

From this contribution, the informations could be extracted as part of tourist trails (information boards) to more spread knowledge of importance of these environmental objects in landscape. From the point of view of transformation, cycles and the study of the sequestration potentials of biogenic elements, hearths, with their immeasurable number in the European landscape, represent a significant and largely unexplored, unique natural lab. Hearths facilitate understanding of long-term effects of the biochar application and associated trade-offs between climate mitigation and other environmental impact categories.

Conclusion

The material extraction of information boards might contain following information (in more consumable form): The hearth environment was characterized by a more distinctive topsoil stratification in favour of charcoal-rich layers with the carbon concentration of over 20 %, average thickness of pyrogenic carbon rich horizons of 11–12 cm and bulk density of 0.73 g cm^{-3} on average, making these values the lowest of organomineral and mineral horizons even in comparison with the surrounding forest soil. Of the elements, the values of C content were more than twofold higher in the hearths. Furthermore, the values of the N content were enhanced and the values of K and S contents were also slightly higher. On the contrary, the concentrations of P, Ca, Mg and Fe were lower. Hearths represent a significant reservoir of carbon in a stable pyrogenic form, as well as the environment with the increased concentrations of nitrogen and partly sulphur. Their cultural-historical dimension, continuity (long time series), diversity, relatively good mapping and mitigation potential towards global climate change make hearths important landscape features that deserve more public attention and can play a key role in awareness-raising activities not merely in the broader environmental protection context.

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Souhrn

Milíře jsou významnou součástí krajiny nejen s kulturně historickým odkazem, ale také se značným ekologickým a environmentálním významem. Stanovení prvkového složení (C, N, P, K, Ca, Mg, S a Fe) na šesti milířích brněnska poukázalo na značnou odlišnost v porovnání s okolní půdou. Milíře se vyznačovaly výraznější stratifikovaností *topsoil* ve prospěch vrstev s koncentrací uhlíku i přes 20 %. Významné rozdíly v objemové hmotnosti i obsahu dalších prvků poskytují dostatečný důvod pro zařazení tohoto tématu jako součásti naučných stezek zaměřených na témata historického využití krajinných součástí.

Milíře představují významnou zásobárnu uhlíku ve stabilní pyrogenní formě a také prostředí se zvýšenou koncentrací N a částečně S. Jejich kulturně historický rozměr, kontinuita, rozmanitost, relativně dobré vymapovaní a mitigační potenciál směrem ke globální změně klimatu z nich činí důležité krajinné prvky, které si zaslouží větší pozornost širší veřejnosti a můžou sehrát důležitou roli při osvětových činnostech i v širším kontextu ochrany životního prostředí.

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SPATIAL CONFLICTS MANAGEMENT IN HRANICE KARST WITH EMPHASIS ON NATURE PROTECTION AND TOURIST MANAGEMENT

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Abstract
The Hranice Karst is a unique karst area in Europe with hydrothermal genesis, specific caves microclimate of underground spaces and mineral waters genesis. The potential of the area is highly diversified and is influenced by various interests (agriculture, surface mining, nature protection, recreation, spa and research). There are often conflicts of interest in the use of this protected area. Long-term and continuous monitoring of natural conditions in correlation with the use of the site in the wider territorial and disciplinary context is lacking for comprehensive management. The basis of the solution is a comprehensive landscape analysis with emphasis on expert identification of potential impacts on ecosystems combined with participatory methods of mapping territorial values and conflicts.
The research method of the area is based on a multidisciplinary approach. Special attention is paid to the following territorial conflicts:

1) Conflict between nature protection and agricultural management (especially in relation to contamination of surface water and groundwater, with special attention paid to subsurface water). The long-term objective in this context is to refine conservation management in the area of interest.
2) Conflict between nature protection and visitor use of the area (especially in relation to the carrying capacity of the area). The intent is to spread recreational destinations across the broader area of interest and to identify gaps in tourism infrastructure with an emphasis on the development of everyday recreation.
3) Conflict between nature protection and land development (especially in relation to surface mining, transport, construction and spas). The aim is to design a consistent development concept that takes into account the different demands of the interested groups.

Key words: recreational potential, water contamination, nature protection, spa industry

Introduction
The management of karst areas is very specific. In these areas, there is usually a strong pressure on the development of the site on the one hand and the preservation of values on the other. Conflicts of interests between the exploitation of the potential of the area for the development of tourist, recreational, therapeutic and other activities and the protection of nature and landscape are very common (Faccini et al., 2012; Ilona et al., 2016; Telbisz, Mari, 2020). Spatial planning based on a participatory approach plays a very important role here (Pantić et al., 2019; Handayani et al., 2019). Hamilton-Smith (2016) emphasizes the need to take into account all relevant factors influencing the development of an area in the management of karst areas. A comprehensive approach to monitoring the development of these sites was thus not very common; research focused instead on the study of partial characteristics of karst areas (geology, hydrology, pedology, etc.) and generally within the Czech Republic. Thus, many works (e.g., Modrá et al., 2018), in the Hranice Karst (Pavlík et al., 2018), address in detail important questions of possible impairment of the karst environment, but their results are not flexibly adopted by other disciplines.
Current trends in landscape research and management follow the principles of a multidisciplinary approach as the basis for strategic management of specific areas. This fact is confirmed, for example, by Özyavuz et al. (2018), Mueller, Eulenstein, (2019). The participatory form of planning for these landscape changes is very effective and is gaining ground in practice (e.g. Nadin, V. et al., 2020; Gonzales et al., 2020). In this context, involving the local community in decision-making and working with the local authority is also important (e.g. McLoughlin, Hanrahan, 2019). The multidisciplinary approach to the study of the Hranice Karst is based on linking basic research in geology, hydrology and pedology with landscape architecture and planning. Possible changes in the area can be verified through a comprehensive study. The general principles can then contribute to a more precise

approach to designing sustainable land-use policies (including adaptation to climate change) based on the identified potential and carrying capacity of the area.

Hranice Karst

Hranice Karst is located SE of Olomouc (Czech Republic) and is formed from Paleozoic limestones. It is a unique karst area with hydrothermal genesis, aspecific microclimate of underground spaces and carbonic acid springs, used also for balneology. There are a number of small protected areas. The most important karst phenomena are the Hranice Abyss – the world's deepest flooded cave – and the Zbrašovské aragonite caves with unique decorations and gas lakes (Fig.1).

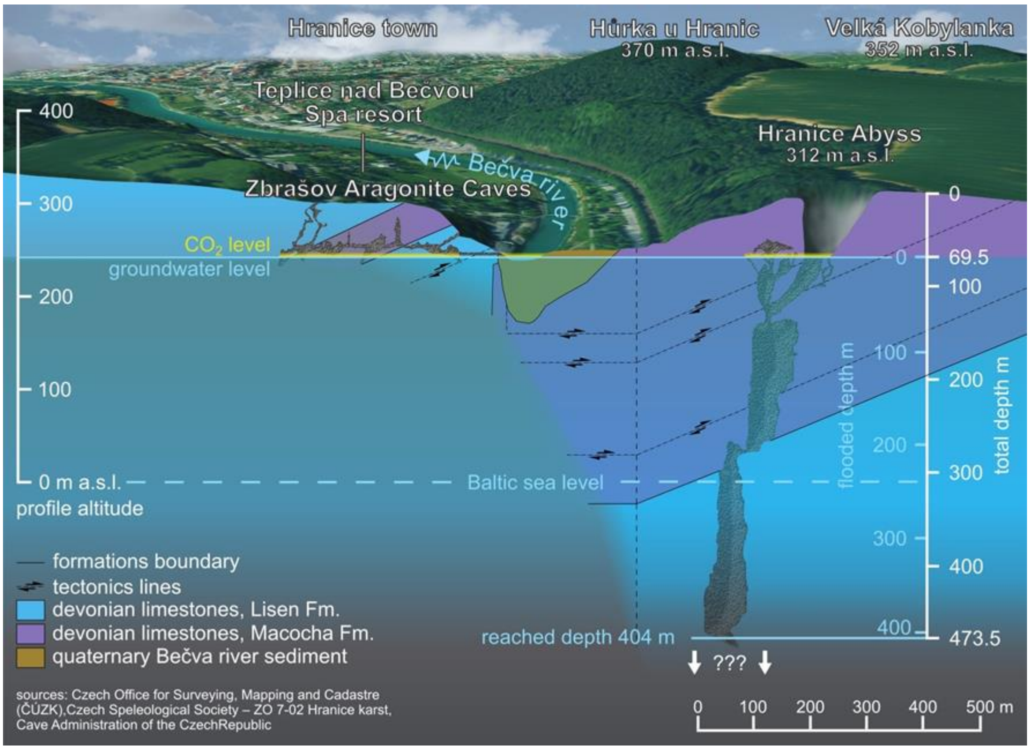

Fig. 1: Hranice Karst schematic illustration

Apart from the protected sites, the area is characterised by conventional agriculture (arable land, meadows). There are also active limestone quarries in the area, which are being further expanded. Recreation and the spa industry are also developed here.

The following territorial conflicts, which are relevant to the further development of the area, have been identified in the Hranice Karst area from a field analysis (Fig. 2), and their coordination should be part of the draft strategic plan:

1) Conflict between nature conservation and agricultural management (with special reference to water protection)

Due to the atypical and complicated geological development of the area of interest, not all connections in the Hranice Karst have been satisfactorily clarified yet, especially hydrological connections. These are mainly the mutual influences and relationships between surface flows (the Bečva River, the Krkavec stream), subsurface waters (including drainage waters) and groundwater springs (sours), which are also used for balneological purposes. Only long-term and careful monitoring can clarify these relationships and connections. Monitoring should focus on regime changes and correlations over seasons, high water levels, emergencies, etc.

The area of interest of the Hranice Karst is also agriculturally exploited, with drains located on a number of plots. These are, in many cases, damaged and non-functional, which in many places leads to waterlogging of agricultural land and the formation of caverns. In the context of intensive agriculture, water monitoring should focus on the possible contamination of deep mineral waters (acidification) not only with nutrients but also with pesticides and their metabolites. If long-term water monitoring, which started in 2021, shows findings of pesticides and their metabolites also in deep groundwaters, it will be necessary to focus on the protection of this unique karst system and propose a special management regime in the area of interest.

The most at risk are the plots of land in close proximity to the Hranice Abyss. These lands are highly erosion-prone and there are soil blocks of arable land over 50 ha. A major conflict is the unclear management of the legal protection zone of the Hranice Abyss and the ploughing of land up to the forest boundary in the immediate vicinity of the abyss.

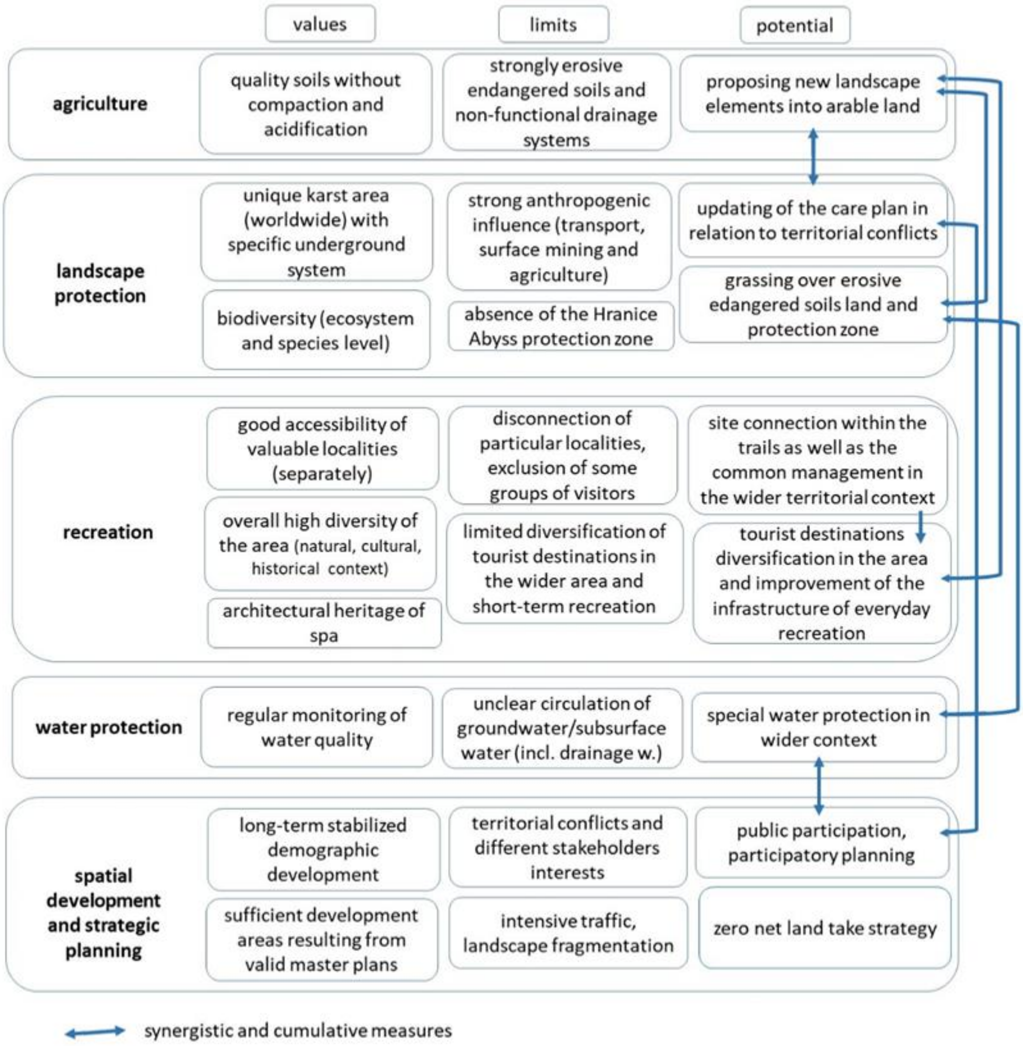

Fig. 2: Overview of the main areas of coordination of territorial conflicts

2) Conflict between nature conservation and visitors to the area

The area is characterised by short-term recreation and limited tourism services outside the central area of Hranice. The area has great potential for the development of coordinated destination management, which is not being exploited. In order to establish the visitor profile and determine their needs, annual quantitative and qualitative monitoring of visitor numbers to the Hranice Abyss was initiated in 2022. From this, it will be possible to propose strategic measures to diversify the tourist attractions on offer in the Hranice Karst area. In addition to the town of Hranice and the Hranice Abyss, the Zbrašov Aragonite Caves are among the key destinations. Huge potential can be seen in the spa industry, which is linked to the natural occurrence of Teplice mineral water. The spa itself is an important set of functionalist buildings. Both the individual buildings (e.g. the train station by Josef Danda, the villa of Ladislav Říhovský by the Oehler family) and the whole and the natural framework are unique in the Czech Republic. The Teplice nad Bečvou Spa can be a key player in the development of the Hranice Karst if properly managed.

In the Hranice Karst area, the tourist attractions are offered independently with no sense of interconnection, e.g. by a navigation route or common promotion. A joint promotion of sites under the Hranice Karst brand would be very beneficial. The proposal of nature trails connecting the sites and suggesting other tourist destinations is also a suitable solution.

Another problem is the exclusion of selected groups of visitors and the related lack of infrastructure. Access to the Hranice Abyss from the east (from the village of Černotín) could solve the accessibility of the site not only for cyclists but also for the disabled. A dense network of cycle paths is available in the area, but there is a lack of facilities for bicycle storage along the way.

Visiting caves and the need to protect them is a very specific issue. Visiting inaccessible caves as part of hobby and professional speleology is often neglected. However, in the context of the ever-increasing interest in so-called outdoor activities, these activities cannot be neglected either. Visiting inaccessible caves is a potentially dangerous activity (Geršl et al., 2017). In Hranice Karst, the danger is increased by the presence of underground lakes and suffocating carbon dioxide.

3) Conflict between nature conservation and land development

The management of territorial conflicts is a task of spatial and strategic planning. Territorial demands are highly diversified and often in conflict with each other. The influence of opencast mining, intensive traffic and sprawling development is evident in the area. These activities have a fundamental impact on other interests in the area, especially nature and water protection, including the spa industry. In the Hranice Karst area, the regulation of land use is a very topical issue.

The diagram (Fig. 2) summarizes the values and limits of the area and presents the potential for strategic management and direct actions in the area. The diagram shows that the coordinated management of individual problems and the protection of values are complementary and mutually reinforcing.

Conclusion

Due to the as yet unclear water circulation system in the karst area, conflicts of interest in the Hranice Karst need to be addressed in a comprehensive and coordinated manner in the wider area of interest. The strategic management of the protection of the values of the Hranice Karst should focus on the implementation of these measures:

- Optimisation of landscape structure to mitigate erosion risk to land, split large blocks of arable land and improve landscape permeability (and site accessibility). Extinct historic roads that are still owned by municipalities are identified as potential areas to reduce land blocks and improve accessibility. These measures are also related to the modification of management in at-risk sites (grassing, reduction of chemigation and heavy machinery movements) in order to promote infiltration of rainwater while eliminating potential pollutants. In this context, long-term monitoring of surface, groundwater and drainage water quality should be continued.
- Creation of a common destination management of the Hranice Karst and physical connection of individual sites by nature trails. In particular, the potential of Teplice's promenade and architectural heritage should be exploited. Furthermore, the interconnection of the backbone sites (abyss, cave, promenade, nature trail in Černotín and Ústí) should be improved. The long-term plan is to distribute recreational destinations and complete the tourist infrastructure including services in the wider area of interest based on verified tourist demand.
- The creation of a consistent territorial development concept should be based on a participatory approach.

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Souhrn
Hranický kras je unikátním krasovým územím se specifickou genezí a vznikem uhličitých kyselek. Potenciál území je značně diverzifikován a je ovlivňován různými zájmy (zemědělství, těžba, ochrana přírody, rekreace, lázeňství). Velmi často dochází ke střetům zájmů při využívání tohoto chráněného území. Pro komplexní management chybí dlouhodobý a kontinuální monitoring hydrogeologických a půdních poměrů v korelaci s využíváním lokality v širších územních i oborových souvislostech. Základem řešení je komplexní krajinná analýza s důrazem na expertní identifikaci potenciálních vlivů na ekosystémy, kombinovaná s participativními metodami mapování územních hodnot a konfliktů. Metoda výzkumu oblasti je založena na multidisciplinárním přístupu**.**

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SPECIFIC GENIUS LOCI OF ABANDONED SETTLEMENTS IN MORAVIA AND SILESIA – OPPORTUNITY FOR RECREATION IN REMOTE AREAS

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Abstract
Within the territory of settlements physically disappeared in Moravia and Silesia after the WWII (the database of these localities you can see at zanikla-sidla.cz), can be observed significant changes in the landscape structure. These trends of changes can be divided into four basic typological groups: 1) afforestation of visually open localities (most often at higher altitudes), 2) change in the structure of the agricultural land with a simultaneous increase in woody vegetation (most often at lower altitudes); 3) preservation of historical landscape structures (rather rare state); and 4) irreversible land use change (usually connected with the mining or water reservoir constructions). Each of these landscape types offers significant potential for tourism development. This potential is supported by specific elements (most often buildings or theirs ruins) resembling the previous presence of people, and completing the genius loci of the area. The significant objects connected with abandoned settlement are churches, chapels, small sacral buildings and cemeteries. These constructions are preserved within several localities without the regional differences but in the Bruntál region (50° N., 17°24′ E) they are more frequent. Efforts to restore these buildings are evident across the localities, and many of this objects fulfill their primary function. Other elements connected with previous human presence are also represented on abandoned settlements´ localities, such as stone paths, bridges and very distinctive landscape elements – stone walls.

Key words: land use change, cultural heritage, tourism, peripheral areas, renewal of traditions

Introduction
Landscape structure has been constantly evolving. Somewhere the changes are hardly noticeable, somewhere the landscape structure has been overwritten to a completely new appearance. The most significant changes are characteristic for the landscape of fur-flung and peripheral areas – in localities of settlements that perished long ago. Landscape structure in these localities has been determined by depopulation – it is a contemporary wilderness, where we can, however, find traces of former human presence. In this region there is a whole range of places, with which everyday life was connected in the past, such as working in the field, going to school, church sermons... Here we can often come across hardened soil under an unused path, a cross far from the road, an old fruit tree or stone walls in the middle of woods. Today these places are abandoned – only wild societies of plants and animals, spruce monocultures or grazing cattle have become their inhabitants. Nevertheless, also with regard to the history it is necessary to keep reminding these places.

Materials and methods
The area of interest is defined by settlements that physically perished in the region of Moravia and Silesia after World War II. The overview of these settlements is included in an interactive map of perished settlements (www.zanikla-sidla.cz). Trends in the development of landscape structure were interpreted based on aerial survey photos taken in the period from 1930s to 1950s. These treasures capture landscape structure before the human settlement perished. This time section is compared with contemporary state of landscape (based on orthophotomaps dating 2020 and based on field exploration). In the processes of landscape structure changes, we keep finding identical features across localities of perished settlements. Based on the typology of these changes we formulate general trends of landscape structure development in these localities. To illustrate these localities' regional context, the typology is supplemented by specific elements that help create genius loci of perished settlements. Elements that we selected to be presented are church buildings.

Results
Changes of landscape structure in the area of perished settlements in Moravia and Silesia after World War II until the present reflect the trends to afforest localities with higher altitudes and to enlarge land blocks' surface area (land blocks meaning continuous areas of land used for the same, agricultural purpose in this context). Localities of perished settlements also bear more significant memory of

landscape connected with previous presence of people, and with regard to the fact that the majority of these localities are peripheral they also have landscape structure stabilized in the long-term. In the area of perished settlements and nearby landscape we can monitor the following trends in changes of landscape structure:

- Afforestation of localities with open view,
- Change of agricultural land resources structure, and concurrent increase in wood vegetation,
- Preserving historical landscape structures,
- Irreversible change of the use of the area.

Afforestation of localities with open view relates especially to locations with higher altitudes around Jeseník (especially perished settlements in the Jeseník and Šumperk districts. More significant increase in forest areas was mainly caused by natural fusion of non-forest vegetation with original continuous tree ground cover or targeted afforestation (usually spruce monocultures). In the past, land used for agricultural purposes was very typical even for these settlements located in higher altitudes, and it was arable land that made place for forest vegetation or that was replaced by pastures bordered by full-grown vegetation. Although the density of road network decreased substantially in these areas, these changes do not considerably influence landscape permeability. Pastures with fences present a rather significant barrier for people.

Locations at lower altitudes are characterised by prevailing agricultural land with stabilised surface area. There are two types of changes in the structure of agricultural land resources. Firstly, there is a change in the size of medium-sized land blocks, which became significantly larger, nevertheless the land blocks still remain relatively small (e.g. the size of a land block of arable land in the agriculturally used area of Annín grew from 0.36ha in 1946 to 5.48ha in 2020). This change is typical for perished settlements located in lowlands in the district of Jeseník and Bruntál and for municipalities on the Czech-Austrian border. In a more jagged terrain this change is complemented by a transformation of arable land to perennial grass vegetation. This trend is the most evident in locations with higher altitudes of Bruntál district.

More rarely we can see preserving of the historical landscape structure formed by a mosaic of perennial grass cover and scattered wood vegetation copying stone walls and creating an aesthetic network that is clearly visible from the surroundings. These localities can sporadically be also found in the Bruntál region, and in localities with open view in the Jeseník district.

The last type of landscape structure changes is an irreversible loss of original sites. It is an overlay of original populated landscape with another – usually industrial – type of use of the area. In case of the post-war development in the region of Moravia and Silesia it is mostly mining and dam construction.

Localities of the perished settlements have distinct genius loci connected with numerous traces of human presence in the now abandoned landscape. In localities with higher altitude we can, for example, typically find stone walls (Duma et all., 2020). Preservation of landscape structure and historical objects is impacted not only by natural conditions and the fact that the localities have not been resettled, but also by the intensity of building demolition. Across localities we can find ruins of buildings originally used for residential purposes. Other historical buildings in various degree of intactness are frequent, too. These are especially small chapels (well maintained, or only ruins), and other small sacral constructions and cemeteries. Very significant buildings in perished settlements are churches. The pictures below show a selection of buildings adding the final touch to the landscape of perished settlements. In the Czech-Polish borderland in the districts of Jeseník and Šumperk these buildings have been preserved only exceptionally, in the Bruntál region, on the contrary, they are more often. Across localities we can see efforts to restore these objects. These objects can be divided into several groups by the current condition and use:

1) Distinct buildings located in woody vegetation not fulfilling their primary function (Fig. 1)
2) Buildings maintained and used in the long-term that fulfil their primary function (Fig. 2)
3) Smaller buildings in open landscape without primary function (Fig. 3)
4) Pious restoration of foundations of a chapel or church (Fig. 4)

Other elements connected with previous human presence are also represented on abandoned settlements´ localities, such as stone paths (Fig. 5), bridges (Fig. 6) and very distinctive landscape elements – stone walls (Fig. 7, 8). We can find them mainly on sloping lands at higher altitudes, especially in the Jeseník region. Stone walls can be considered as unique landscape features with enormous importance in biodiversity. Simultaneously, they complete the genius loci of abandoned localities.

Fig. 1: Hutov (Bruntál district)

Fig. 2: Lipňany (Třebíč district)

Fig. 3: Ječmeniště (Znojmo district)

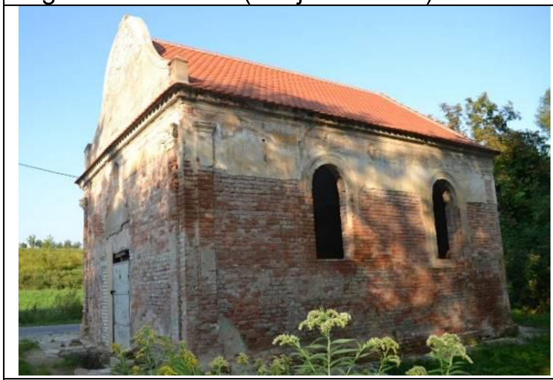

Fig. 4: Štolnava (Šumperk district)

Fig. 5: Studnice (Bruntál district)

Fig. 6: Ztracená Voda (Bruntál district)

Fig. 7: Hřibová (Jeseník district)

Fig. 8: Kamenné (Jeseník district)

Discussion

The development and new role of perished settlements in Moravia and Silesia corresponds with the situation of perished villages on the Polish side. Latocha (2020) defines several trends in the development of depopulated Polish municipalities in the Czech-Polish borderland (Re-wilding; Stopping/reduction of the secondary succession, Educational paths, eco-museums, information boards; Restoration of sacral landscape; Large-scale tourist infrastructure; Renovations & new housing; Villages for sale). All of these trends can be observed in the Czech territory, too. Nevertheless, the efforts to restore the settlement function are minimal. Land plans embracing localities of perished settlements do not include any designs of areas designated for permanent residence at all. To lower extent there are some plans of new recreational areas.

In the area of perished settlements and in their neighbouring landscape we can very often find functional elements of the Territorial System of Ecological Stability. A number of localities are a part of the NATURA 2000 network or they are located in the protection zone of the Jeseníky Protected Landscape Area.

A big potential for the reconstruction of natural and cultural heritage of localities of perished settlements lies in data from aerial laser scanning (Affek et all., 2021). To identify the potential of the area in detail it is suitable to use the "reviving of villages" concept with the emphasis on economic changes and specifically changes in tourism infrastructure (Latocha et all., 2021). Vaz et all. (2020) recommends to establish development activities in the cross-border regions based on common history including the memory of the inhabitants. This potential is, to a limited extent, offered by the Czech-Polish and Czech-Austrian borderland. Another possible tool is a presentation and records of cultural and natural wealth of perishing localities in the form of a modern chronicle of settlements (more information on the concept to be found at: mko.mendelu.cz; Vavrouchová et. all., 2015).

Conclusion

Landscape structure in the area of perished settlements has undergone significant changes in comparison to the original conditions. However, at present the new shape of these localities is stabilized. Anthropogenic elements that are so typical for these localities increase the attractiveness of the area. Most often this relates to historical buildings with a various level of maintenance and with different types of use. In general, we can state that localities of perished settlements have a high potential for educational activities in the form of educational trails creation and for the development of tourism.

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Souhrn

Na území sídel, která na Moravě a ve Slezsku po druhé světové válce fyzicky zanikla (databázi těchto lokalit si můžete prohlédnout na zanikla-sidla.cz), lze pozorovat výrazné změny ve struktuře krajiny. Tyto trendy změn lze rozdělit do čtyř základních typologických skupin: 1) zalesnění pohledově otevřených lokalit (nejčastěji ve vyšších nadmořských výškách), 2) změna struktury zemědělské půdy se současným nárůstem dřevinné vegetace (nejčastěji v nižších nadmořských výškách); 3) zachování historických krajinných struktur (spíše ojedinělý stav) a 4) nevratná změna využití území (obvykle spojená s těžbou nebo výstavbou vodních nádrží). Každý z těchto krajinných typů nabízí významný potenciál pro rozvoj cestovního ruchu. Tento potenciál je podpořen specifickými prvky (nejčastěji stavbami nebo jejich ruinami) připomínajícími dřívější přítomnost lidí a dotvářejícími genius loci oblasti. Významnými objekty spojenými s opuštěným osídlením jsou kostely, kaple, drobné sakrální stavby a hřbitovy. Tyto stavby jsou zachovány v rámci několika lokalit bez regionálních rozdílů, ale na Bruntálsku (50° s. š., 17°24′ v. d.) jsou častější. Snahy o obnovu těchto staveb jsou patrné napříč lokalitami a mnohé z těchto objektů plní svou primární funkci. Na lokalitách opuštěných sídel jsou zastoupeny i další prvky spojené s dřívější přítomností člověka, jako jsou kamenné cesty, mosty a velmi výrazné krajinné prvky - kamenné zídky.

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SUSTAINABILITY CRITERIA FOR MTB TRAIL PROJECTS

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Abstract
MTB trail projects are often described with the term "sustainability". Unfortunately the use is often unjustifiable. This is most likely caused by misunderstanding the meaning of the concept of sustainability. In our paper, we explain how conservatively designed MTB trail projects differ from those which approach on the bases of current trendy influences that are often interpreted superficially. We also explain why we recommend caution towards such trendy projects. The explanation goes by introducing criteria of the sustainable trails and the three most important trail-planning rules of the established best-practice. From our many years of experience in trail planning and design, we propose several rule of thumb indicators by which to easily assess mountain biking trail projects on the basis of their sustainability.

Key words: trail planning, trail planning rules, best practice

Sustainability of MTB Trail Projects

In the last 10 - 15 years, the number of recreational trails specially designed and built for MTB has been increasing in the Czech Republic. We believe that this phenomenon needs no further introduction, as we assume that interested readers of this paper have already encountered its manifestations.

In this paper we want to focus on the concept of "sustainability" because most of current MTB trail projects use it to describe their qualities. Our analysis of recent trail projects in the Czech Republic shows that trail designers utilize the term because it legitimizes their work to state officials, land managers and the public but operate with a rather simplistic version of it. We believe that time is right to help the wider interested public that comes in contact with such projects in their professional capacity to explain what sustainability of trail projects means and how it influences their quality.

It should be noted that the term "sustainability" is often misused even in environmental and ecological contexts. It was such misuse that probably began to associate the label "sustainable" with "environmental friendliness". The fact that trails are built from natural materials also contributed to this an impression. The habitual misuse of the term "sustainability" in relation to MTB trails is common not only in the Czech Republic but also elsewhere in the world where MTB trails are being built, for example the Great Britain, where the phenomenon originated.

Trail sustainability of course means that trails are built with respect to nature and landscape. However, it also means that trails will not negatively influence other landscape functions, such as forestry or access for other user groups. It also means that the trails will not put excessive burden on public budgets, nor will they put burden on their operators to administer, inspect and maintain them.

The first MTB trail projects both in Britain and the Czech Republic truly sought to implement sustainability. The new trail system and trail destinations quickly gained great popularity, and other projects soon followed. However, the followers did not lose too much time and effort describing their work in their own words. Instead they copied the wording of the originators. As a result, the supposed sustainability began to spread across trail project documentation, promotional texts and websites, creating the impression that all natural surface trails for mountain biking are sustainable.

Conservative vs. Trendy Trail Design

After the first wave of MTB trail projects, which were attempted to achieve harmony with nature and landscapes (we call them "conservative") innovations began to emerge. Some skilled and technically advanced mountain bikers started to demand additional elements of trails to those that source from the natural shape of the terrain - so-called technical trail features (TTFs) jumps, berms, table-tops, steeps, step-downs, step-ups and additional wooden obstacles. Many trail designers are trying to adapt to such demand by starting to create "trendy" trail projects. It even sometimes seems that nobody wants the "conservative" trails anymore.

However, this is far from the truth. The share of ordinary, beginner to medium advanced off-road cyclists is by demographic definition an order of magnitude greater than the share of "core" and "expert" riders. Unlike them however, the majority of mountain bikers seem silent. They do not express

their view on social networks and specialized forums nor do they usually campaign their political representatives for more trails. They act as a silent majority.
We do not want to be misunderstood to advocate against skilled core mountain bikers neither against well-thought-out projects for them. There are projects based on trendy design principles that are based on expertise. Thanks to established mechanisms they successfully cope with increased management and maintenance. However, we consistently point out that:

1. There are substantially fewer core mountain bikers than it may seem judging on the loudness of their opinions. The largest part of the mountain biker public does not voice their opinion and risks to be neglected.
2. Technical trail features incur significant and long-term responsibilities for the operators. They require repeated inspections and frequent maintenance to prevent user injury and legal liability, but also to maintain their functionality and the expected user experience.
3. MTB trails designed for high-speed use and jumping (so called jump-lines) bring potential danger to other visitors to the forest. Unlike formal bike parks, trails in the forest cannot be fenced off. Visitors from other user groups have a legal right of access to them and cannot be prevented from entering.
4. Technical trail features on trails may be perceived by some people as un-aesthetical, unsuitable to forest environment or damaging the landscape.
5. The authorities should allocate resources into trails pragmatically: to try to satisfy the widest possible part of the MTB user group with the least possible amount of resources. They should not be pressured to develop costly and expensive-to-maintain projects for a relatively small group at the expense of the wide general MTB public who seem to prefer "conservative" trails.

A well-thought project based on good practice that is focused on core MTB users needs to address and balance these three components from early stage onwards: the size of the target group, the volume and intensity of maintenance and the impact on other functions of the landscape.

Sustainability Criteria
When considering a project of MTB trails, the initiator, the designer, but also the investor and the future trail manager should responsibly assess how the trail project will meet the basic sustainability criteria listed below. As we explained above, the "sustainability" of trails cannot be seen as an environmental issue alone. If the sustainability criteria are neglected, there is a risk of project failure, economic loss and loss of credibility, in worst cases even liability sanctions.

We have adopted the sustainability criteria from our mentor, the Welsh trail designer Dafydd Davis, and adapted them by years of experience working in developing trails in the Czech Republic:
- Trails should only have a modest, consensus-based impact on pre-existing land use.
- Trails should not require an excessive volume and intensity of management, administration and supervision.
- Trails should not require an excessive volume and intensity of follow-up maintenance.
- Trails should benefit the location and not reduce its value. All that in relation to the landscape, communities, environment, cultural heritage and nature conservation.

It is worth noting that point 3 in particular is often underestimated by trail proponents. They often focus great efforts into obtaining a permit and subsequently into the construction of the trails. However they often fail to appreciate that an implementation of the trails creates a long-term financial and labour commitment to their maintenance. The more intensive and elabore the technical trail features (berms, jumps, and wooden constructions) placed into the trail are, the more demanding and more necessary the maintenance is (to ensure the desired user experience, and to provide for consistent conditions that prevent accidents and protect from legal liability).
This is the most persistent reason why we call for caution towards the current trend of implementing TTF heavy trails in the open countryside. For the same reasons we are strong proponents of a more conservative approach to trails.

Best Practice
The visual appearance of conservative trails may give the impression that they are very simple structures and that their design does not require any qualifications. The current fallacy is that it is enough to be a good MTB rider to be able to design MTB trails. But designing trails is not just about being able to imagine a bike flowing through the terrain. It is a craft. Experience and strict adherence

to established design principles are at least as important. These principles are relatively few and simple, but are based on both natural laws and cumulative experience of many previous trail builders. They were established primarily to protect the trails from the destructive effects of erosion and to sustain (sic!) their functionality through long term and / or intensive use.

The construction principles for trails are not standardized or prescribed by industrial norms in the Czech Republic. In the Czech and foreign literature they are referred to as "best practice". In Czech context, they are known mainly from the publications of the US trail advocation organization IMBA (and our translations to Czech). The most important principles that a designer of nature-friendly trails must adhere to in order for trail to withstand the pressures of natural forces and long term use are the following:

1. The 10% rule - the average trail grade should not exceed 10% (and absolute short distance grade should not exceed twice the value of the average grade).
2. The half rule - the average trail grade should not exceed half of the grade of the fall line.
3. The mineral soil rule - the thread and the body of the trail should consist of mineral material (either local mineral soil in full bench cut or imported quarry stone) only. No organic material should be left or used.

It is worth noting that not all trail designers who refer to good practice and IMBA standards in both the permit documentation and their promotional materials actually follow them. If they would, their projects would simply look quite different. If a designer diligently follows the principles of good practice, (s)he by nature of the field arrives at a more conservative design.

How to Recognize Quality MTB Trail Projects (A Cookbook)

Nature conservation officers and forest management personnel are not experienced enough to recognize a quality MTB trail project. That is quite understandable, because trail design is still a relatively young discipline that is not yet sufficiently covered by both domestic and European higher education. However we believe that, as in many other disciplines, it is possible to apply Pareto's 80/20 principle to the field. To be able to differentiate among the projects officials do not need to master the discipline of trail design, they just need to focus on a few basic indicators:

1. Designed average grade. The average grade of the trail should not exceed 10%. iIt is safer to keep even lower values. The average grade of the trail can be easily, quickly checked. All that is needed is a line design drawn on a contour map and a calculator. Even a cursory check is very telling of any trail project.
2. Trail construction solutions. Does the project account for mineral construction layers, or does it declare that the trail ridden-in or raked into organic matter? Trails based on organic soil, currently sometimes referred to as "enduro", have a short durability.
3. Technical trail features (berms, jumps and wooden structures). What status will they have after construction? Will they be part of the forest or will they be taken out from designated forest land? What rules will apply to them? Will they comply with the Czech Forest Law (which is preferred) or will they require a special Code of Practice to be issued? How will their subsequent administration, revision and maintenance be ensured?
4. Consultation process. What stakeholders does the project envisage to consult in the preparatory phase? Are the initiators and designers ready to consult with the forester?
5. Trail management upon completion. How is the management and maintenance of trails solved? Who will be responsible for the trails?
6. References. We recommend that you check provided references by direct contact to the referred party. Were the projects implemented or did they remain only on paper? How do the implemented projects work in the long run? Were the implemented projects volunteer-run or investment projects?

Souhrn

V našem příspěvku jsme vysvětlili, jak rozumět termínu “udržitelnost” ve vztahu ke stezkám. Udržitelnost zde nemá pouze environmentální podtext, v úvahu je nutné brát také ekonomické a sociální souvislosti. Popsali jsme, že současné trendy v projektování stezek mají kvůli snahám o popularitu u zdatnějších terénních cyklistů tendenci se odklánět od důrazu na udržitelnost a stavět obtížné stezky s překážkami. Skupina zdatnějších terénních cyklistů je však relativně malá, ačkoli je hlasitá a iniciativní. Hlas řádově větší skupiny - běžně zdatných rekreačních terénních cyklistů, kterým vyhovují “konzervativně” budované stezky, prakticky není slyšet. Přes to, že se většina domácích projektantů stezek ohání “udržitelností” a “dobrou praxí”, domníváme se, že to jsou spíše jen

proklamace ve vztahu k úřadům a veřejnosti. Zmíněná kritéria udržitelnosti a zásady dobré praxe v příspěvku dále představujeme, a navrhujeme několik základních ukazatelů, podle kterých úřady, správci a vlastníci pozemků či političtí zastupitelé snadno rozpoznají, zda autor předloženého záměru stezek rozumí svému řemeslu či nikoliv.

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SUSTAINABLE TOURISM IN WHITE CARPATHIANS PROTECTED LANDSCAPE AREA

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Abstract
Protected Landscape Area (PLA) Biele Karpaty The White Carpathians offer great natural potential which attract many domestic and foreign tourists. This region can become a valuable asset for sustainable tourism development. The purpose of the paper is to identify the types of sustainable tourism that can be carried out in the PLA. We will also define existing prevention and protection measures that reduce the risk of biodiversity degradation in the White Carpathians.

Key words: Biodiversity, CHKO Biele Karpaty, nature reserve (NR), national nature reserve (NNR), nature-based tourism, orchids.

Introduction
Over the recent years, demand for nature-based tourism has increased. More tourists are searching for meaningful travel experience including aspects as nature conservation and natural life, cultural authenticity, contact with local communities, information about local flora and fauna. All requests stated above are hidden in the treasure of the White Carpathians region. For the richness of natural phenomena, biodiversity and relatively well preserved conditions, the Carpathians were included among the most important ecoregions of the world which need to be protected, preserved and sustainable use in the future ensured (Kadlečík, 2016). Basic function of the PLA is protection of all merits of landscape, its feature and typical badges and nature resources.
Ecotourism is a sustainable form of natural resource-based tourism that focuses primarily on experiencing and learning about nature, and which is ethically managed to be low-impact, non-consumptive, and locally-oriented. It typically occurs in natural areas, and should contribute to the conservation or preservation of such areas. (Fennell, 1999: 43. *Ecotourism: An Introduction*).

Location and specification
The White Carpathians are a long mountain range situated at the frontier between the Slovak Republic and Morava; the landscape with valuable meadow biotopes, large woods, pastures, rich orchid grasslands and limestone edges. The highest peak of the White Carpathians is Veľká Javorina (970 meters).

Fig. 1: The Highest Peak of the White Carpathians Veľká Javorina Ⓒ L., Škvareninová

The PLA stretches on an area of 44 568 ha. In order to preserve its beautiful scenery, diverse species of flora and fauna, to enhance the demonstration parts of the impressive landscape of climatic, aquatic, soil and forest ratios, health-creative values, the White Carpathians PLA were proclaimed in 1979. They have the highest species diversity of orchids in Central Europe.

Fig. 2: Orchis/ neotinea tridentata, NR Beckovské Skalice Ⓒ L., Škvareninová

Butterfly Parnassius apollo Linnaeus is playing irreplaceable role in the ecosystems in the Slovak nature. His population is under the serious threat of an extinction, but the greatest number can be found in the NNR Vršatské Bradlá.

Fig. 3: Parnassius apollo Linnaeus, NNR Vršatské Bradlá. Ⓒ L., Škvareninová

Materials and methods

Our research methodology is based on secondary sources- statistic data collection, scientific document analysis, in-depth assessment. In order to achieve the following objectives, we combined the scientific documentation with direct observation conducted in the field; carried out with the support of the White Carpathians PLA Administration members. Administration of the PLA Biele Karpaty seats in Nemšová, Trenčín region.

Results

Soft forms of tourism in the PLA have a great potential for sustainable socio-economic development and conservation of natural and cultural activities. The main types of tourism activities are as follows:

1. Hiking- *Chmeľová (925m)*
2. Cycling routes- *Pruské- Krivoklát- Cottage Gilianka, Ilava- Červený Kameň via border to Morava*

3. Walking Trails- *1. Around Vršatec; 2. From Castle to Castle; 3. Through the Biely Vrch to Krivoklát*
4. Birdwatching – *Special Protection Area Dubnické Štrkovisko*
5. Butterfly-watching- *NNR Vršatské Bradlá*
6. Wild fruits and mushroom picking- *Forests of the White Carpathians*
7. Visiting ruins of medieval castles- *Vršatec Castle, Beckov Castle*
8. Fishing- *Váh river*

Visitors can enjoy variety of above mentioned activities, meanwhile they can build relationship with the nature and understand how to protect it. The role of White Carpathians PLA besides conservation measures is to provide an environmental education, operate information centers and to monitor all illegal actions that degrade flora and fauna in the territory. Educating the local tourists is the most effective way how to ensure long-term goals of sustainable tourism. The responsibility for the management of the PLA is attributed to central, regional or local government, NGO's, private sector or to local communities. Preserving the values of ecosystems in ecotourism destinations implies the need to constantly monitor the evolution of ecotourism and the associated impact in such destinations (Mateoc-Sîrb, N.; Albu, S. , et al., 2022). Managers and PLA planners play a key role in order to ensure that tourism does not possess any risks to biodiversity. PLA administration constantly and collectively tracks and monitors the state and development of biodiversity and natural values of the whole region. Nature conservation in Slovakia (the White Carpathians PLA respectively) is based on species and area protection, both of which are regulated by national (Act. No. 543/2002 on Nature and Landscape Protection, as amended) and EU legislation. The State Nature Conservancy of Slovak Republic is the central expert organization for nature and landscape conservation in Slovakia. The main tasks include work on legislation, policy, and guidelines documents as well as management of protected area, surveys and research provision and habitats monitoring.

Conclusion

The White Carpathians PLA plays an essential role in protecting biodiversity, ecological stability of the territory and other natural assets. In this paper, we have identified all possible types of sustainable tourism. The main goal is to sustain the balance between the nature conservation and biodiversity degradation. In order to avoid risks of nature degradation caused by tourism, the White Carpathians PLA administration also plays inevitable role to monitor tourist activities in the territory. However, cooperation of all, public and private bodies, is important with the aim to reduce environmental impacts, to address the needs of visitors and the host communities.
In the forthcoming future, the White Carpathians may become an attractive touristic destination, in particular for ecotourism, nature-based tourism and culture tourism. It is necessary to further develop research and monitoring oriented towards species, habitats and ecosystems management, biodiversity threats and various management measures applicability and effectiveness.

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Souhrn
Chráněná krajinná oblast Bílé Karpaty skrývá vzácné přírodní bohatství, které objevuje stále více domácích i zahraničních turistů. Cílem této práce bylo definovat možnosti dlouhodobě udržitelného cestovního ruchu, který zároveň zaručí ochranu vzácných druhů rostlin a živočichů. Důležitým faktorem pro dosažení rovnováhy mezi dopady cestovního ruchu a zásahy do původních struktur krajiny je pravidelný monitoring území, aby nedocházelo k porušování zákona č. 543/2002 Sb. o ochraně přírody a krajiny.

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SVITAVA RIVER IN BRNO - EVALUATION OF RECREATIONAL POTENTIAL

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Abstract
The article focuses on the Svitava River in Brno. The historical development of the floodplain is outlined. The article summarizes the changes around the river in the city cadastral area and their impact on recreation. The changes are evaluated for the last ten years. The flow is divided into 7 parts according to city districts, through which the river flows. In each of these parts, an evaluation of the recreational potential is realized according to the methodology by Jan Bína,2002. The article also includes the processing of planned changes in the river floodplain, including regional and flood protection plans.

Key words: Regional planning, river revitalization, urban area, urban recreation

Introduction
The Svitava River has been connected with the Brno city since the beginning. At first it was an opportunity for development, later it became a limiting factor for the expansion of urban areas. During the 19th century, several regulations took place, which irreversibly affected the river and its floodplain and the consequences of the interventions, which were mainly functional, are still visible in the river floodplain to this day. The flow regulated in this way is less useful in terms of involvement in the urban area and its recreational potential is reduced. In this article we will evaluate the individual parts of the river according to city districts and focus on the latest (and planned) changes in the floodplain that affect recreation.

Material and methods
The river Svitava springs near the village Kukle near the town Svitava at an altitude of 475 m above sea level. Its flow is 98 km long and the catchment area is 1146.9 km^2. In Brno, it flows into Svratka in the Přízřenice district. Several important streams flow into the river - Křetínka in Letovice, Úmoří and Bělá u Jabloňan, Býkovka in Rájec and Punkva in Blansko. It flows through several larger cities - Svitavy, Letovice, Doubravice nad Svitavou, Rájec-Jestřebí, Blansko and Brno. The river flows for the most part through a relatively narrow cut valley (CUZK, 2022). Svitava flows into the territory of Brno in Obřany (in the north) and in Přízřenice (in the south) it flows into Svratka. The Svitavy River in the city of Brno is 14 km long (CUZK, 2022). Svitava has an average flow (measured at the mouth) of 5.1 m^3/s (Čurda in Novák, 2000). It flows through 7 city districts - Obřany, Maloměřice, Brno-North (Cacovice, Husovice, Zábrdovice), Židenice, Černovice, Brno-South (Komárov, Horní Heršpice, Přízřenice), Tuřany (Holásky, Brněnské Ivanovice). There are several larger weirs in Svitava. Svitava was widely used for industrial production and leads to many drives (CUZK, 2022).
Svitava has always flowed through the industrial part of the city. It was a water source for the factories, but over time it became an obstacle to their development. Waterlogged floodplain was a limitation especially for the railway development, which would have to bridge numerous river branches (Hálová - Jahodová, 1975).
The first regulation was carried out in 1848. It took three years to dredge the river channel. The river in the south of Brno flows through a trapezoidal channel with steep walls and shallow depth. Due to low capacity during floods, water overflowed from the riverbed, the entire southern part of Svitava is also unnatural and its eventual return to its original state is de facto impossible. The second regulation wave took place after the Second World War and certainly had a much less devastating impact on the river floodplain (Dřímal, Peša, 1969).
The first examined section measures 6.9 km and belongs to the cadastral territory of Obřany, Maloměřice and Husovice districts. This is the most natural part of river in the city. The riverbed modifications here are minimal. The second part includes the area of the second regulation. It belongs to the Zábrdovice and Židenice districts. Svitava forms the boundary of the local part Trnitá in the length of 1.75 km; it shares this boundary with the already mentioned Židenice and Černovice. Trnitá is, however, part of the Brno-South municipal district, which uses the river as a border up to its confluence with the Svratka River. The total length of the river in this section is 3.2 km. The last part of the river belongs to the municipal district of Brno-South and is 2.4 km long. Before the regulation, the

flow here was only one-kilometre-long and this difference is due to the fact that the confluence was moved downstream during the regulation.
An evaluation of the recreational potential has been prepared for each of these sections, which is commented on in the results.

Results

The first part of the flow is in the most natural state. The river is wide with low banks and meanders. There are paths with benches in the river floodplain, access to water is possible. There are also playgrounds and several parks near the river. The area is suitable for many sports - hiking, running, cycling or even fishing. Paddlers also have the potential. The advantage is good transport links and access. However, the river can endanger buildings that are relatively close. The waterfront is currently being restored in the brownfield area New Zbrojovka in Zábrdovice. The riverbed will widen and both banks will have access to a new bridge.
The second river part is in a relatively natural state, but it is not the most suitable for recreation. Svitava is surrounded by an industrial area and although there is a bike path, the area around the river is unsuitable for walking. The obstacle is also two large roads that the visitor must overcome. In the case of Hladíkova Street, an underpass of a busy road bridge is created, which will make recreation much easier. In addition to passing cyclists, the locality is widely used by locals who walk their dogs here. To improve the area, it would definitely be appropriate to add benches, trees and waste bins, which would at least make the use of space more pleasant by local residents.
The last two parts of the river have common features. It is an upright segment along which a cycle path runs throughout. As in the previous part, it is necessary to overcome the busy multi-lane road. This segment is not very widely used, because the Svratka river flows very close, which has much better facilities for recreation. There is no access to water at all; the slopes are very steep and dangerous. Only in the last tens of meters closer to the confluence with Svratka is the surroundings of the river more natural.

Discussion

The problem is the long-term upright part of the river. This segment is not entirely suitable for recreation; in addition, it is a dangerous water management treatment with unsatisfactory capacity. Unfortunately it is not possible to solve this problem, because the land in the floodplain belongs to different owners and the change of the riverbed would be expensive. In industrial zones, the integration of the river into the overall environment is offered, but even here we come across various landowners and, above all, a non-existent local management plan. The integration of the river itself into the urban area is very desirable and will benefit not only the recreation but also the appearance of the place (Löw, 2003).

Conclusion

Recreation near the Svitava River in the Brno is run more by local citizens. Only a small part of the river's surroundings is so attractive that visitors can relax from a greater distance. The only exceptions are cyclists who use bike paths. Although some parts are currently undergoing reclamation, the most exposed section will unfortunately not be able to be adjusted to meet the requirements of modern times in the foreseeable future. The Svitava River will thus perhaps show its full potential to future generations

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Souhrn

Článek nastiňuje historický vývoj v záplavovém území řeky Svitavy. Zabývá se současným stavem a zaměřuje se zejména na rekreaci v záplavovém území. Zmiňuje probíhající změny a negativní vlivy, které ovlivňují rekreaci v území.

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TECHNICAL ELEMENTS IN SUBURBAN FORESTS USED FOR RECREATION

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Abstrakt
The aim of the paper is to present the possibilities of improving the recreational function of certain localities by designing suitable equipment and technical elements. On the one hand, the public can enjoy spending their free time in nature by locating certain facilities and designing routes. On the other hand, it is necessary to regulate the movement of visitors to avoid collisions with forestry or collisions between different groups or operators of different sports activities. The implementation and modification of rest areas, nature trails, information boards, restoration and maintenance of wells or monuments can make localities more attractive. These modifications can serve as a destination for short trips in locations where there are no interesting views, nice meadows, or other beautiful natural environments.
Earth screws can be used to anchor wooden structures and elements instead of concrete foundations.

Key words: nature trails, rest areas, wooden structures, Earth screws

Introduction
Suburban forests, as specified in the Forest Act (No. 289/1995 Coll., the Forest Act and on Amendments to Certain Acts), fall into the category of special purpose forests, which are forests where the public interest in improving and protecting the environment or other legitimate interest in fulfilling non-productive functions of the forest is superior to production functions. In most large cities, the recreational function predominates in suburban forests. People use this forest environment for physical and mental rest, for walking, relaxation or sport. In addition to the recreational function, these forests are assumed to have a bioclimatic function (mitigating wind speed or temperature extremes, increasing humidity, etc.) or a hygienic function (trapping dust, micro-organisms, noise, regenerating and ionising the air, etc.).
Health affects all areas of a person's life. It determines the integration of people in society, classifies or, on the contrary, excludes people from certain jobs. Disability, especially physical, mental or sensory disability, limits a person in his life (Buřvalová, 2007). Especially for the physically disabled, their condition does not allow them to perform some types of sports, but can be a complication in the actual transportation if the roads are not wheelchair accessible. Physical disabilities often prevent people from realizing even walking in the forest. In order to help people with disabilities to live independently and to participate in society, it is necessary to make not only buildings but also nature accessible and to allow free movement in them. Removing barriers will fulfil the right to freedom of movement. Barriers do not only affect disabled people, but a much wider range of people, namely older people with reduced mobility, people with prams and small children, or people temporarily disabled after an accident.

Materials and methods
For the creation of barrier-free routes and for the design of technical accompanying elements in the suburban forest, it is possible to rely on Decree No. 398/2009 Coll. (Decree on general technical requirements ensuring barrier-free use of buildings). The results of a project focused on the issue of identifying the necessary requirements and setting parameters for designing forest paths for wheelchair users in the Czech Republic, Poland and Slovakia (Fialová et al., 2015) were used in the preparation of this article.
Which technical elements should be proposed in suburban forests is clear from the results of the survey, which was the basis for the "Concept of the use of suburban forests of Brno" (Sekanina et al., 2011). People mostly look for wells, sitting areas with shelters or nature trails (see Figure 1), but with the main principle of quality routing through interesting nature and with quality marking of the route.

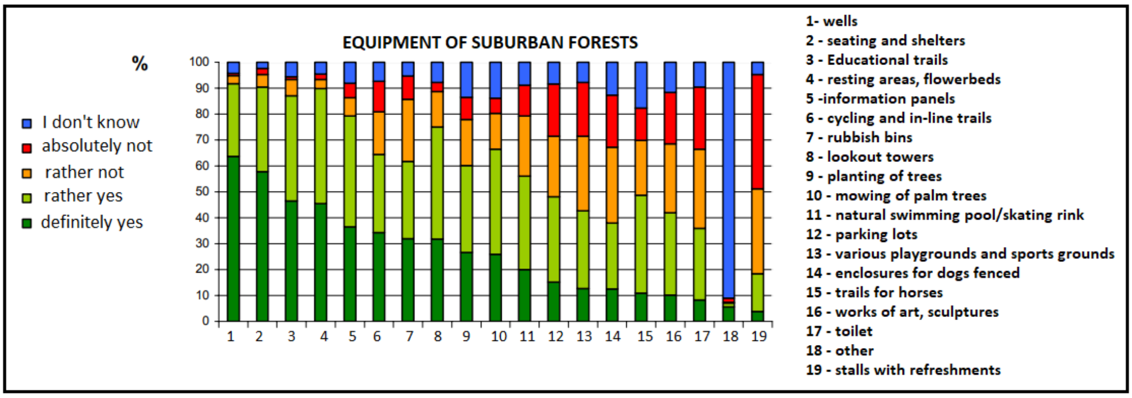

Fig. 1: Preference for suburban forest amenities (lesweb.brno.cz)

Forest paths will never be fully accessible, so information about "barrier" or "barrier-free" will need to be communicated to groups of people who have any mobility limitations. According to the methodology developed in cooperation with the Prague Wheelchair Organisation (POV) and adopted by the Ministry of Regional Development as a methodology for off-road routes, the Czech Tourist Club classifies routes for wheelchair users into three levels of difficulty. Accessible routes - blue are intended for less able wheelchair users, unaccompanied wheelchair users, handbikes and electric wheelchairs, where the routes must lead on paths with asphalt, concrete or natural paved surface, which does not get wet and muddy even in rainy weather, the terrain roughness should not exceed 20 mm. The gradient should have a slope of up to 2% or a maximum gradient of 8% for a section length of up to 9 metres. The cross slope is to be a maximum of 2 %. The road should be 1,8 m wide, short straight passages may be 1,0 m wide. Partially accessible routes - red are intended for able-bodied wheelchair users, wheelchair users with an escort, handbikes and electric wheelchairs, which must lead along paths with asphalt, concrete or even natural paved surface, which, however, does not get wet and muddy even in rainy weather, the terrain unevenness should not exceed 50 mm. The gradient should have a slope of max. 6 %, or max. 12 % for the length of the section up to 9 metres. The cross slope shall be a maximum of 2 %. Cross slope max. 2 %, or 4 % only in the case of a longitudinal slope of max. 2 %. Path width min. 1,2 m, short straight passages min. 0,9 m. Difficult to access routes - black routes are suitable for wheelchair users with an escort and all-terrain electric wheelchairs. Routes may also lead on natural surface paths, which may become slightly waterlogged or muddy in places in wet weather, the terrain roughness should not exceed 70 mm. Gradient up to 12%, or max. 20% for sections up to 9 m long. Cross slope max. 2 %, cross slope max. 6 % only in case of longitudinal slope max. 2 %. Path width in straight sections min. 1 m, in curves 1,2 m, short straight passages min. 0,8 m. (kct.cz/vozickarske-trasy)

Results

When walking in the forests, people will welcome natural attractions (rocks, springs, watercourses, fauna and flora) as well as man-made ones (small buildings and technical elements in the landscape). Characteristic features of a recreational forest are certain stand modifications (choice of tree species, stand structure, increase in clearing age, aesthetic treatment of stands), restrictions on certain economic activities (heavy mechanisation, application of pesticides, fertilisation) and recreational facilities. It is not desirable to build in the suburban forest buildings for recreational facilities of the type of hotels, guesthouses, cottages, kiosks, but only furnishings - small shelters, benches, tables, covered fireplaces, etc. Although the construction of lookout towers will also be a frequent destination for walks. Educational trails and quality paths can be used to direct the movement of visitors through the forest so that the quiet parts of the suburban forest with minimal traffic are also preserved.

When designing the technical elements, care must be taken to ensure the aesthetics and suitability of the materials used. Devices made of natural materials will be suitable not only from an aesthetic but also from an ecological point of view. Stone and wood are therefore the best materials, and wood is also the most natural. Most of the structures will be lightweight timber, but we can also use stone masonry, e.g. for the low walls forming the base of a bench, the retaining walls of a well, the lower part of a shelter, the lower part of a footbridge, etc.

The timber structure needs to be anchored while ensuring structural protection of the timber. The elements are most often anchored to concrete footings or stone walls. Anchoring by means of fittings is the most suitable way to avoid direct contact between the timber and the soil or foundation. It is least suitable to anchor timber elements directly to the concrete. An excellent alternative to the conventional types of anchoring of timber structures to concrete is ground screws, see Figure 2. The ground screw, when screwed into the ground, compacts and compresses the soil in its surroundings thanks to its cone-shaped body, thus creating a very solid foundation that can be immediately loaded thanks to the regular threaded surface on the screw body. Thanks to earth screws, any wooden element or structure can be fitted quickly, easily and without the use of concrete. Their main advantages are their easy installation but also their low price. The screws do not pollute the soil, and no unused concrete footing remains in the ground after the wooden structure has reached the end of its life, as the earth screw can be dismantled and can be reused elsewhere after dismantling. We minimize interference with the surrounding environment, almost completely eliminating land reclamation after the relocation of the structure. Also, in the case of the existing structure, the often unsightly foundation footings are not visible at the anchorage point, see Figure 3. The entire structure of the small building can then be prepared in the factory and assembled on site in a relatively short time. The site is thus not burdened by construction activity for a long time.


Fig. 2: Ground screw for anchoring wooden elements and Fig. 3: Inappropriate anchoring of wooden elements from an aesthetic and safety point of view

If we choose a roofing material for small buildings in a forest environment, it is again advisable to design a natural material. The most suitable natural roofing material is shingle roofing, see Figure 4. We can also design a roof made of plastered or unplastered boards (without removing the curve), where the boards can be laid parallel to the eaves or perpendicular to the eaves. Another natural covering that can be used is a thatched roof made of straw bundles. It can be implemented as plain or graded, depending on the way the bundles are tied. If there is no requirement for a natural material, asphalt shingles of a suitable shape and less distinctive colour can be used on the formwork, see Figure 5.

Fig. 4: Shingle roofing

Fig. 5: Asphalt shingle roofing

The wooden roof structure can also be used to cover the wells. The water intake is most often realized by a terrain cut or a water intake with a pre-set sedimentation tank. A wooden carpenter's canopy construction with the aforementioned natural coverings can then be installed on the stone base forming the spring water sump. For the masonry wall, it is advisable to use stone from the local area to ensure that the building blends in well with the terrain.

These pleasant resting places can be a problem for the disabled, especially those in wheelchairs, but also for families with pushchairs.

In some locations, particularly on flat terrain, there are only minor barriers that can be removed at little cost. This can create a "barrier-free" route, which can then be marked with tourist signs. In the field, the difficulty of the route according to the POV methodology is indicated by the colour of the wheelchair symbol in the signpost tip, see Figure 6.

Fig. 6: Directional sign indicating the route for wheelchair users - accessible route blue (kctkv.cz)

If the route is suitable for wheelchair users on the basis of the methodology mentioned above, it can be supplemented with educational panels of the necessary height to be legible for this group of people. Shelters for such routes should be spacious enough to allow wheelchair movement underneath. The minimum space for turning the trolley is a circle with a diameter of 1.5 m. If possible in the locality, we can also access wells where a certain height difference needs to be overcome, with a low-slope ramp and a staircase for other pedestrians.

Conclusion

If suburban forests have a mainly recreational function, it is possible to define human activities by appropriate placement of technical elements of visitor infrastructure. The majority of people then move mainly in the locations offered in this way. Such elements are information boards, but also boardwalks, bridges and footbridges over watercourses or benches, shelters, etc. It is advisable to design the technical elements in natural materials and to use earth screws for the installation of wooden posts.

However, there is also a need to focus on removing barriers that prevent a certain segment of people from visiting suburban forests. Accessible trails can also make the forest accessible to disabled visitors seeking short-term recreation close to home. There is an effort to design trails where wheelchair users can navigate independently. Specifically, this means identifying suitable forest trails and designing routes suitable for wheelchair users with firm surfaces and low elevations that allow safe passage for wheelchairs. When implementing rest areas, remember to allow sufficient space for wheelchairs to stop, as well as for pushchairs or information boards of the necessary height. Wheelchair routes are then marked with directional signs, which are placed especially at junctions to indicate the next direction of the route.

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Decree No. 398/2009 Coll., on general technical requirements ensuring the use of buildings by persons with reduced mobility and orientation

Souhrn

Pokud mají příměstské lesy funkci zejména rekreační, je možné vymezit lidské aktivity vhodným umístěním technických prvků návštěvnické infrastruktury. Většina lidí se pak pohybuje převážně v takto nabízených lokalitách. Takovými prvky jsou informační tabule, ale i povalové chodníky, mosty a lávky přes vodní toky nebo lavičky, přístřešky apod. Je vhodné technické prvky navrhovat z přírodních materiálů a pro osazení dřevěných sloupků využít zemní vruty.

Je však také potřeba zaměřit se na odstraňování bariér, které určitému segmentu lidí brání příměstské lesy navštěvovat. Díky bezbariérovým stezkám může být les přístupný i tělesně postiženým návštěvníkům, kteří vyhledávají krátkodobou rekreaci v blízkosti bydliště. Je snaha navrhnout takové trasy, kde by se mohl vozíčkář pohybovat samostatně. Konkrétně to znamená vytipování vhodných lesních cest i pro vozíčkáře s pevným povrchem a malým převýšením, které umožňují bezpečný

průjezd na invalidních vozících. Při realizaci odpočinkových ploch pamatujme na dostatečný prostor pro zastavení invalidního vozíku, ale i kočárku. Informační tabule na takových trasách musí být potřebné výšky.

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THE DEVELOPMENT OF GREEN AREAS IN THE COMMUNE OF ŁOMIANKI AND THE PROTECTION OF VALUABLE NATURAL AREAS

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Abstract

Łomianki belongs to the urban-rural communes of Warsaw suburbs in Poland. There are a number of forms of protection in the commune, including Natura 2000 areas (31% of the area) and the Kampinos National Park (15%). The importance of nature as the green infrastructure of urbanized space is increasing due to the progressive climate change. The green infrastructure of the commune provides a number of ecosystem services. These areas are threatened by urbanization pressure.

The subject of this study is to develop guidelines for improving the functioning of green areas in the commune of Łomianki. For this purpose, small-scale, field and social studies were carried out, including extensive analyzes of legal acts and local documents determining the development of the commune. A survey was carried out among the inhabitants of the commune, which contributed to learning about their opinions and needs in the field of greenery. The proposed solutions are to become the basis for the sustainable management of green areas by the local government unit and improve the quality of life of the inhabitants of the Łomianki commune.

Key words: anthropropression to nature protection areas, management and development of green areas, ecosystem services, green infrastructure

Introduction

Łomianki is an urban-rural commune located in the Mazovia Province, in the West Warsaw County. The area of the commune of Łomianki is about 39 km2, the number of inhabitants in 2021 is 27 957 people and each year it increases by 1-2% (GUS, 2021). The number of people per km2 increased to 716. In 2019 it was 701.[3] The commune covers the city of Łomianki with 14 estates and 9 villages.

The spatial and functional development of Łomianki is significantly influenced by its location. Łomianki belongs to the Warsaw Metropolitan Area, located 15 km from the center of the capital. The whole area of the commune is situated in the buffer zone of the Kampinos National Park and in the Vistula valley with its oxbow lake and 4 lakes. The Warsaw-Gdańsk transit route, road no. 7 (E-77), which is one of the important entrances to the capital, runs through Łomianki (SUiKZP, 2015).

There is a process of suburbanization in the commune, which may have a negative impact on naturally valuable areas, including forms of nature protection such as the forest complex - Kampinoski National Park (558ha) and the Vistula valley, with dominant willow and poplar riparian forests - constituting the Natura 2000 area (686ha) (Matuszkiewicz M., Kowalska A., 2009).

The commune with an area of 3880 ha has only 33 ha of landscaped green areas, including 10.79 ha of parks, lawns and squares in public space, 17 ha of greenery along roads, 5.2 ha of cemeteries and 1 ha of communal forests. It constitutes only 0.85% of the total area of the commune and is a serious problem in implementing the idea of its sustainable spatial and functional development, and in activities aimed at adaptation to climate change. The share of public parks, squares and recreational green areas in the commune is only 0.3%. The forms of nature protection and the Kampinos National Park cover 23.3% of the commune's area, which significantly improves the balance of natural areas.

The vast majority of green areas in the area in question are home gardens, within which species of ornamental trees and shrubs grow in various arrangements and density. Coniferous trees and shrubs are planted most willingly. Large trees dominate the oldest estates and villages of the commune - in Dąbrowa, Buraków and Łomianki Majowe. There is a lack of trees in the areas intended for development and in the newly emerging residential estates of single-family houses.

[3] source: https://www.lomianki.pl/pl/samorzad/zarzady-osiedli-i-rady/zarzady-osiedli

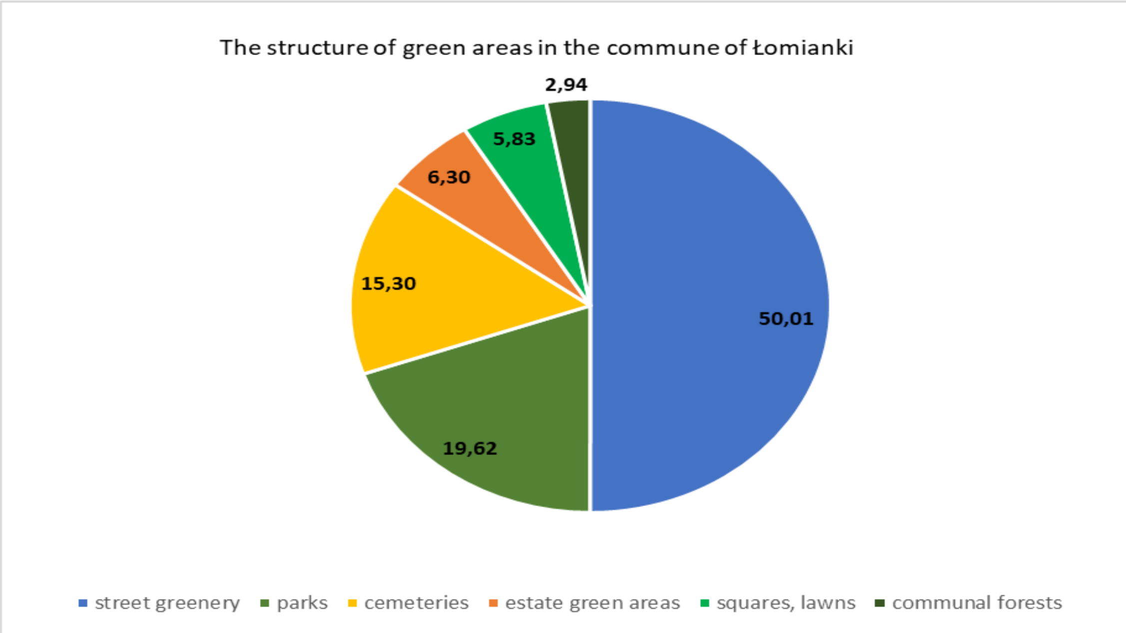

Fig. 1: The structure of green areas in the commune of Łomianki (own elaboration based on data from the Central Statistical Office of Poland)

The spatial policy of the Łomianki commune assumes intensive development of former agricultural lands and pastures in the Vistula valley. The presence of forest-water complexes covered by the form of nature protection and the dominance of single-family houses with gardens in the commune contribute to the commune's low involvement in the acquisition of new public green areas.
The aim of this article is to present the problems related to having a negligible amount of public green areas, especially wooded areas, which results in an increase in human pressure on areas covered by the form of nature protection. The result of the research is the development of a program for sustainable development of the commune, including guidelines for the standards of management of tree cover in the commune. One of the basic conditions for the sustainable development of a modern city is the presence of a developed and efficiently functioning system of green infrastructure (Borowski J. et. al,. 2018).

Material and methods

The study is based on field research carried out in 2021, where data on green areas and trees in the estates of the Łomianki commune were collected. The condition of green areas was assessed using a valuation scale, where 1- means bad, 2- average, and 3- good conservation of the greenery.
Factors such as plant condition, species composition, and the presence of invasive plants were taken into account. Spatial analyzes of green areas were also carried out on the basis of indirect data. Strategic documents of the commune and acts of local law were used to prepare the document.
The data compiled by the Central Statistical Office was used to compare the state of preservation of greenery in the commune of Łomianki and the way of managing trees over a period of 15 years (2005-2020). Spatial data, including a map of tree crown coverage, were used to assess the potential for afforestation in the urban and rural areas of the commune.

Results

Currently, there is 3.86 m2 of public green space per inhabitant of the commune, which is not conducive to building relationships and ties that shape the civil society. In the years 2005-2020, a slight increase in this indicator can be seen due to the construction of the Fabryczny park. From the value of 1.74 in 2015, this indicator increased to 4.08 in 2018, to decrease in subsequent years (4.0- in 2019; 3.93 in 2020 and 3.86 in 2021) due to the lack of new green areas with a constant increase in the number of inhabitants.
As part of the management of natural resources, the commune authority records tree losses and new plantings. In the period from 2015 to 2019, the balance of tree losses and plantings is slightly positive (the average is 1.12), so 12% more trees are planted than removed. In 2018, an exceptionally high number of plantings (830) and tree removal / cavities (642) were recorded. The comparison shows that the compensation of environmental losses is too low, close to the 1: 1 ratio, which means that one large tree removed from space is replaced with just one small and young specimen.

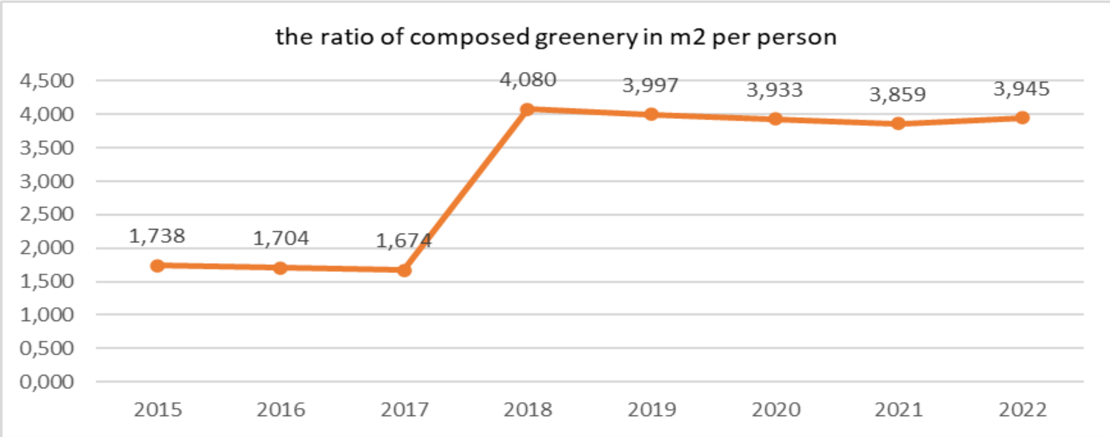

Fig. 2: Indicator of the green areas in m2 per one inhabitant of the Łomianki commune (own study based on GUS data).

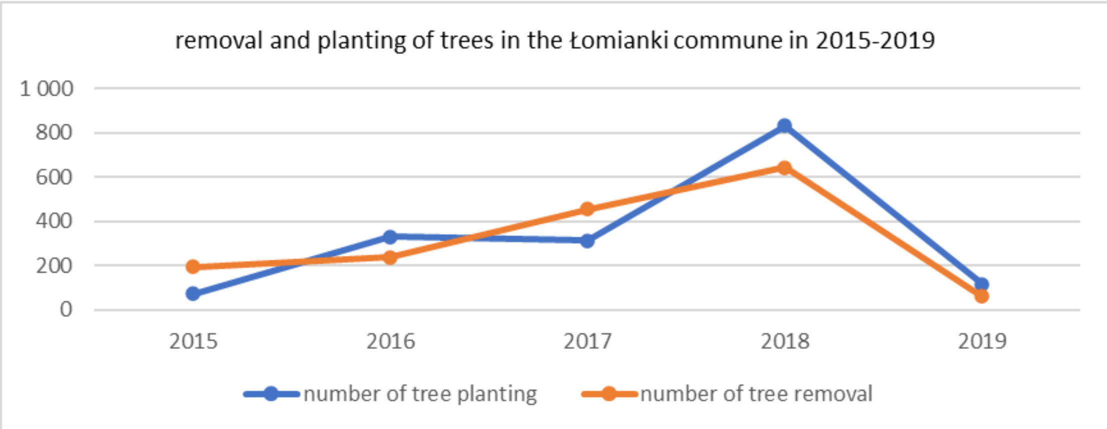

Fig. 3: Removal and planting of trees in the Łomianki commune in 2015-2019 (own elaboration based on GUS data)

Most of the land belongs to private owners (approx. 70%). Only about 4% of the land is owned by the commune. This limits the limited possibilities of land development and afforestation, and forces the commune to purchase land for investments aimed at improving the quality of life of the commune's inhabitants and improving the spatial order. Although the provisions of the Study of the Conditions and Directions of Spatial Development establish a relatively large share of the biologically active PBC area in most villages and settlements (> 50%), it should be clearly emphasized that this indicator does not allow to estimate ecosystem services. Trees provide the most ecosystem services in urbanized space. The study of the biologically active surface ratio is becoming insufficient today in the era of municipalities' adaptation to climate change.

On the basis of the map of tree crowns from 2012, the percentage share of tree cover in Mazowieckie communes was compared. Łomianki, with an average tree area of 15%, has a similar share of trees as Wołomin (14.90%), Kobyłka (16.50%), Halinów (16.10%), Chynów (14%), Tarczyn (14%) and Mszczonów (16.50%) and Warsaw (14.10%). The neighboring communes have a higher tree density factor.

The total tree crown coverage of individual housing estates and villages of Łomianki was analyzed, as well as the percentage of urbanized space after deducting the legally protected areas, such as Kampinoski National Park and Łęgi nad Wislańskie, which are protected by nature reserve and Natura 2000. The most developed urbanized areas are in the central zone of the commune. Łomianki Równoległa has a tree coverage lower than 0.01% of the area.

The minimum share of trees is visible in the areas of Łomianek Stare (2.93%), Łomianek Trylogia (3.06%) and Łomianek Powstańców (5.95%). Low coverage with tree crowns - less than 10% of the area - has Dziekanów Leśny (5.18%), Dziekanów Nowy (5.28%), Łomianki Chopina (7.71%), Łomianki Dolne (7.11%), Sadowa (8 , 17%) and Łomianki Górne (8.81%), Dziekanów Bajkowy (9.16%) and Łomianki Centralne (9.75%). Dąbrowa Zachodnia (51.19%) and Dąbrowa Leśna (36.68%) should be considered green. Łomianki Majowe has a level of 20.51% of land cover with trees. About 15% of the trees cover Dąbrowa Rajska, Kępa Kiełpińska and Dziekanów Polski.

Fig. 4: Covering with tree crowns in the commune (prepared by A. Lewińska, J. Jastrzębska based on mapakoron.com)

Figure 5 presents the ranking of administrative units of the Łomianki commune, from the least to the most wooded, with the separate areas under legal protection (ie KPN Forests and Reserves within the Vistula riparian forests and Natura 2000 Area.

In Dziekanów Leśny (71.05%) and Sadowa (68.57%), a large share of the tree cover is due to the presence of KPN forests within the boundaries of the villages. With the exception of these areas under legal protection, the percentage of tree cover drops drastically to 5.18 and 8.17% of the total area of the village council area, respectively. It should be noted that many trees are located in the private space of home gardens. For this reason, the spatial structure of the trees cannot be ensured. Especially in zones intended for intensive development (Łomianki Chopina and Łomianki Dolne), a further decrease in the share of trees in these spaces should be expected. The difference between the urban and rural part of the commune is presented below. The urbanized part of the city is twice as wooded as the village councils. The share of trees, excluding areas under protection, in the city of Łomianki is 25%, and in the rural area - only 10%. This is a serious problem, as the rural part is dominated by private spaces, on which the spatial policy of the commune has a limited influence.

Basing the natural potential of the commune almost exclusively on areas covered by the form of nature protection poses a significant threat to the environment. Increased anthropopressure and intensification of development in the buffer zone of these naturally valuable areas negatively affect the condition of plants, biodiversity and disturbs the functioning of these ecosystems. Invasive species appear in these areas, intensive use increases the risk of tree collapses and windbreaks, hence decisions are made to remove trees growing near trails and tourist infrastructure.

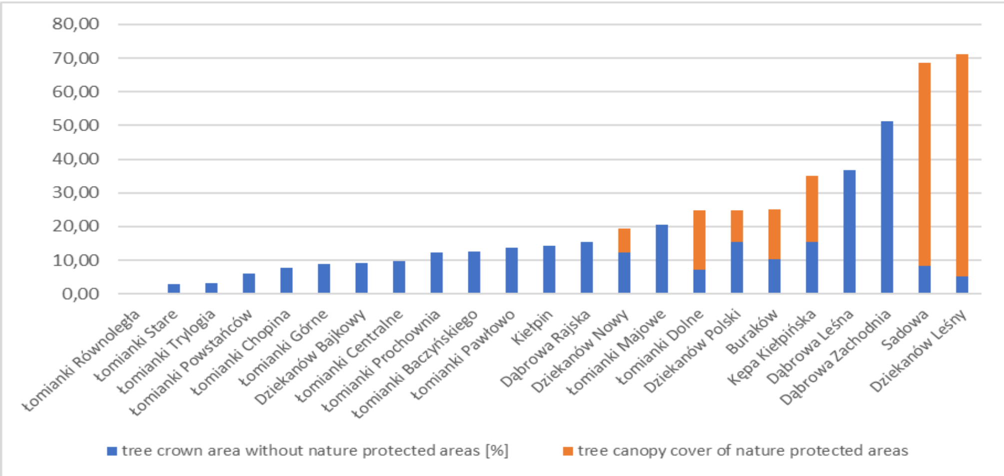

Fig. 5: Covering with tree crowns in the Łomianki commune (own study based on the map of tree crowns)

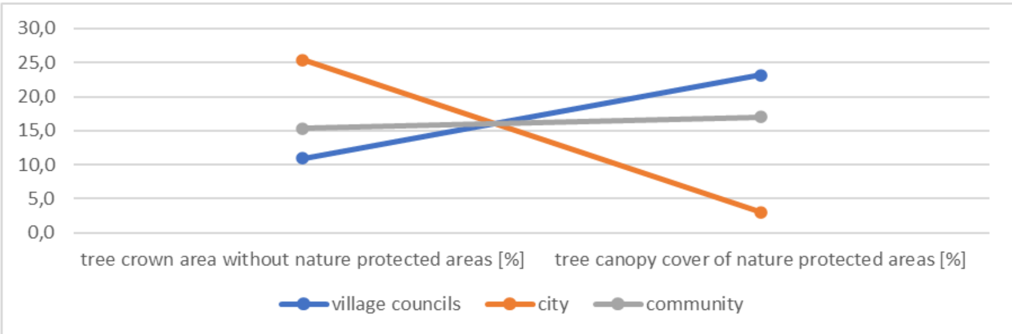

Fig. 6: Comparison of tree crown coverage in individual structures of the Łomianki commune, in village councils and in the city (own work based on the map of tree crowns)

Discussion and conclusion

The forms of nature protection, the meadows of the Natura 2000 area in the Vistula Valley and the Kampinos National Park cover 23.3% of the commune's area, which significantly improves the balance of natural areas. However, when considering the presence of trees as the most important components of green infrastructure, the commune compares average with other local government units in Mazovia. The tree crown coverage of the Łomianki commune is only 15.3%. Interestingly, the city of Łomianki is greener, with 25.4% of the area covered by trees, while in village councils the tree crown coverage is only 10.9% of the urbanized area. The situation of trees in the intensively developing Łomianki Dolne and Łomianki Chopina is bad and will worsen, because most of the trees in these administrative units grow on private plots, on the management of which the commune has a limited influence.
Rational management of natural resources, using the potential of trees to adapt to climate change is an important task of local government units today. The basis for sustainable tree management will be:

- developing standards and good practices for skilful design and shaping of trees in accordance with their requirements, the nature of the place, specificity and function, using the potential of greenery in adaptation to climate change;
- the use of tools and techniques to improve the monitoring and assessment of trees, allowing for the analysis of changes, their management or regression, which will contribute to increasing the knowledge about threats and harmful factors;
- conducting and developing the principles of proper care and protection of trees, reducing the risk of damaging trees;

- activation of the society to activities for the benefit of trees. Raising awareness of the role of trees and the low scale of risk associated with their presence. Preparation and development of a support system for residents (substantive and financial). Education of children and adolescents, incl. by allowing unhindered contact with nature;
- building a substantive and financial support system for administrators of trees and natural spaces. Raising professional qualifications, assistance in obtaining funds for pro-ecological activities;
- creating clear laws and regulations at the local level, developing procedures and presenting good practices;
- promoting and disseminating the system of insurance against civil liability for trees and against accidents / damage caused by trees;
- developing and searching for effective ways to minimize the risk.

Long-term management of trees covers the stage from tree planning, through shaping, maintenance, then risk-based assessment and, as a result, protection

The implementation of the plan should be monitored and verified. It is worth noting that despite the existence of risk from trees, it is important to remember about their protection, which is a legal obligation of every citizen.

For the commune of Łomianki, an important priority is both the sustainable development of green areas using their potential in shaping spatial order, biodiversity, improving the quality of air, water and soil, as well as the safety of residents and their property. The goal of the commune is to consciously use the ecosystem services provided by trees while taking care of the health, life and property of its inhabitants.

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Souhrn

Łomianki patří k městským a venkovským obcím na předměstí Varšavy v Polsku. V obci se nachází řada forem ochrany, včetně území Natura 2000 (31 % území) a Kampinoského národního parku (15 %). Význam přírody jako zelené infrastruktury urbanizovaného prostoru roste v důsledku postupující změny klimatu. Zelená infrastruktura obce poskytuje řadu ekosystémových služeb. Tyto plochy jsou ohroženy urbanizačním tlakem.

Předmětem této studie je vypracování pokynů pro zlepšení fungování zelených ploch v obci Łomianki. Za tímto účelem byly provedeny maloplošné, terénní a sociální studie, včetně rozsáhlých analýz právních aktů a místních dokumentů určujících rozvoj obce. Byl proveden průzkum mezi obyvateli obce, který přispěl k poznání jejich názorů a potřeb v oblasti zeleně. Navržená řešení se mají stát základem pro udržitelnou správu zeleně ze strany samosprávného celku a zlepšit kvalitu života obyvatel obce Łomianki.

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THE EROSION PROTECTION SEGMENTS ANS POSSIBILITIES OF THEIR ALTERNATIVE USE

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Abstract
The paper deals with the implementation of elements of anti-erosion protection, integration into the landscape and their production and non-production potential. There are given examples of the use of implemented elements for the restoration of historic landscape structures, the creation of valuable habitats and the subsequent environmental education or recreation for local residents.

Key words: Erosion, non-production potential, landscape structures, recreation

Introduction

Part of sustainable farming is the implementation of anti-erosion measures. These measures often complicate the current way of cultivating the land. The problem is also the provision of care for the implemented PEO and their possible subsequent use.
An eligible solution is the cooperation of farmers with landscaper., Particular elements of anti-erosion protection can be designed in a multifunctional form -like segments of territorial system ecological stability (TSES), extensive orchards, alleys and other landscaping structures. The paper shows the possible use of implemented elements of erosion protection in practice.

Material and methods

The protection of agricultural land against erosion is regulated by Decree 240/2021 Coll., related legal regulations and methodologies. The implementation of effective anti-erosion measures is generally hindered by property relations.
The paper presents a set of implemented anti-erosion measures, which were implemented by the ecologically managed agricultural company Javorník CZ, s..r.o., which manages 8 cadastral areas in the White Carpathians Protected Landscape Area. All measures were designed in accordance with the White Carpathians Protected Landscape Area Management Plan.
A different approach to anti-erosion protection was applied on land owned by the Town of Kroměříž, which gradually, in cooperation with the economic entity, is implementing a multifunctional area with significant recreational potential in a suburban area (locality Těšnovice) in the immediate vicinity of the protected area Obora.

Results

Two different projects are presented. Both are characterized by sequential long-term implementation.
<u>Sustainable management in the landscape of the White Carpathians</u>
Due to less favourable habitat conditions, the agricultural land in the White Carpathians was extensively farmed until the middle of the 20th century. This created a unique White Carpathian landscape with a richly structured landscape structure and high biodiversity. Collectivization drastically disrupted traditional farming methods and emptied the landscape (loss of biodiversity, clearing t
he plow, scaling up the landscape, elimination of historic landscape structures.
Society-wide changes in the 90s brought new opportunities for farming and significantly strengthened the interests of nature and landscape conservation.
The enlightened management of the agricultural company Javorník based in Štítná nd Vláří – Popov created a research team that used the practical experience of the agricultural entity, the professional methodological activities of the staff of the White Carpathians Protected Landscape Area Administration and the Agency for Agriculture and Rural Development in Zlín. Experts from Mendel University and the University of South Bohemia were also involved in the project. The public participated through community representatives. The coordination and technical side of the project were processed by the design studio Arvita P spol. s r.o. Within the framework of the Operational Program Environment, the 1st stage of the project (Sustainable management in the landscape of the White Carpathians) was implemented in the years 2013-2016. The measures were implemented on 79.7 ha, of which anti-erosion elements on 20.9 ha. Accompanying management measures affected 615 ha.
The 2nd stage of a similar scope is currently being implemented and the 3rd stage is being prepared for the coming grant period. The result of an environmentally friendly and rationally designed project is

a comprehensive restoration of a functional and beautiful agricultural landscape corresponding to the present time.

Community orchard – Cherry Field

Completely different is there second presented project situated in the highly productive landscape of Haná. The anti-erosion protection project implemented by the City of Kroměříž was initiated by the owner's need to efficiently and economically manage the property - agricultural land. Erosion-endangered land in an area of 6.5 ha was set aside in order to prevent further damage to the land and the lower settlement. It was agreed that the land would remain agricultural land. The target site is a community park with several other ecologically significant sites. The plantings are a sample collection of native woody plants and rapid colonization by small animals is also expected. The whole area will be implemented gradually in partial steps without any subsidies. Area is there crossed by a walking trail accompanied by cherries - hence the name Cherry Field. Successively harmonious landscape park will be created here, which will benefit from valuable distant views and show its visitors (observers) our common communities, whether meadow, wetland or forest, and at the same time become home to many animals. This solution will create an ecologically stable and biodiversity-rich habitat that will also have an anti-erosion function. The location remains (except for small segments) part of the productive agricultural land.

Discussion

The implementation of anti-erosion protection is a basic condition for sustainable landscape management. However, despite all efforts, implementation is very prolonged and difficult. Farmers lack sufficient positive motivation to implement erosion protection. It is quite certain that the establishment of permanent elements, such as borders, gaps, linear and scattered greenery, complicates land management and makes them more expensive for high fuel price.

The personal long-term experience of the designer shows the need for much greater education and communication with farmers. Better coordination of subsidies would also be beneficial - currently unmaintained field roads significantly contribute to the manifestations of water erosion. Frequent solution of erosion problems by simply grassing the site is not the optimal solution. Where holistic agriculture with crop and livestock production operates, a certain proportion of arable land is needed even in less-favored areas. Implementation of anti-erosion elements in the form of restoration of landscape structures (taking into account the needs of the farmer and the mechanization used) are certainly a good solution for everybody.

Conclusion

The landscape there is not only a space for agricultural production, but also a subject of public interest, because in addition to agricultural production, it plays an essential role for its natural, cultural and historical values. It is an integral and important part of the lives of the inhabitants, not exclusively for owners and producers.

An important part of both projects was the cooperation of all parties involved - from farmers to nature and landscape conservation workers, local authorities and other stakeholders. The main task of the designer here was to raise awareness of the project, to find a common language and to coordinate the diverse, occasionally and conflicting needs and interests of the parties involved. This was achieved mainly due to the very active approach of project investors and enlightened economic entities.

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THE IMPACT OF SHORT-TERM RECREATIONAL ACTIVITIES ON THE HABITAT OF FLOODPLAIN VEGETATION IN THE URBAN ENVIRONMENT

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Abstract

Forest vegetation is one of the main elements of the landscape image. These fragments form a landscape and have irreplaceable microclimatic and ecological functions in the landscape. Development and urbanization of natural localities in Petržalka accumulate many inhabitants in these parts of the natural floodplain forest ecosystem. This concentration of the population poses a danger to ecological stability, and biological balance and, in some cases, disrupts the ontogenesis of individuals. The environmental conditions and the structure of the forest are the most important individual factors necessary for the proper function of the ecosystem. As a result of frequent short-term recreational activities in exposed and marginal forest areas, mechanical damage to trees and herbs is also frequent. A direct example can be the destruction of greenery or damage to the environment, which can include stepping on sidewalks in addition to reserved areas or a form of alienation of young plants. In this paper, we focus on mapping the changes in morphogenesis and health status of woody plants caused by recreational activities.

Key words: fragmentation, floodplain forest, countryside

Introduction

The relationship between extra-urban, intra-urban, and anthropogenic activities has many aspects relevant for consideration. The landscape that surrounds us with all its elements is a consequence of the interaction of natural and human factors. Plant communities can adapt to the anthropogenic influences which they are exposed. Short-term tourism is also one of these impacts. In the lowlands of Slovakia, the most common type of short-term tourism is hiking and cycling. The basis of hiking and cycling lies in the activities that accompany movement in the natural environment with a purpose. (Matlovičová, 2015) By appropriate management of the human activity, we can preserve and develop the natural elements of the landscape and thus prevent their devastation. (Plesník, 2010)

Material and methods

In the research process, we used standard methodological procedures developed on a survey of currently available sources of information and a field survey. First, we had to determine the site to evaluate the interest area. The area of interest was selected using various map materials, e.g., military mapping, orthophoto maps, and vector maps of the current state of the area. According to predetermined criteria, was the selection of research areas possible, the monitoring areas had to contain fragments of floodplain forests and anthropogenic activity to happen.

The location of the monitoring area in the field was using the Handheld Nautiz X6 device and the MAPUJ application. During the terrain research, we directly recorded the attributes of individual polygons and points.

To evaluate the current state of tree species in the model area, we used the methodology of the Arboricultural standard from 2019. In the field, we evaluated the health of the trees based on Arboricurtural standards. The health status of the tree is assessed based on a summary analysis and a concurrence of several phenomena affecting the integrity of the individual:

- mechanical damage,
- infestation by wood-destroying fungi, xylophagous insects,
- the presence of coarse dry branches,
- the presence of cavities and exits,
- the presence of defective and damaged branches
- other damages caused by human activity (Arboricultural Standard, 2019)

Further data processing took place in the QGIS free-and-open-source (FOSS) geographical information system (GIS).

Results

The solved area is located directly near the residential complex Slnečnice on the merge of Petržalka. Inhabitants use this fragment of the forest as a communication channel to reach the main course of the Danube. Activities performed in this location mainly affect the plant floor and partially the shrub floor. (Heinrichová, Reháčková, 2013) The woody plants on the solved polygon were most vital, there were many outcrops on the plant floor. The age of the tree growth averaged around 30 years (28.4 years).

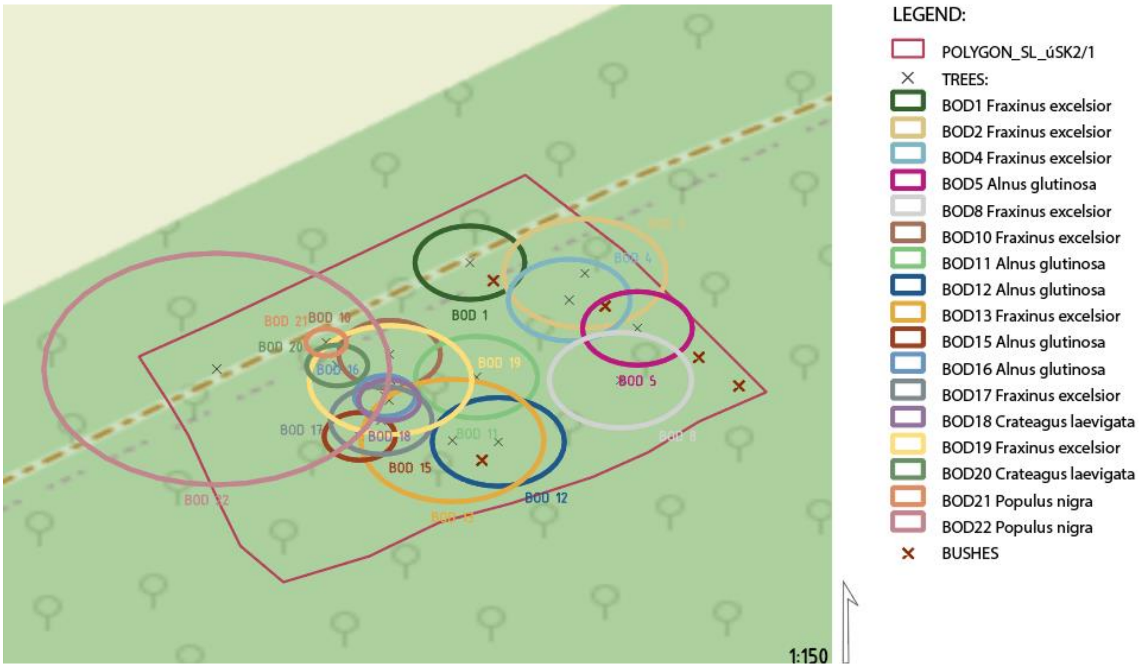

Fig. 1: inventory area at a scale of 1: 150

Populus nigra, whose age is a calculation, deviates from this average in age intended for approximately 141 years.

Tab. 1: percentage of tree species in the locality

Name	count	Percentage
Fraxinus excelsior	8	36.4
Alnus glutinosa	8	36.4
Crateagus laevigata	3	13.6
Sambucus nigra	2	9.1
Populus nigra	1	4.5

The species representation of trees according to Viceníková 2003, recalls the species composition of floodplain willow-poplar and alder forests. These habitats occur in the vicinity of large rivers and are linked to their aquatic regime. (Viceníková a Polak, 2003) There was no visible damage to the stoma stump due to frost or human activity. Human activity affects the floodplain community overall. Disturbed forest areas are exposed to invasive plant species, which were present near the interest polygon. The Forest community with its tree population creates phytoclimate overal. (Rožnovský, Litschmann, (ed) 2003) The crossings open access to adverse weather conditions, and disturbing biological processes (tree growth, rejuvenation), and the forest is rapidly receding. As a result, is the rapid outflow of rainwater, reducing groundwater status. In the area was recorded direct damage to the natural environment, namely footpaths and damage to the assimilative parts of plants. By damaging the assimilative parts of invasive species, their reproduction also occurs, which affects the diversity of floodplain forests.

Fig. 2: images of damage found at the site

Discussion

Floodplain forest habitats in the urban environment of Bratislava are under pressure and stress increases caused by anthropogenic factors. The development and urbanization in Petržalka represent a violation of ecological stability and biological balance. These led significantly contributed to the fragmentation of the remains of Bratislava floodplain habitats in the studied area. A forest is a complex of biotic and abiotic elements defined by time and space. At the same time, it is the societies of many organisms that implement, and interact with each other, and their complex interactions affect the ecosystem. (Hutárova, 2011) Floodplain forests are azonal forest communities located along the longitudinal, regularly, and irregularly water and flood regime. These bioclimatic conditions conditioned the development of organisms that adapt to waterlogging. Habitats of floodplain stands have been associated with periodic water fluctuations. By disrupting the water regime of the Danube, the conditions for the growth of floodplain forests have changed. (Viceníková a Polak, 2003)

Conclusion

Based on an overview of the topic, the work succeeded in examining the relationships between habitats and external anthropogenic influences on the current state of floodplain vegetation. In this case, tourism affects the plant floor and the spreading of invasive plants. By unintentionally damaging and assimilating parts of plants, they inadvertently help their spread. Participants in individual types of tourism work on ecological balance very differentiated. The collection of plant material and young plants is also a problem. These deficiencies can be remedied by proper management. Negative phenomena can be minimized by designing a physical barrier and introducing periodic inspections and removal of invasive plant species. (Hutárová, 2011)

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Souhrn
Terénním výzkumem jsme ověřili současný stav a druhové složení fragmentu lužního porostu v blízkosti městské části Petržalka. Složení rostlin poukazuje na nepřímé zásahy antropogenních faktorů do struktury studovaného biotopu. Pro zachování těchto biotopů je nutné správně nastavit management dané lokality a minimalizovat antropogenní zásahy do rostlinného patra. Flóra lužních lesů se mění a je závislá na mnoha rušivých faktorech, jejichž eliminací se do popředí dostávají druhy, které nejsou součástí lužních společenstev.

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THE IMPACT OF THE COVID-19 EPIDEMIC ON THE NUMBER OF VISITORS IN SELECTED PROTECTED AREAS IN THE CZECH REPUBLIC

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Abstract
Visitor monitoring has been taking place in many protected areas of the Czech Republic for many years. This provides nature conservationists with knowledge about the impact of visitors on the objects of protection of these areas. The 2020 COVID-19 epidemic and related government measures disrupted current long-term attendance trends in many localities. Based on several case studies, the text illustrates how the epidemic and the measures taken specifically affected the number of visitors to Czech protected areas.

Key words: Visitor counting, protected areas, COVID-19 epidemic

Introduction
The COVID-19 epidemic has started to resonate in Czech public space in March 2020 when the first cases of infection appeared in the country. A significant part of "coronavirus measures" included various restrictions of moving in public. These included both individual restrictions and quarantines of infected or potentially infected individuals, as well as mass lockdowns on nation level with different intensities (e.g. curfews, limitations in travelling between districts or abroad, etc.). This exceptional situation has had an impact on a wide range of human activities and sectors in 2020 and partly also in 2021. Similar impacts have occurred in the area of outdoor recreation in protected areas. Therefore, due to the COVID-19 epidemic it was possible to observe significant changes in long-term trends in attendance based on visitor monitoring data.

Methods of visitor monitoring in protected areas of the Czech Republic
Continuous visitor monitoring has been carried out for many years in selected protected areas of the Czech Republic by usage of automatic counting devices. Data from this monitoring contain information on the number of visitors per hour at monitored site (Zahradník et al., 2012, Zahradník et Banaš, 2016, Zahradník et al., 2017).
Obtained tourist attendance data from protected areas are subsequently used in monitoring the natural environment in relation to tourism and in protected area management (Švajda et al., 2015; Popelka et al., 2016, Zahradník et al., 2018, Banaš et al., 2020).
In 2020 and 2021 during the COVID-19 epidemic the Nature Conservation Agency of the Czech Republic (NCA CR) operated up to 79 attendance counting devices in 17 protected landscape areas (PLA). The results of visitor monitoring presented below are from sites where significant change in external conditions that could potentially affect number of visitors at these sites (besides the COVID-19 epidemics) has not been recorded in 2019-2021.

The onset of the COVID-19 epidemic and its impact on attendance in the Křivoklátsko PLA
The Křivoklátsko PLA is located at a convenient distance for a day trip from the capital city of Prague. Many residents of the capital, same as inhabitants of Central Bohemian Region, own holiday cottages in the Křivoklátsko PLA. The case of Křivoklátsko PLA could be sample example of the significant impact of the COVID-19 epidemic on attendance in protected area. Tourist attendance is monitored at 8 sites in long-term period. Four counting devices are installed at official hiking trails, four at unofficial paths. The average year-on-year change in number of visitors of all monitored sites in 2016 compared to the previous year (2015) was +5.1%. In 2017, the change was -6.1% compared to 2016. In 2018 the year-on-year change increase to +0.1% and in 2019 the value was +0.9%. During the epidemic period in 2020, the number of visitors raised up compared to 2019 on average by 60.7%. This leap represents an unprecedented change in the development of the trend in tourist attendance over the

last five years. The development of attendance at the Křivoklátsko PLA, i.e. totals of number of visitors from each site over the last five years, is illustrated in Figure 1.

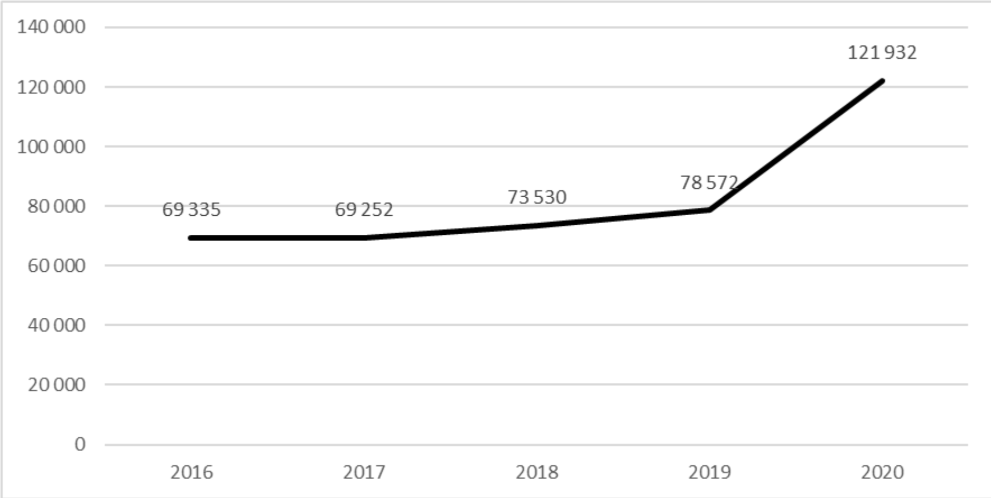

Fig. 11: Attendance at the Křivoklátsko PLA (absolute number of visitors from monitoring sites) in 2016–2020.

Focused on monthly visitors numbers at the Křivoklátsko PLA in 2020, data shows that the largest increase in attendance compared to the long-term average occurred in March (+95.2%), April (+164.6%), May (+112.1%), November (+222.4%) and December (+108.9%). Tourist attendance in March, April and May 2020 was influenced by the onset and duration of the so-called first wave of the epidemic and the first lockdowns. Data for November 2020 demonstrate the beginning of the second autumn wave of the COVID-19 epidemic which comes after summer attenuation of epidemic and which persisted till 2021. As different months have different effects on the overall change in attendance (a larger change in attendance during a low-attendance month may have less weight than a smaller change during a high-attendance month), Figure 2 also illustrates the percentage contribution of each month to the overall change in average attendance in 2020. This shows that the real increase in the number of visitors to the Křivoklátsko PLA during the epidemic in 2020 was primarily caused by higher attendance in April and May. With a bit of exaggeration it could be said, that many people from Prague fled from the overcrowded metropolis to the Křivoklátsko region, seeking for calm at their cottages or on one-day trips. On the other hand, during the fading of the spring wave of the epidemic (June 2020), the recorded attendance at monitoring sites declined compared to the long-term average.

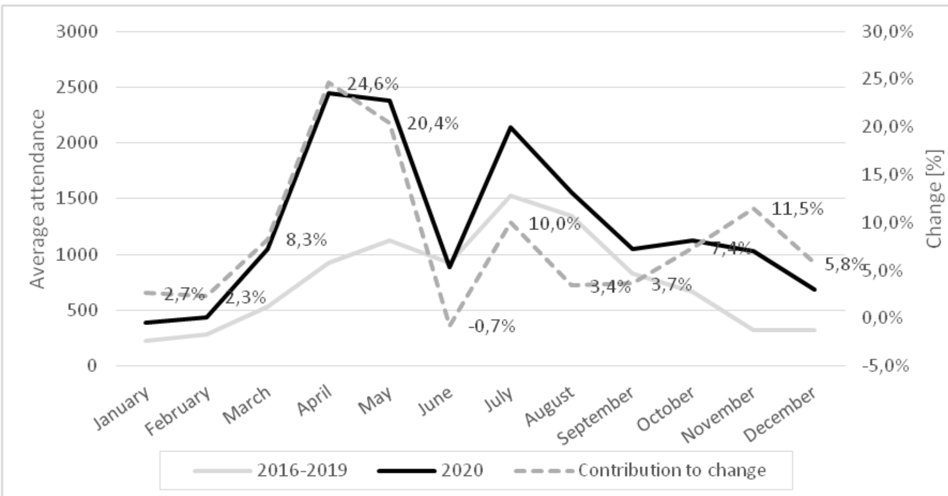

Fig. 2: Comparison of the average attendance of monitored sites at the Křivoklátsko PLA until 2019 and in 2020.

Impact of COVID-19 epidemic on tourist attendance at the Jeseníky PLA

The automatic visitor monitoring at the Jeseníky PLA has been carried out since 2009. Together with the Beskydy PLA, these areas have the longest data series of visitor monitoring. Monitoring of attendance in the Jeseníky PLA was performed at 11 long-term monitored sites until the end of the 2021. At all of them the historical seasonal maximum in number of visitors was recorded during the epidemic period (i.e. 2020 or 2021). The average attendance at the long-term monitored sites in the Jeseníky PLA was 25.3% higher in 2020 than the average tourist attendance in 2016-2019. Compared to the Křivoklátsko PLA where the increase of number of visitors was mainly influenced by stronger attendance during the spring wave of the epidemic, in the Jeseníky PLA the average attendance during the spring wave was lower than in the 2016-2019. The increase of attendance during the summer months in the Jeseníky Mountains, especially July (see Figure 3), were the highest in the annual overview. This led to overcrowding the Jeseníky PLA during the summer months according to experts from the NCA CR.

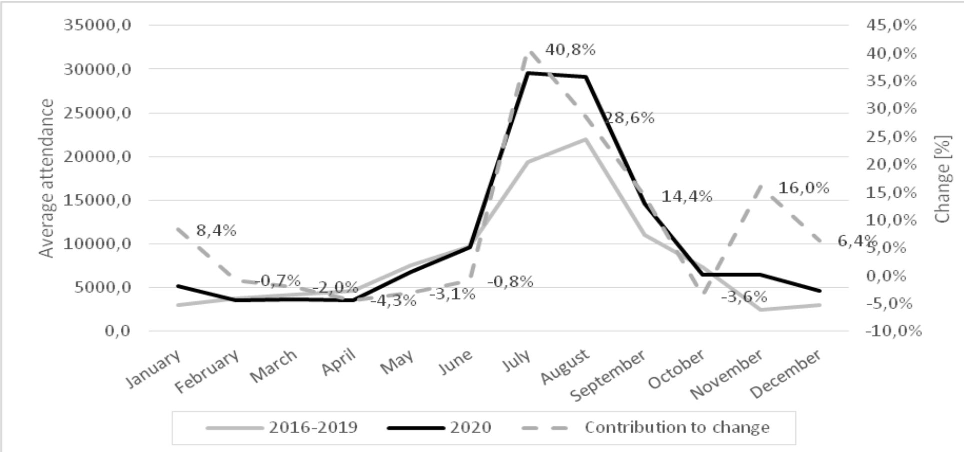

Fig. 12: Comparison of the average attendance of monitored sites at the Jeseníky PLA until 2019 and in 2020.

The difference in attendance between Křivoklátsko PLA and Jeseníky PLA is potentially caused by different type of visitors in each PLA. A significant part of Jeseníky PLA's visitors during the first wave of epidemic were so-called winter visitors (skiers, cross-country skiers, ski mountaineers, etc.). However, all services and visitor facilities were closed during the first wave of the epidemic in the Czech mountains as part of government measures to prevent the spread of the COVID-19. Therefore, the average number of visitors to the Jeseníky Mountains was lower than the average in 2016-2019 during the spring wave of the epidemic, compared to the Křivoklátsko PLA. As the global COVID-19 epidemic situation has made travelling abroad difficult, many people have decided to spend the summer holidays in the country. From this perspective of view, the Jeseníky PLA disposes of very good conditions for individual day trips same as a number of tourist attractions, a dense tourist infrastructure and a good accessibility from the regional cities of Olomouc (100 000 inhabitants) and Ostrava (300 000 inhabitants). The territory of the Jeseníky PLA, same as other Czech mountains, provided during the epidemic a relatively easily accessible alternative destination of summer holidays for a part of the public, who would normally spend it abroad.

The Třeboňsko PLA as an example of negative impact of COVID-19 epidemic on tourist attendance

The visitor monitoring data from the Třeboňsko PLA are less robust than attendance data of the previous demonstration PLAs. The long-term visitor monitoring is taking place at a single site - the Lužnická cycle route in the national nature reserve Stará a Nová řeka. There are also data from four other counting devices which have been continuously monitoring attendance since 2018. The data from long-term visitor monitoring shows a continuous upward trend in attendance during the period 2015-2019. However, during the 2020 epidemic, the attendance at this site has dropped year-on-year (by 22.2%). same as at three others monitored sites. The attendance at the monitored sites in the Třeboňsko PLA has decreased of 8.7% between 2019 and 2020.

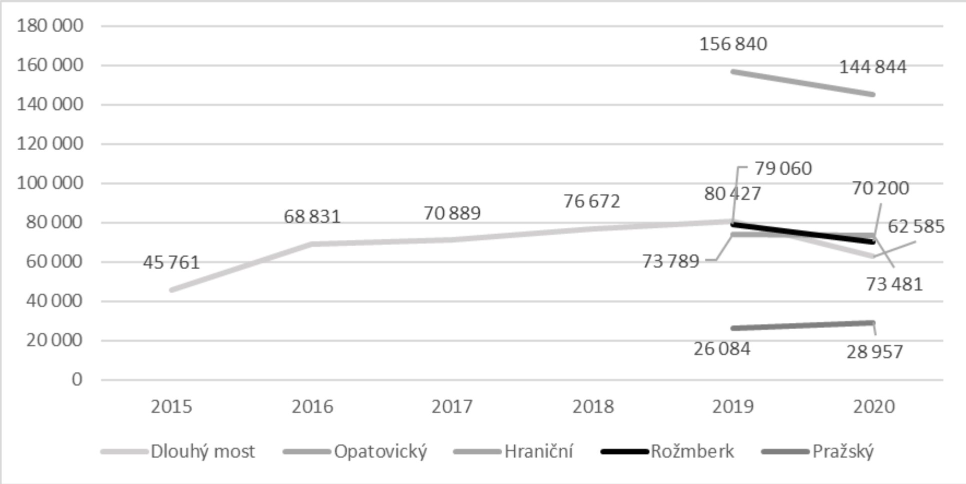

Fig. 4: Development of attendance at the Třeboňsko PLA.

Despite the limited range of dataset from this area, it is important to point out the reverse in the long-term trend of increasing attendance at the reference site which has occurred also at other sites with shorter-term monitoring period. During the COVID-19 epidemic in 2020 has been observed decline in number of visitors to monitored sites, which is related to the decline of attendance in the whole Třeboňsko PLA. The changes in trends in numbers of visitors reflect the local characteristics of attendance in this PLA. Significant proportion of visitors to Třeboňsko PLA is represented by bicycle riders, who usually come to the region from various parts of the Czech Republic for a multi-day cycling holiday. However, according the government measures during the 2020 epidemic a significant part of accommodation services was closed. On this base it could be assumed that at the PLAs which attendance consists of multiple-days visitors, such as the Třeboňsko PLA, has showed decline in the number of visitors during the 2020 COVID-19 epidemic compared to the normal situation before.

Conclusion

At number of the monitored sites, a significant reversal of the previous long-term trends in tourist attendance has been occurred in 2020 and 2021. There is no doubt that the tourist attendance in protected areas of the Czech Republic reacted to the COVID-19 epidemic and related measures in 2020 and to a certain extent in 2021. In many of the monitored sites, a reversal of the previous long-term trends in visitor numbers occurred in 2020 and 2021. It is therefore obvious that only further years will reveal weather this fluctuation in numbers of visitors driven by the COVID-19 epidemic situation was only temporary deviation which reacted to government measures. The specific situation caused by the COVID-19 epidemic could possibly pose a trigger for a new trend of development of local tourism and for continuous increased tourist load in certain Czech protected areas.

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Souhrn
Předkládaný text ilustruje na vybraných příkladech vliv epidemie COVID-19 na návštěvnost českých chráněných území. Z dat automatického monitoringu návštěvnosti vyplývá, že návštěvnost většiny CHKO v České republice se v roce 2020, který byl koronavirovou epidemií zásadně poznamenán, více či méně odchylovala od dosavadních vývojových trendů. Konkrétní projev epidemie a na ní navázaných opatření však nebyl v jednotlivých chráněných územích totožný. Zatímco v některých CHKO došlo vlivem epidemie k navýšení návštěvnosti (např. CHKO Křivoklátsko, CHKO Jeseníky), jinde oproti předchozím letům návštěvníků ubylo (např. CHKO Třeboňsko). Tato skutečnost je způsobena tím, že návštěvnost v řadě území je utvářena místními specifiky. Navíc jednotlivá epidemiologická restriktivní opatření vyvolávají u veřejnosti různé hromadné efekty. Omezení ubytovacích služeb vede k poklesu návštěvnosti v územích, kde převažují vícedenní turisté, a naopak generuje zvýšenou návštěvnost v územích s velkou četností časově snadno dostupných významných turistických atraktivit.

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THE IMPLEMENTATION OF A GIS AS AN EFFECTIVE TOOL FOR THE VALORIZATION OF TYPICAL FOOD PRODUCTS FROM MARGINAL AREAS

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Abstract

The economy of marginal areas is frequently compromised by the inadequacy of the transport system, lack of co-operation between farms, and insufficient distribution of their typical products, whose valorization may be an important factor for exploiting rural tourism. In those areas, the problem that more frequently arises is the difficulty in planning land development, due to the lacking or poor knowledge and classification of every information, together with the inadequate capability to get new information and to simultaneously analyze several different data. In this paper, a GIS method has been employed for an application in land use planning with reference to an internal area of Basilicata Region (Southern Italy), well known for its typical food products (sheep and goat cheese). This GIS has been implemented, so as to match information of geographical level (terrain height, gradient, slope orientation, soil utilization, structures and infra-structures, *etc.*) with pasture characteristics (pasture aromatic herbs, grass percent coverage, nutritional values, *etc*.). It has revealed a very useful tool, allowing to individuate new areas that may be devoted to pasture, with the best characteristic and highest potential performance, able to contribute for an increase of quantity and a standardization of quality in production of “*Pecorino”* cheese.

Key words: Internal areas; Built heritage; Traditional foods; Rural tourism; Landscape protection.

Introduction

Sheep and goat breeding occupies an important place in animal husbandry conducted in internal areas, not only because of the economic weight of its production, but also because of the social aspects connected with this activity (Picuno C.A. et al., 2017; Statuto & Picuno, 2017; Picuno C. et al., 2020). Products derived from sheep and goat milk have very different characteristics, often original, whose diversity is closely linked to the peculiarities of the breeding areas and production techniques, often connected to ancient and consolidated traditions. In some Italian internal regions, most of farms are located in mountainous areas (Statuto et al., 2017; Picuno C. et al., 2019), which further accentuates marketing problems, while at the same time it highlights the different characteristics of the production area. The present paper aims, through a GIS approach, at the identification of the main characteristics of the pasture sites used by sheep and goat farms producing “*Pecorino*” cheese, within a study area delimited on the basis of homogeneity characteristics of this cheese production (Statuto et al., 2013).

Material and methods

The study area, located in Basilicata Region (Southern Italy - figure 1), comprises 31 municipalities, which are currently included in the specification for the production of *'Pecorino di Filiano*' cheese.

In this area, agriculture has always been one of the main livelihood factors for the resident population (Statuto et al., 2019). Aim of the present work has been to inventory, integrate and correlate, by means of spatial superimposition, all the information useful for the creation of a decision support system. This result was obtained by dividing the operations into the following phases:

A) identification and filing of the following basic information layers:

- administrative limits;
- inhabited centres;
- road network;
- hydrological data;
- geo-lithological data;
- altimetric data;
- vegetation data;
- thermo-pluviometric data;
- sheep and goat farm locations.

B) inventory and update all information useful for the creation of the relevant data-base (Table 1).

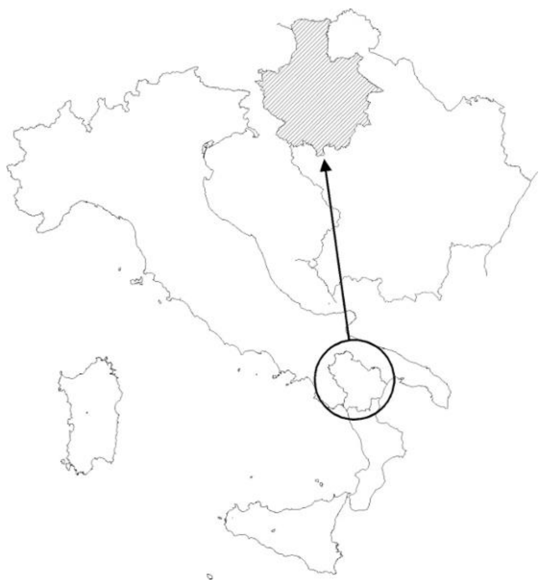

Fig.1: Basilicata Region and study area (in grey color).

Tab. 1: Homogenization and integration of the basic information layers

LAYER	QUALITY
Elevation belts (DEM - Digital Elevation Model)	MORPHOLOGICAL
Slope	
Exposure	
Permeability	CLIMATIC
Temperature-rainfall	
Phyto-climatic belts	
Land use	VEGETATIONAL
Map of areas currently used for grazing	
Farm buildings distribution	ANIMAL HUSBANDRY

In order to evaluate the productive potential of the pastures used by the flocks in this area, a specific Geographical Information System has been implemented. Once the archiving, homogenization and integration of the data has been completed, the layers have been set up, through appropriate processing, then grouped into distinct "quality" classes, which proved particularly useful in subsequent resampling operations. After the first processing, the data were re-sampled, attributing a different degree of importance (operation of "*weighing*" the information layers) both to each class of the single theme and to the different thematic levels obtained, in order to characterize the areas with greater production potential. In order to assign the weights, the influence of the single factors was first identified, and then the weights were assigned to the different information levels and quantified according to the estimated forage productivity. After resampling, the themes were processed using multiplicative algorithms. The result of the simultaneous processing of the information levels is a summary map called the “Grazing Potential Map” (Figure 2).

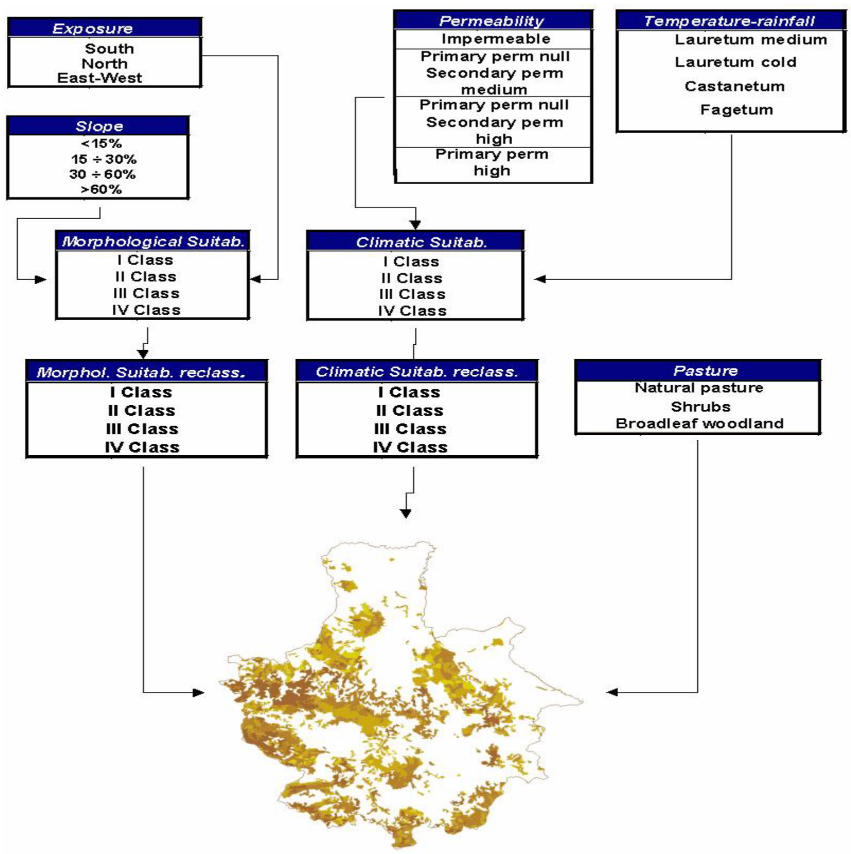

Fig. 2: Grazing potential map

Then, considering that the characteristics of greater or lesser value of pastures can be identified through agronomic and nutritional parameters, some of these parameters were measured on a sample of farms in the study area. These data, concerning both sheep and goat farms, as well as the pastures they use, were grouped in five classes (Table 2) in order to show the relationship between the types of supplements and the classes of grazing potential, making them comparable with the previous elaborations, so as to be superimposed on the grazing potential map.

Tab. 2: Pasture classes, grouped depending on supplied food supplements

	V CLASS	IV CLASS	III CLASS	II CLASS	I CLASS	TOT
Oat	6	6	0	5	0	17
Oat, barley, maize, broad beans	7	3	1	1	1	13
Oat, barley	4	1	1	3	3	12
Barley, maize, broad bean	0	4	0	3	0	7
Oat, barley, broad bean	0	2	1	0	0	3
Maize, barley	1	2	0	0	0	3
No food supplement	1	2	0	0	0	3
Oat, maize	0	0	0	2	0	2
Oat, maize, barley	1	0	0	1	0	2
Barley	2	0	0	0	0	2
TOT	22	20	3	15	4	**64**

Results

A first verification of the reliability of the new information level obtained was carried out by overlaying the location of the sheep and goat farms on the grazing potential map reported in figure 2. This overlay operation highlighted how, while the greatest number of small farms falls in areas belonging to lower grazing potential classes, farms with a greater number of animals are located in portions of the territory identified by a higher value of grazing potential (fig. 3/a).

Then, the "propensity to graze" of the areas used for cereal production has been finally assessed by superimposing the agronomic and nutritional parameters (tab. 2) on the grazing potential map (fig. 2).

This, allowed to highlight the classes of potential, proving that most of the area shows a strong vocation for grazing (fig. 3/b).

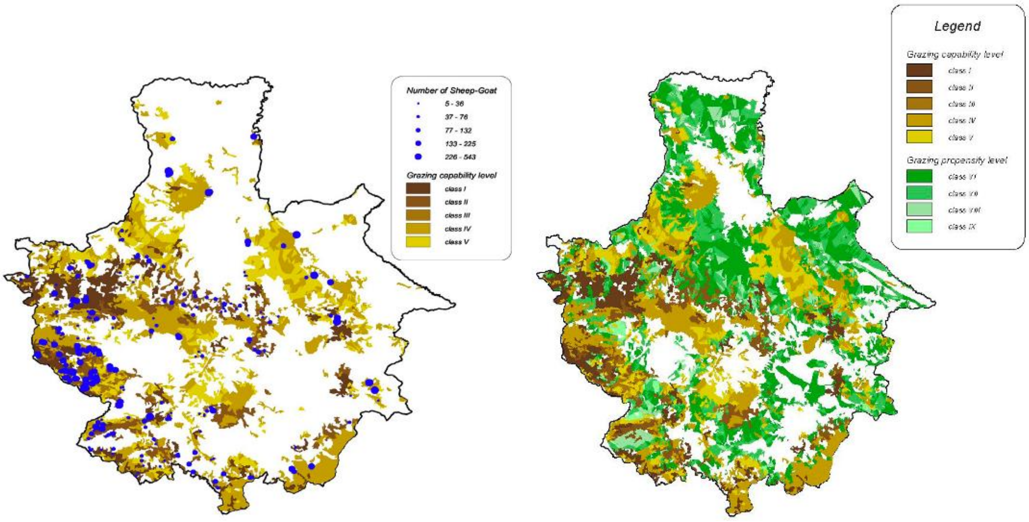

Fig. 3: a/Grazing potential crosse with position of sheep-goat raising farms (left);
b/Grazing propensity map (right)

Discussion

The obtained results show how they are strongly dependent on the possibility that large areas of agricultural land - currently used for cereal cultivation, since they benefit from economic subsidies provided by the European Union – may change their use, since these subsidies would cease in the near future. This, may relaunch pasture areas, boosting production of *pecorino* cheese as well.

The spatial overlay highlighted also how the values of energy contained in the milk produced from the ingestion of 1 kg of standard barley has increased in correspondence to classes with higher potential, thus confirming the better predisposition to grazing of areas identified with higher pasture potential. This elaboration, carried out considering the distribution of some qualitative parameters (*e.g.*: Dry Matter - DM; Rough Proteins - RP; Rough Fibers - RF) showed that, as for DM, the classes with the highest potential coincide with the highest values, while this result was not obtained for the other two parameters (RP, RF). This discrepancy is probably justified by the variability of the species present in the pasture turf and, in particular, in the associations of legumes and grasses. The greater use of oat as a supplement is due to the greater availability of this foodstuff on small farms with fewer animals, while on farms with a larger number of animals the combinations of oats and barley, and oats, barley, maize and broad beans are more widely diffused.

Conclusion

The elaborations carried out in the present research allowed to create a synthesis informative GIS tool, in which the vocation of pastures towards fodder production is reported. A further refinement of this study can be sought, both by further integration of the qualitative/quantitative data of the pastures and by processing other agronomic parameters.

At the same time, further analysis of the area's road network should be implemented, with special attention on rural tracks/paths, so as to assess the possibility of optimizing the infrastructure network serving the farms, given the extremely important role it plays in the marketing of the produced goods.

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Souhrn
Hospodářství okrajových oblastí je často ohroženo nedostatečným dopravním systémem, nedostatečnou spoluprací mezi zemědělskými podniky a nedostatečnou distribucí jejich typických produktů, jejichž zhodnocení může být faktorem růstu pro země, které se kvůli orografickým a geografickým znevýhodněním často opožďují ve svém hospodářském rozvoji. V těchto oblastech se častěji objevuje problém s obtížemi při plánování rozvoje půdy, který je způsoben nedostatečnou nebo špatnou znalostí a klasifikací všech možných informací spolu s nedostatečnou schopností získávat nové informace a možností analyzovat současně mnoho různých údajů. Z tohoto pohledu se jeví jako velmi užitečný nástroj využití geografického informačního systému (GIS), protože umožňuje porovnat informace geografické úrovně (výška terénu, sklon, orientace svahu, využití půdy, struktury a infrastruktury atd.) s charakteristikami pastvin (aromatické byliny na pastvinách, procentuální pokrytí travou, nutriční hodnoty atd.) V tomto článku byla použita metoda GIS a zpracování obrazu pro aplikaci v územním plánování s ohledem na vnitřní oblast regionu Basilicata (jižní Itálie), známou svými typickými potravinářskými produkty (ovčí a kozí sýry). Cílem tohoto výzkumu bylo zjistit nové oblasti, které mohou být věnovány pastvinám s nejlepšími vlastnostmi a nejvyšším potenciálem, které mohou přispět ke zvýšení množství a standardizaci kvality při výrobě sýra "Pecorino". Zavedený GIS umožnil díky křížení mnoha informačních úrovní získat tematické mapy se specifickým využitím, které zvýraznily oblasti určené k pastvě. Poté byl podle vah přiřazen různý stupeň důležitosti agronomickým a výživovým parametrům, přičemž zvláštní pozornost byla věnována pastvinám a kapacitě ekologické zátěže různých oblastí. Opětovný výběr těchto informačních úrovní vedl k vytvoření konečné tematické mapy - nazvané "mapa náchylnosti k pastvě" - kde jsou zobrazeny oblasti s vyšším produkčním potenciálem a nejlepšími botanickými vlastnostmi. Závěrem lze říci, že tento přístup GIS se tak ukázal jako velmi užitečný nástroj pro zhodnocování potravinářských produktů vnitřních oblastí, a tím i posílení agroturistiky při současné ochraně venkovské krajiny.

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THE IMPORTANCE OF HISTORIC FERRY SITES FOR THE TOURISM ALONG THE MIDDLE SECTION OF THE LABE RIVER (CZECH REPUBLIC)

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Abstract
Ferries on the larger rivers have historically played an important role in the daily lives of the local communities, but many were also important to travellers and traders from more distant destinations. The locations of ferries have been recorded on the basis of old topographical maps from the 1760s, 1840s, 1880s and 1950s. This paper focuses on the historical ferry sites along the middle section of the Labe river between Kolín and Mělník. The aim of the work was to evaluate the historical significance of the ferries on the selected section, to trace the remains of the related buildings and to assess the possibilities of their usefulness for contemporary tourism. The key issue is the accessibility of the ferry sites to the hiking and cycling marked routes, where it is possible to create e.g. an information panel about the once operated ferry in a given place. The highest potential for further utilisation have the surviving buildings at the ferries, e.g. ferry houses, roadside inns, etc.

Key words: River ferry, Labe river, Old topographic maps, Tourism

Introduction
Ferries on the larger rivers have historically played an important role in the daily lives of the local communities, but many were also important to travellers and traders from more distant destinations. They are still used for everyday commuting, especially in larger metropolitan areas (Cheemakurthy et al., 2017; Deca et Carnegie, 2021), while also being subject to emerging trends in mobility (Tarkowski et Puzdrakiewicz, 2021). Ferries do play an increasingly important role in sustainable tourism, especially as a link between the most visited attractions of anthropogenic and natural origin (Lee et Leung, 2021; Tarkowski et al., 2021) as well as an attractive alternative how to overcome barrier effect of river for walking and cycling marked routes (McGrath et al, 2020).The paper builds on previous research focusing on historical ferries, notably Dostál et Havlíček (2021). Its main aim is to reveal the reflection and the current use of such sites for the purpose of expanding the tourist possibilities in region.

Area of study
The study area is represented by the part of the middle section of the Labe river defined by the town of Kolín (river km 920.5) and the confluence with the Vltava river near Mělník (river km 837.38). Although being a lowland river landscape, it offers extensive opportunities, especially for active leisure. Especially lovers of cycling, water sports and fishing will find a lot to enjoy here. There are also several notable historical towns such as Kolín, Nymburk, Stará Boleslav, Mělník and the important spa Poděbrady.

Methodology
Scoping phase
The locations of ferries have been recorded in GIS on the basis of old topographical maps from the 1760s, 1840s, 1880s and 1950s. It was based on data taken for the paper by Dostál et al. (2021), where the methodology for identifying sites from old maps is described in detail. Of all the identified sites in the study area, those that did not meet the following criteria were potentially excluded: degree of preservation of surroundings, accessibility by public roads and footpaths, loss of the site due to watercourse regulation, short length of existence.

Field phase

Each site not excluded during scoping phase was visited and explored to identify the preserved elements of the ferry (if any) and existing patterns for recreational use of the site were observed. The valuation map is shown in Table 1. The fieldwork also included an assessment of the preservation of the genius loci in the form of various toponyms, which refer to the existence of a ferry in the past.

Tab. 1: Field observation of identified sites (Dostál et Havlíček, 2021; modified)

#	transportation significance	in situ remains	genius loci	existing river crossing (to 200 m)	nearest all year river crossing	linkage to trails - left x right bank
A	ferry on major road	construction elements are existing	used in water transport	permanent	over 3,000m	educational trail, bike trail of 1st or 2nd class
B	ferry on secondary road	some construction is preserved	other use	occasional all year	from 1,000m to 3,000m	marked trail, street
C	ferry of local importance	only little terrain traces	another reminder*	occasional seasonal	from 200m to 1,000m	common dirt road, footpath
D	ferryboat (personal)	all traces have vanished	none	no crossing	to 200m	no linkage

* significant toponyms, info-board etc.

Results and discussion

Based on a preliminary selection during the scoping phase, we selected 28 sites out of a total of 45 sites identified in the study area. These were evaluated in the field according to the parameters listed in Table 1. In one of the locations (near Oseček), the ferry is still in operation today, albeit only as a motorboat in seasonal operation. Of the 28 sites assessed, only one (3.6%) was located on a major road, 8 sites (28.6%) were link sites on the secondary road network and 14 (50%) were links of local significance. Ferryboat used to operate at 5 sites (17.9%). From the point of view of tourist attractiveness, it is important to preserve certain remnants of the site. Apart from Oseček ferry, which is still in operation today (Fig. 6), practically complete constructions have been preserved only on the Záryby ferry. In five sites (17.9%) we find significant remains in the form of, for example, a ferryman's house or a roadside inn (Fig. 2-5, Fig. 7). In many sites (15; 53,6 %) it was possible to identify terrain remains, mostly forming the characteristic shape of the riverbank (Fig. 1). This can be identified as an artificial bay in the classification of anthropogenic landforms according to Kirchner and Smolová (2010), although they do not directly refer to such an example in their publication. A relatively significant part of the sites is also currently used for water transport, although mainly for recreational and individual navigation (9, 32.1%). On the other hand, in half of the cases (14, 50.0%) no manifestations of genius loci were found. For the consideration of the potential for restoration of the link, the distance to the surrounding operating footbridges and bridges, as well as the connection to the important touristic roads is crucial. Of the sites assessed, 24 (85.7%) are linked to a 1st class cycle route, with the Elbe cycle route running along the entire course of the Labe river in this section. Half of the ferries are located more than 1 km from the fixed link, with one quarter even more than 3 km. Based on the field research, it can be concluded that the potential of the historic ferries in the studied section of the Labe river is not sufficiently exploited, with a few exceptions. Due to the presence of an important cycle route, it is proposed to add information signs about the history of the ferry in the area, including old photographs

Fig. 1: The anthropogenic shape of the riverbank typical for the sites of former river ferries

and information from archival sources. Alternatively, the operation of the ferry could be commemorated by related objects such as the ferryman's house, a display of a typical vessel, or other artefacts used for the operation of the ferry (e.g. the bell used to signal the ferryman, the steps and piers to the ferry).

Reminders of historic ferry site – gallery of best examples

Fig. 2: Hadík ferry – ferryman's house with historical flood markers

Fig. 3. Na Štěpáně – modernised building of roadside inn connected to former ferry

Fig. 4. Záryby – preserved ferryman's house

Fig. 5. Záryby - small exhibition inside ferryman's house

Fig. 6. Oseček – the only existing ferry in the study area, however operational only seasonally

Fig. 7. Oseček – Ferryman's house adapted to recreational object

Ferries in local toponyms

There is recreational village “Na Přívoze” just next to Oseček ferry. Further on, we had found three cases of street name derived from former ferry (Mlékojedy: “ K Přívozu”; Brandýs n/L: street "U Přívozu"; Sedlčánky: ulice "U Přívozu"). Indirectly, the former existence of the ferry can also be concluded from the street name referring to another village, which is located on the opposite side of the river, without a bridge or ford on the way between them. Such cases were found in Lázně Toušeň (street "Káranská"), Kostomlaty nad Labem (street "Hradišťská") and Hradištko (street "Klavarská"). Rare reference to the ferry site is also to be found in agronyms, the only occurrence is near Obříství where "Mezi Obřístvím a Štěpánským přívozem" is to be found in cadastral map. No other types of toponyms were found.

Conclusion

The results show that the potential of historic ferries in the studied section of the Labe river is not sufficiently exploited in tourism, with a few exceptions. If we want to increase the tourist attractiveness of these places, the focus on those sites where significant structural remains were preserved is needed. In the area of interest, ferrymen's houses or inns have been identified in several sites. Based on a survey from recent aerial photographs and field observations, it was possible to identify specific terrain remains on the riverbank that can be classified as an artificial bay in the classification of anthropogenic landforms. A significant number of the former ferry sites is now in the exploitation for recreational and individual navigation. The potential for restoration of some of these ferries is dependent on the distance from nearby functional footbridges and bridges, as well as the connection to major tourist routes.

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Shrnutí
Přívozy na větších řekách hrály v minulosti významnou roli v každodenním životě místního obyvatelstva, mnohé však byly významné také pro cestující a obchodníky ze vzdálenějších destinací. Lokality přívozů byly evidovány na základě starých topografických map z období 1760, 1840, 1880 a 1950. Tento článek se zaměřuje na historické lokality přívozů na středním úseku Labe od Kolína po Mělník. Cílem práce bylo vyhodnotit historickou významnost přívozů na vybraném úseku, dohledání pozůstatků souvisejících objektů a zhodnotit možnosti jejich přínosu pro současný turistický ruch. Klíčová je otázka dostupnosti lokalit přívozů na pěší a cyklistické značené trasy, kde je možné v daném místě vytvořit např. infomační panel o kdysi provozovaném přívozu. Vysoký potenciál využití pak mají dochované objekty u přívozů, např. přívozní domky, hostince u přívozu apod.

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THE INFLUENCE OF THE RECREATIONAL RESERVOIR ON WATER QUALITY IN AUŠPERSKÝ STREAM

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Abstract

The article focuses on monitoring the quality of water in the Aušperský stream, which flows through 2 reservoirs - Horní rybník and Dolní rybník. Horní rybník serves as aquatic habitat for waterfowl and amphibians. Horní rybník is used for recreation and sport fishing. Under Dolní rybník, treated wastewater from the industrial area flows into the Aušperský stream. The Periodic sampling was performed on selected specific profiles. Furthermore, algae and cyanobacteria were collected and determined. The evaluated analyzes of selected water quality indicators were subsequently compared with the valid legislation of the Czech Republic. The evaluation showed that none of the reservoirs had a higher incidence of cyanobacteria, only an increased number of green algae and diatoms, especially in the summer months. According to selected indicators, the reservoirs do not have a negative effect on the quality of the water in the stream.

Key words: monitoring, water quality indicator, cyanobacteria, aquatic habitat, sport fishing

Introduction

Small water reservoirs (SWR) are an integral part of the agricultural landscape and make a significant contribution to the protection and creation of the environment. In addition, SWR significantly contribute to the improvement of water quality in the river basin (Pelikán et al., 2020). The quality of water in water reservoirs intended for recreation changes during the year. The problem of eutrophication and increased concentrations of pollution in tanks has also multiplied in recent years due to high temperatures and droughts, where minimal inflows into tanks and increased evaporation cause low water levels in reservoirs and consequently increased concentrations of pollutants (Hubačíková et al., 2020). Eutrophication is also associated with blooms of toxin-producing cyanobacteria. In some species of cyanobacteria, the exudate pool can include a suite of toxic compounds that are harmful to human health. For example, microcystin is among the most commonly occurring toxin produced by cyanobacteria in natural waters, and can cause liver complications and damage to the nervous system if ingested (Walls et al., 2017). The quality of water in the reservoirs is also affected by the number of visitors in the summer months. Their increasing number threatens the ecological functions of water bodies. Ponds are "significant landscape elements" and are subject to protection under the Nature and Landscape Protection Act No. 114/1992 Sb., on water areas that are intended for swimming and recreation according to Decree No. 568/2020 Sb. Another piece of legislation is Act No. 151/2011 Sb., sets out the hygienic requirements for outdoor swimming pools and the obligations of their operators. The requirements are specified in the implementing decree No. 568/2020 Sb., the operator of a natural or artificial swimming pool or sauna is obliged to ensure that bathers are not exposed to health risks resulting from bathing water pollution. Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC This Directive contains provisions for:

(a) monitoring and classification of bathing water quality;
(b) bathing water quality management; and
(c) informing the public about the quality of bathing water.

Water quality in streams is often affected by treated and untreated wastewater from municipalities. The quality of wastewater can affect the flow positively and negatively. For wastewater discharged into surface waters, the limits are set by Government Regulation No. 401/2015 Sb. on indicators and values of permissible surface and waste water pollution and permits for the discharge of waste water into surface waters.

Materials and methods

The Aušperský stream flows through the village of Popůvky, which is located about 12 km southwest of Brno. The total catchment area of the Aušperský stream is 7.27 km^2. The Aušperský stream springs

in the forest at an altitude of about 380 m. The valley of the nameless stream creates waterlogged meadows, which were declared a natural monument Aušperský stream in 1989. The subject of protection is an ecologically important landscape element, a preserved meandering stream with natural meadow vegetation. The locality is also important as a nesting place for endangered bird species and a breeding ground for amphibians (Němcová, 2017). Aušperský stream feeds Horní rybník and Dolní rybník. Below Dolní rybník, the stream flows under the same name.
The ponds were built in the 18th century in the northwestern part of the village of Popůvky on the Aušperský stream by the owners of the Troubky estate. At least one of the ponds existed as early as 1749. The Dolní rybník was at the beginning of the 20th century released and turned into a field, but in 1949 its revitalization began and a year later it was re-impregnated. At present, the Horní rybník and the Dolní rybník belong to a private owner (Rouzek, 2015).
Horní rybník is about 177 m wide and about 128 m long, the total water area is about 2 ha. The shores of the pond are unmaintained, overgrown with coastal vegetation and trees. In the water of the pond there is a large number of broken branches and leaves from the surrounding trees. The pond currently serves primarily as a nesting place for birds and a place for frogs to breed. Due to the number of fallen branches, the pond is not very suitable for swimming. Dolní rybník is about 180 m wide and about 390 m long, the total water area is about 7 ha. The shores of the pond are maintained and regularly mowed. Dolní rybník is currently used for fish farming and commercial fishing. The pond is also used by locals for swimming and relaxation in the summer months (Němcová, 2017). Under the reservoirs, treated water from the industrial area flows into the stream.
From April 2019 to March 2020, regular monthly sampling was carried out in specified profiles. Water quality indicators - amount of O_2, electrolytic conductivity, pH and water temperature were determined in the field, other indicators - total, chemical oxygen demand, nitrate nitrogen, were analyzed in the DALE laboratory. Hach instruments (HQ30d portable multimeter, DR/4000V spectrophotometer and Digital Reactor Block 200 mineralizer) were used to measure and analyze the samples. The results of the analysis were compared with the valid legislation of the Czech Republic, with RG No. 401/2015 Sb. (Haluzová, 2017). Furthermore, in the locality of interest, in the vegetation period of 2016, the collection and determination of algae and cyanobacteria were performed (Němcová, 2017).

Fig. 1: Area of interest and sampling profiles (source:mapy.cz, edited authors)

To monitor the quality in the stream, 5 sampling profiles were selected with regard to the location of the ponds and the location of the outlet of the treated wastewater from the industrial area.

Results and Discussion
A total of 7 water quality indicators were monitored on the Aušperský stream. Nitrate and total phosphorus indicators were chosen for the contribution. The other indicators show a similar trend as the two presented below.

Nitrates
Nitrogen together with phosphorus are among the most important biogenic elements in water. Nitrogen compounds are used in all biological processes taking place in groundwater, surface water and wastewater. Nitrates are the final product in the aerobic environment in the decomposition of

organic matter. Nitrates can be anthropogenic, they come from fertilizers that are used in agriculture or they come from wastewater from households, industry.

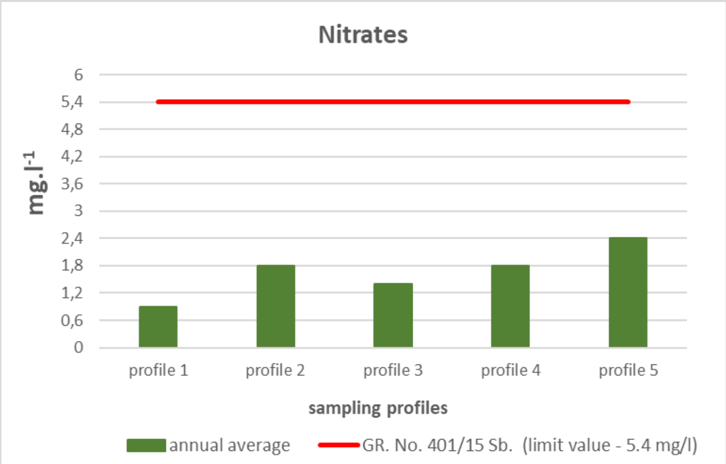

Fig. 2: Annual average values of nitrates (source: authors)

According to GR. No. 401/2015 Sb., the limit value for nitrates in surface waters is set at 5.4 mg.l^{-1}. The graph shows that during the annual monitoring of nitrates, the values of all monitored profiles are below the limit value, which is 5.4 mg.l^{-1}. Although nitrates are found in all waters, much of them enter the water by flushing from the surrounding farmland.

Total Phosphorus

The main indicator of polluted wastewater discharged into surface waters is total phosphorus. At the same time, the phosphorus content has a major effect on water eutrophication. This indicator was also monitored on the Aušperský stream. Phosphorus sources can be anthropogenic. The following Fig.3 shows the annual average values in the individual profiles.

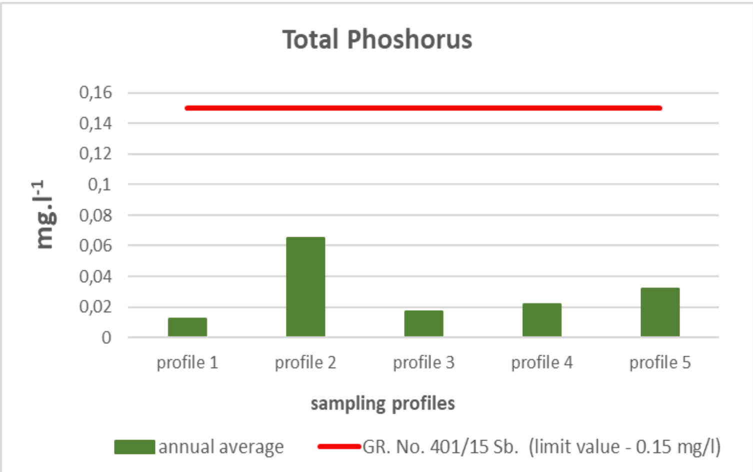

Fig. 3: Annual average values of total phosphorus (source: authors)

Limit value of total phosphorus according to GR. No. 401/2015 Sb., is 0.15 mg.l^{-1}. All monitored profiles of the Aušperský stream show below-limit values. Here, phosphorus sources can have an organic character in the decomposition of biomass phytoplankton and zooplankton, which are located at the bottom of both reservoirs and in the stream.

Cyanobacteria and algae

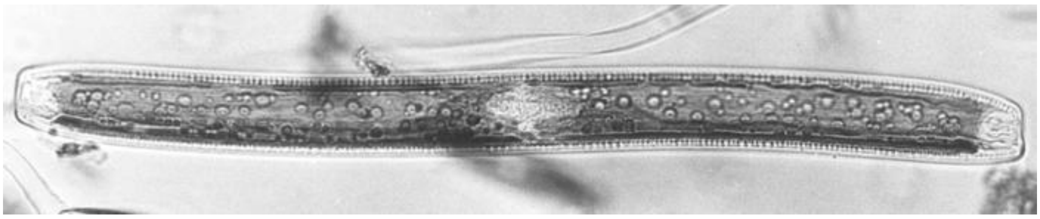

Fig.4

Nitzschia sigmoidea ((Nitzsch) W. Smith) (source:nordicmicroalgea.org)

221 taxa were determined in the monitoring of cyanobacteria and algae. From the total number of 221 taxa, there were 10 taxa of cyanobacteria, 27 taxa of euglen, 120 taxa of diatoms, 51 taxa of green algae, 10 taxa of conjunctiva and 3 taxa of other algae. During the entire growing season, the most abundant diatom was *Nitzschia sigmoidea* ((Nitzsch) W. Smith), which occurred in all localities, the second most numerous were the green algae *Dinobryon stipitatum* (Stein). The highest number of taxa of cyanobacteria and algae was determined in the Horní rybník (156 taxa), followed by the Dolní rybník with 142 taxa and the lowest number of taxa was determined in the Aušperský stream (126 taxa).

Conclusion

Legislative limits were not exceeded in any of the indicators in all samples profiles. The water in the Aušperský stream is of very good quality. The monitoring results show that the water of the Horní and Dolní rybník and the Aušperský stream does not detect an increased amount of cyanobacteria in the summer. This information is very positive due to the use of Dolní rybník for swimming.
The Aušperský stream is not negatively affected by both reservoirs, not by the treated wastewater flowing from a nearby industrial area.

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Souhrn

Článek je zaměřen na sledování kvality vody v Aušperském potoce, který protéká 2 nádržemi - Horní rybník a Dolní rybník. Aušperský potok pramení v lese v nadmořské výšce asi 380 m. V oblasti nad rybníky potok protéká lesem, kde se na něj asi ve vzdálenosti 1,5 km od pramene napojuje jeho jediný přítok bezejmenný potok. Údolí bezejmenného potoka vytváří podmáčené louky, které byly v roce 1989 vyhlášeny přírodní památkou Aušperský potok. Předmětem ochrany je ekologicky významný krajinný prvek, zachovalý meandrující tok s přirozenými lučními porosty. Lokalita je také významná jako hnízdiště ohrožených druhů ptactva a místo rozmnožování obojživelníků Horní rybník slouží jako vodní stanoviště pro vodní ptactvo a obojživelníky. Dolní rybník slouží k rekreaci a sportovnímu rybolovu. Pod Dolním rybníkem přitékají do potoka vyčištěné odpadní vody z průmyslového areálu. Periodický odběr vzorků byl proveden v letech 2019 - 2020 na vybraných profilech. Dále byly během vegetačního období 2016 sbírány a determinovány řasy a sinice. Vyhodnocené rozbory vybraných ukazatelů jakosti vody byly následně porovnány s platnou legislativou ČR. Z hodnocení vyplynulo, že žádná z nádrží neměla vyšší výskyt sinic, pouze zvýšený počet zelených řas a rozsivek, zejména v letních měsících. Což je z hlediska koupání v Dolním rybníce pozitivní informace. Nádrže, dle vybraných ukazatelů jakosti vody, nemají negativní vliv na kvalitu vody v toku. Kvalitu vody výrazně neovlivňuje ani vypouštěná odpadní voda z průmyslového areálu.

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THE INFLUENCE OF TOURIST INFORMATION MATERIALS ON THE EMERGENCE OF OVERTOURISM

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Abstract
Tourist information materials, such as leaflets, brochures, maps, guides and web presentations, significantly influence people's decisions about the form of their future or current vacation. Unfortunately, often the very form of passing on information about potential tourist destinations in the region encourages the tourist to visit especially the most famous tourist destinations, which can then suffer from the negative effects of mass tourism. On the contrary, lesser-known tourist destinations, which would welcome an increase in attendance, are often presented in these materials as of secondary importance. How is this possible when many localities are currently struggling with the negative effects of overtourism and at the same time most Czech rural regions live in long-term undertourism? The article presents the results of experimental research, in which the perception of tourist information materials was analyzed. The results of the research point out the main mistakes that the creators of these materials commonly make and thus support the uneven tourist development of the area. Furthermore, examples of good practice that act as a prevention of overtourism and potentially develop the whole region and not only selected highlights are presented.

Key words: Mass tourism, sustainable tourism, destination marketing, human-information interaction, overtourism prevention

Introduction
Uneven tourism development is a phenomenon that has worldwide validity. While some of the most popular sites suffer from overburdening, most other regions would rather welcome more tourists to them. This imbalance is largely caused by tourist information materials, from which the future tourist learns about the offer in the selected region. Various forms of tourist information influence people when choosing a destination (web presentations, social networks, book guides, etc.) and when staying in it (leaflets, brochures, maps, advertisements, etc.). If the information contained in them were presented in an appropriate form, they could contribute to reducing differences in destination traffic. Unfortunately, the opposite is true. Most tourist information materials in their form support the increase of disparities and the emergence of overtourism in the most visited localities.
This article presents the results of experimental research, which took place in 2021 on the territory of the Bohemian Paradise UNESCO Global Geopark, in which the reactions of people to various designs of tourist information materials were investigated. These results are supplemented by a content analysis of book guides focused on the tourist regions of Bohemian Paradise, the Giant Mountains and the Jizera Mountains.

Material and methods
The first method used is a content analysis of book guides for the three tourist regions mentioned above. All available guides found in the collection of the Regional Scientific Library in Liberec and the National Library in Prague were analyzed. There were a total of 73 of them, the oldest of which dates from the 1920s (Kafka's illustrated guide to the Czech Kingdom), the most recent was from 2021. The analysis monitored two key indicators: what is the geographical scope of the guide (what area it covers) and what space is devoted to the most famous tourist destinations (share of the total scope).
The second method used is an experiment in which randomly selected respondents (N = 100) evaluated existing and fictitious tourist information materials (leaflets, brochures and maps) and told interviewers which tourist destinations they were interested in and would like to visit based on these materials. The existing materials were selected from the entire territory of the Czech Republic, with emphasis on various forms and content of materials. Fictitious materials can be imagined as various templates for the distribution of information on the leaflet, where promotional material of a non-existent region was created using artificially created texts and random photos. These fictitious materials were created to verify the knowledge gained by analyzing real tourist materials and to clean them of the unwanted effects of knowledge of the presented regions. The design of the experiment is presented in Figure 1.

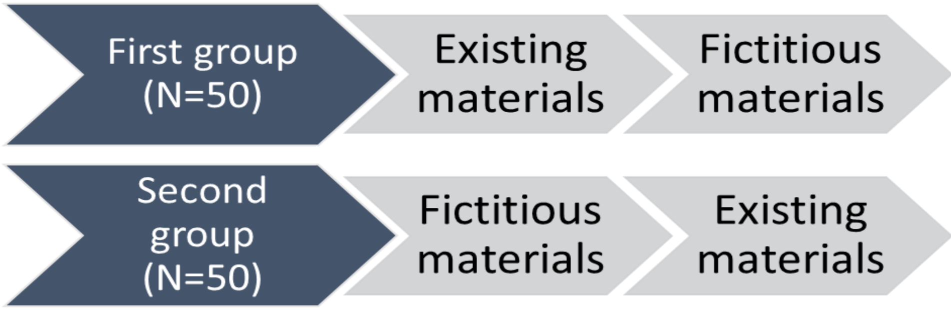

Fig. 1: Design of experimental verification of the influence of tourist information materials on the reader's preferences.

Results

The main results of the content analysis of book tourist guides are shown in Table 1. The analysis identified three phases of the development of the content of these books, each of which is the result of a different period of tourism development in the Czech Republic. The first phase reflects the timid beginnings of tourism, when there were only a small number of guides on offer and did not cover the entire territory of the Czech Republic. This corresponds to the relatively wide territorial scope covered by these guides. Attention is paid to the whole area in roughly the same way, only the most important tourist destinations are supplemented by other materials. However, this concept of the guide does not only lead to visit the most famous places, but also supports travel in general.

Tab. 1: Three phases of content development of book tourist guides.

	First phase	Second phase	Third phase
Duration	1920s - 1950s	1960s - 1980s	1990s - 2020s
Characteristics	Very wide delimitation of the tourist region, very even coverage of the territory.	Focus on smaller areas, more detailed description of major destinations.	Content commercialization, splitting into mainstream guides and guides for local readers.
Guide example	Kafka (1926)	Pacovský (1970)	Koláček (2015), Řeháček & Pikous (2019)

The second phase reflects the development of tourism during the communist era, when future top locations are already clearly profiled, but guides are not created on a commercial basis. During this period, it can be seen that the guides pay more attention to more well-known localities, cover smaller areas and less interesting regions disappear completely.

The third phase is a reflection of tourism as a mass phenomenon and a guide as a commercial product. The focus of the guides becomes twofold: on the one hand, they are short guides aimed at visitors from other regions who want to get to know the most famous sites; then guides to local audiences or specific topics (hobbies) that describe the whole region in detail. The mainstream guides then praise the most famous sites, which is why overtourism takes place there. Most of the photos come from the most famous locations, they are given more space in the description, more suggested routes lead to them, etc. Book guides must take in the bookstore, so the more photos of famous places, the more the customer buys them. Conversely, guides aimed at local audiences (e.g. Řeháček & Pikous 2019) these phenomena do not occur, but the emphasis is on the overall impression of the region, its natural beauty, history, genius loci, etc. This type of book guide can be an example of how to promote the region without the risk of overtourism.

The analysis of tourist information materials yielded similar results. The materials contain a number of elements that encourage readers to visit certain sites, usually the most famous. The following were identified as elements that could influence the reader's opinion: (a) visual attractiveness of photos, (b) space dedicated to the destination on the leaflet, (c) order in which the destinations are presented, (d) numbering, (e) superlatives in the description, (f) the position of the description on the leaflet. An example of a leaflet that clearly leads to a visit to three selected destinations is shown in Fig. 2. A space larger than the rest of the region is devoted to the three selected rock towns. Although we will also read about other rock towns in the leaflet, their promotion seems more like a mention of something that is not so interesting and worth a visit.

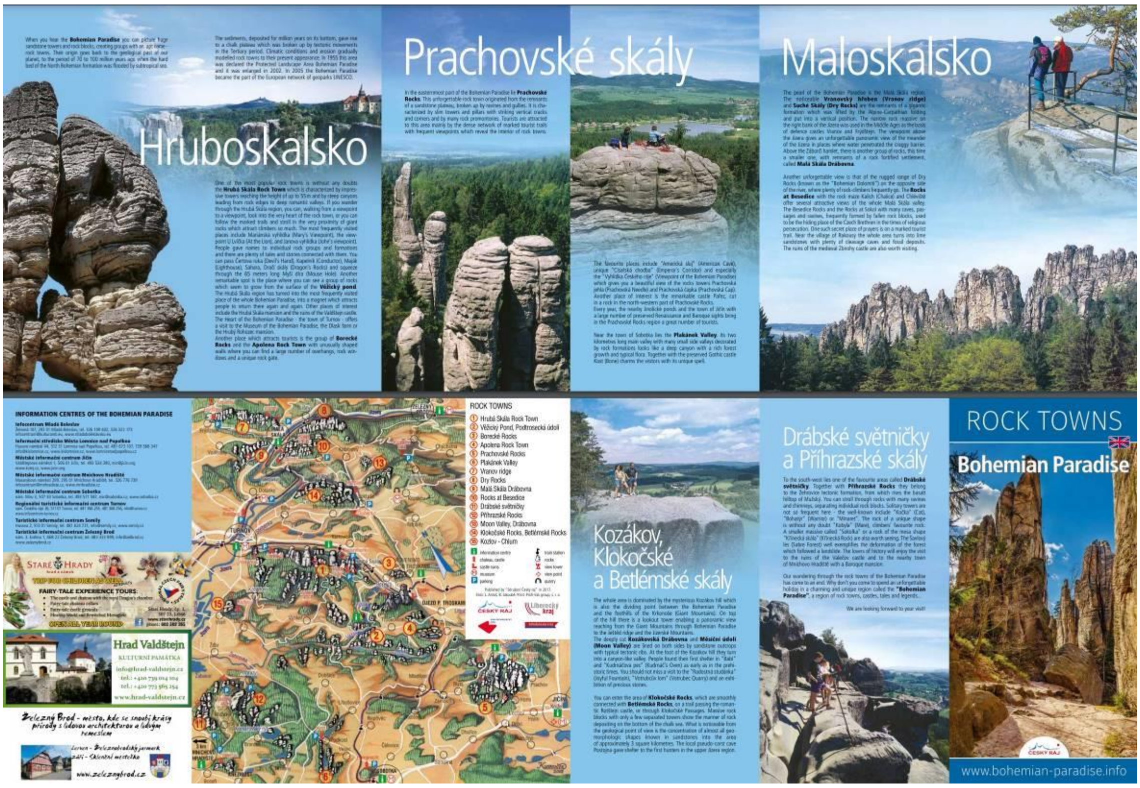

Fig. 2: An example of a leaflet promoting “rock towns” in the Bohemian Paradise, front and back side. Source: Bohemian Paradise Association, publicly available.

So what should a leaflet look like that provides a balanced information about the various points of interest in the region? First of all, all localities should be given about the same amount of space, and each locality should have about the same attractive and large photo. Furthermore, localities should not be numbered and sorted according to the presumed importance, but, for example, according to alphabetical order, position on the map or other random element. No superlatives should appear in the description, or superlatives should be listed for all sites. It is also advisable to use a layout other than the classic one (e.g. presentation of locations in a circle around the map) in order to disrupt the normal reading order of the text (from left to right, from top to bottom).
Some leaflets in the research did not contain the most famous sites at all. They are the result of a recent trend in which the regions are trying to do so-called demarketing (see Hall & Wood 2021, Gulsen et al. 2021, Drugova, Kim & Jakus 2021) in order to avoid overtourism in these localities. However, research has shown that visitors do not rate these materials very positively or that they are not very suitable for them, because they do not find links to top sites that they know from other sources. When a visitor does not find what he expects in the material, he feels deceived or does not consider the material to be good. It is therefore better to promote all destinations in a balanced way than to promote only lesser-known locations.

Discussion and Conclusion
Tourists' expectations regarding the experiences associated with their visit to the region are largely influenced by the tourist information materials they encounter. Whether it's book guides, various leaflets, brochures and maps, or presentations on websites and social networks, they can all significantly influence a visitor's decision on which destination to visit. Unfortunately, it is a sad fact that most tourist materials inform about attractions in the regions in an unbalanced way, devoting significantly more space and attention to the most famous localities. This approach then leads to overtourism in the most visited destinations, while in the rest of the region there are often very few tourists.
The article briefly presents the conclusions of the research conducted in 2021. These results are consistent with the findings of other marketing research from other fields (e.g. Huddleston et al. 2015,

Ziliani & Ieva 2015). The consequences of unbalanced promotion in the form of polarization of tourism are proved by studies dealing with overtourism in rural areas (Vegnuti 2020, Drápela 2021, Drápela et al. 2021). However, it has not yet been satisfactorily demonstrated that balanced promotion of the regions will alleviate the negative effects of overtourism in the most visited localities. Future research will have to prove that.

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Souhrn

Turistické informační materiály, jako jsou letáky, brožury, mapy, průvodci a webové prezentace, výrazně ovlivňují rozhodování lidí o podobě jejich budoucí či aktuální dovolené. Bohužel často samotná forma předávání informací o potenciálních turistických cílech v regionu vybízí turistu k návštěvě zejména těch nejznámějších turistických cílů, které pak mohou trpět negativními dopady overturismu. Naopak méně známé turistické cíle, které by zvýšení návštěvnosti uvítaly, jsou v těchto materiálech často prezentovány jako druhořadé. Jak je to možné, když se řada lokalit v současnosti potýká s negativními dopady masového turismu a zároveň většina českých venkovských regionů zažívá stav permanentního underturismu? Článek prezentuje výsledky experimentálního výzkumu, ve kterém bylo analyzováno vnímání turistických informačních materiálů. Výsledky výzkumu poukazují na hlavní chyby, kterých se tvůrci těchto materiálů běžně dopouštějí a podporují tak nerovnoměrný turistický rozvoj oblasti. Dále jsou uvedeny příklady dobré praxe, které působí jako prevence nadměrné turistiky a potenciálně rozvíjejí celý region a ne pouze vybrané zajímavosti.

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THE INFLUENCE OF WOODLOTS ON THE PHOTOCLIMATE OF GREEN AREAS AND THE QUALITY OF RECREATION

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Abstract
The quality of people's recreation in urban green areas (parks, municipal forests etc.) is remarkably influenced by the availability of sunlight. Especially the intended shaping of woodlots (landscape architecture) can have a very positive local impact on the sense of thermal comfort, diversified sun exposure, etc. The appropriate tree cover can regulate the degree of insolation of the site in the daily and seasonal aspects. The optimal structure of tall green forms (e.g. spatial and age structure, species composition) is the condition to achieve it. Due to the proper spatial arrangement of trees, it is possible to expose places that should be in full sun, keeping other areas in the periodic partial shade. The desired solar exposure can also be obtained by the selection of tree species (tall, low, broadly branched, columnar, etc.), the proper planting density and the distribution of trees regarding other forms of land development (topography, water system, road layout, buildings, etc.). Tree stands with a luminous, loose and airy structure have particular recreational and hygienic values. During recreation in a bright tree stand of parks and forests, the availability of sunlight has long been recognized as having great health-promoting importance due to the increased natural possibility of skin synthesis of vitamin D_3 (the so-called "sun vitamin"). Also, with the favourable availability of solar radiation, the therapeutic impact of urban green areas becomes significant, especially during the COVID-19 pandemic.

Key words: Parks and municipal forests, recreation, vitamin D_3, sun light, luminous stands and woodlots

Introduction

The quality of places and areas for leisure depends mostly on natural factors (biotic and abiotic), which can significantly contribute to the stimulation or limitation of the human body's feeling of so-called comfort or "well-being". This synthesis of physical, chemical, biological and meteorological stimuli can be defined as the bioclimate. The concept of bioclimate is closely linked to recreation. Hence "recreation bioclimate" should be interpreted as the set of biological variables acting on the quality of recreation, among which greenery, especially trees, is an essential factor. Depending on the area covered and the ecological diversity, tree stands (e.g. in the park) can significantly modify the bioclimatic conditions locally and in neighbouring areas. The decisive factor, in this case, is the structure of tall greenery (spatial, species-specific) achieved by long-term landscaping and nurturing - visually appealing and ensuring favourable recreational bioclimatic conditions, i.e. optimal solar and thermal conditions, air circulation, air composition, etc. The main goal of the publication is to show some chosen aspects of photo-climate inside stands and woodlots concerning the hygiene of the recreation in parks.

Material and methods

The general goal of shaping and maintaining woodlands and stands in big parks worldwide is strongly connected with the requirements of broadly defined recreation. To follow this goal, the literary review and observations were conducted in chosen reference sites in Europe. The authors present general links between the shaping of the structure of park stands and their potential to provide optimal conditions for the people's recreation. This publication mainly focuses on evaluating solar conditions inside tree stands and the health needs of people in relation to the availability of sunlight during recreation in parks. Conclusions show the vital connection between the favourable availability of solar radiation in urban green areas and its therapeutic impact on the population's health.

Results

Recent studies confirm that urban green spaces with lush vegetation (e.g. parks, municipal forests, woodlots, etc.) have a remarkably beneficial effect on human health (soma and psyche). Hight self-esteem and life satisfaction, subjective feelings of happiness and easing social tensions are

significantly related to the quality of green spaces [Kuo & Sullivan, 2001, Qing Li, 2010; Dadvand *et al.*, 2015; Derks *et al.*, 2020; Slater, 2020; Soga *et al.*, 2020; Venter *et al.*, 2020; Murray, 2021].
Literature analysis and in-situ research conducted by the authors (several countries in Europe) reveal interesting facts regarding the vital role of shaping tree stands in parks for the quality of recreation. It appears that park tree stands with loose, non-schematic structures are not only visually attractive (referring to the landscape style in garden art). At the same time they present potentially high environmental values and allow to achieve remarkable recreational comfort - Figure 1. [Łukaszkiewicz *et al.*, 2018; Łukaszkiewicz *et al.*, 2018a; Łukaszkiewicz *et al.*, 2018b; Łukaszkiewicz, 2019].

Fig. 1: Luminous, loose woodlots with a canopy cover of max. 40% of the total area creates favourable conditions for recreation and relaxation (bioclimate, thermal comfort). A pine grove on the grounds of Villa Borghese, Rome. Visible passive recreation on the grass under the canopy [photo J. Łukaszkiewicz, 2015]

Although the composition of woodlots with the features of a landscape style (urban and suburban parks, municipal forests) aims to create a picturesque landscape and thus achieve a high aesthetic comfort, the resulting spatial arrangements can be highly comfortable in terms of bioclimatic conditions. Skilful use of various forms of tall greenery in the landscape composition (from compact massifs and clusters, through loose groves to separate forms (groups, clumps) and single trees, displayed in vast, illuminated garden interiors, allows to obtain refined scenery (micro landscapes), included in brightly shaped stands. Especially extensive border zones of such tree stands are beneficial due to bioclimatic conditions and increased biodiversity. The recreational durability there may be improved thanks to skilful planning of spatial structure and species selection. Hence, parks in a landscape style (or those composed to this style in terms of composition) are still trendy not only because of their historical and aesthetic values but also because they remain places of outstanding recreational value, primarily because of the good accessibility of the **sunlight** [Łukaszkiewicz *et al.*, 2018; Łukaszkiewicz *et al.*, 2018a; Łukaszkiewicz *et al.*, 2018b; Łukaszkiewicz, 2019, Fortuna-Antoszkiewicz & Łukaszkiewicz 2021; Bamwesigye *et al.*, 2021].
High greenery can significantly modify the bioclimatic conditions locally and in neighbouring areas depending on the surface size and ecological diversity. In such a case, the greenery structure has got the decisive significance (spatial structure, species structure, age structure) obtained through long-term shaping and maintenance - visually attractive and ensuring optimal light and thermal conditions, ventilation, atmospheric air composition, etc. [Łukaszkiewicz *et al.*, 2018; Łukaszkiewicz *et al.*, 2018a; Łukaszkiewicz *et al.*, 2018b; Łukaszkiewicz, 2019, Murray, 2021].
The therapeutic impact of urban green areas becomes significant - especially during the COVID-19 pandemic - becomes even more apparent when the favourable availability of solar radiation is taken into account [Fortuna-Antoszkiewicz & Łukaszkiewicz 2021; Bamwesigye *et al.*, 2021].
Luminous stands of parks or urban forests with a loose canopy can provide the increased natural possibility of skin synthesis of vitamin D_3 (the so-called "sun vitamin"), which is of great health-promoting importance. It is essential, especially when in economically developed countries (e.g. Europe), the so-called "computer generation" (children and adolescents) spent minimal time outdoors, getting little contact with daylight and sun rays. [Webb *et al.* 1988; Wacker & Holick, 2013; Łukaszkiewicz, 2015].
The same is happening among a large part of the adult population due to office / remote work (extended stay indoors) - significantly intensified during the periods of "lockdown" introduced due to the COVID-19 pandemic.

A well-known fact is that staying in the green surroundings allows proper exposure of the human body to solar radiation (ultraviolet B radiation (UVB) - wavelength of 280-315 nm) stimulates the cutaneous synthesis of vitamin D_3 in epidermal cells (keratinocytes). It is estimated that skin synthesis can cover 80 - 100% of the daily requirement of the human body for vitamin D. Today it is also known that both the geographical latitude (the angle of the sun's rays), the time of year, time of day and weather conditions have a significant impact on the quality of skin synthesis of the "sun vitamin". For example, in Europe (areas located north of the latitude 30°N), from October to March, skin synthesis of vitamin D_3 is ineffective due to inadequate light conditions. In addition, cloud cover and air pollution may temporarily reduce the availability of UVB radiation [Wacker & Holick, 2013; Łukaszkiewicz, 2015].
Among the inhabitants of Central Europe (e.g. Poland), the skin synthesis of vitamin D_3 may be effective only from spring to early autumn (from mid-March to the second half of September), between 10:00 - 15:00 (approx. seven hours during the day), that is, in the season and time of the day, ensuring the right angle of sunlight, air temperature conducive to sunbathing and in the predominantly cloudless weather. Under these conditions, exposure of at least 18% of the body surface (i.e. exposed face, neck, forearms, and calves) for approximately 15 min. should provide half of the minimum daily dose of vitamin D for the body [Webb *et al*,. 1988; Wacker & Holick, 2013; Łukaszkiewicz, 2015].
On a social scale, the importance of an adequate vitamin D supply cannot be overestimated - especially during the COVID-19 pandemic. Presently, the "sun vitamin" is regarded as an essential but not a sufficient factor for the proper functioning of the human body's vital physiological pathways of cells. Vitamin D is considered the "enabling" factor: it must be present to enable the physiological processes, but its presence is insufficient to stimulate or trigger them. Therefore the low level of vitamin D supplementation is not a cause of pathology or dysfunction, but it impairs the cellular response to the internal or external stimuli. Hence, vitamin D deficiency is inevitably associated with several pathologies and dysfunctions and increased susceptibility to viruses [Cheng *et al.*, 2003; Baggerly *et al.,* 2015; Holick, 2017; Charoenngam *et al.,* 2019; Pludowski *et al.,* 2019; Charoenngam & Holick, 2020].
For example, in Poland, vitamin D_3 deficiency is shared among the studied sub-populations of children, adolescents, adults and seniors. Although the situation improves in the spring and summer months due to exposure to the sun, people's predominant lifestyle and work in cities prompt the consideration of using preventive or intervention strategies to improve the overall health situation, especially during the COVID-19 pandemic [Pludowski *et al.,* 2014; Łukaszkiewicz, 2015; Pludowski *et al.,* 2016; Rusińska *et al.,* 2018; Zemb *et al.,* 2020; Charoenngam *et al.,* 2021].

Discussion and Conclusions

The civilization changes in the lifestyle of city dwellers translate into a strongly felt socially - specific for each epoch and time - need for recreation and leisure [Huizinga, 1985]. Currently, also because of the post-pandemic period (COVID-19), it is of great importance to provide high-quality recreational green areas (for everyday and holiday recreation), most often close to places of residence due to the intense pace of life and increasing communication difficulties [Ewing *et al.,* 2008; Canales *et al.,* 2017; Łukaszkiewicz *et al.* 2018a,b; Łukaszkiewicz *et al.* 2021].
The recreational importance of urban parks and forests is connected exceptionally with tall green. Trees can significantly stimulate the feeling of the so-called comfort ("well-being") and influence the "*recreational bioclimate*" ment as a whole of biological factors determining the quality of recreation. Depending on the size of their area and ecological diversity, tree plantings can significantly modify the bioclimatic conditions locally and in neighbouring areas. In such a case, the greenery structure has the decisive significance (spatial layout, species structure, age structure) obtained through long-term shaping and care - visually attractive and ensuring optimal sunlight and thermal conditions, ventilation, atmospheric air composition, etc.
As shown earlier, **sunlight** is essential for the quality and hygiene of rest for people staying in green areas (parks, communal forests). In particular, the targeted shaping of trees (landscape architecture) can have a local very positive effect on sun exposure and the perception of thermal comfort, which determines the quality of rest in a given site. Appropriate woodlot shaping can regulate the degree of insolation of a given area. The prerequisite, however, is the optimal structure of tall green forms (e.g. spatial structure, age structure, species composition). Due to the appropriate spatial structure of tall forms of greenery, it is possible to expose places that should be in full sun, keeping other areas in periodic shade. The desired solar exposure can also be obtained by selecting tree species (tall, low, broadly branched, columnar silhouettes) and the appropriate planting density and the way of arrange trees in relation to other forms of land development (topography, water system, road layout, buildings, etc.).

Our research shows that park tree stands with a less dense, non-schematic structure formed towards achieving high recreational comfort at the same time are beneficial in terms of their favourable availability of solar radiation and its therapeutic impact. During recreation in a luminous stand of parks and forests, the availability of sunlight has long been recognized as having great health-promoting importance.

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Souhrn

Kvalita rekreace lidí v městské zeleni (parky, městské lesy atd.) je výrazně ovlivněna dostupností slunečního světla. Zejména záměrné tvarování lesních ploch (krajinářská architektura) může mít velmi pozitivní lokální vliv na pocit tepelné pohody, diverzifikované oslunění apod. Vhodný stromový porost může regulovat míru oslunění lokality z denního i sezónního hlediska. Optimální struktura forem vysoké zeleně (např. prostorová a věková struktura, druhová skladba) je podmínkou k jejímu dosažení. Díky vhodnému prostorovému uspořádání stromů je možné oslunit místa, která by měla být na plném slunci, a ostatní plochy ponechat v pravidelném částečném stínu. Požadovaného oslunění lze dosáhnout také výběrem druhů stromů (vysoké, nízké, široce rozvětvené, sloupovité atd.), vhodnou hustotou výsadby a rozmístěním stromů s ohledem na další formy zástavby (topografie, vodní systém, uspořádání komunikací, budovy atd.). Stromové porosty se světlou, rozvolněnou a vzdušnou strukturou mají zvláštní rekreační a hygienické hodnoty. Při rekreaci ve světlém stromovém porostu parků a lesů je již dlouho uznávána dostupnost slunečního světla, které má velký zdravotně-propagační význam díky zvýšené přirozené možnosti syntézy vitaminu D3 (tzv. "slunečního vitaminu") v kůži. Rovněž při příznivé dostupnosti slunečního záření se terapeutický vliv městské zeleně stává významným, a to zejména v období pandemie COVID-19.

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THE STABILITY OF BANKS IN POST-MINING LAKES AS A LIMIT TO THEIR RECREATIONAL POTENTIAL

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Abstract
In the lowland areas of the Czech Republic, the mining sites of sand and gravel-pits are often naturally filled with groundwater. This creates typical post-mining lakes of great importance in the landscape. Not only do these lakes create valuable semi-natural habitats sought after i. a. endangered water bird species and become hotspots of local ecological stability, they also quickly become popular destinations for various recreational activities. Wanted or unwanted, spontaneous recreation cannot be stopped as fisherman; swimmers; divers; various sportsmen etc. always seem to find a way to enter the lakeside. This phenomenon has to be reckoned with at all stages of the restoration, planning and management of these areas. In post-mining lakes, where recreation is one of the desired functions, bank stability plays critical role in ensuring the safety of visitors and thus becomes one of the main limiting factors of its recreational potential. In this article, we present a unique low-cost approach how the stability can be improved. This can hopefully contribute to a reasonable management of these precious areas by supporting both its ecological and recreational values.

Key words: bank stabilization, grain size distribution, lowland floodplains, post-mining sites, recreation

Introduction
In the Czech Republic we can find more than 200 registered sand and gravel pits. Their occurrence is associated with the lower stream of larger rivers and most sand and gravel pits are located in river floodplains. Annual production of sand and gravel pits in the Czech Republic (CR) in 2020 was 11.3 million m^3. This mineral resource is relatively limited, but both sand and gravel are important commodities desired especially in construction industry (buildings, road surfaces, or terrain work). According to the study by Czech geological survey (CGS), a large part of the sand and gravel reserves will be extracted within ten years (CGS, 2022).
Due to their location in river floodplains, the excavated pits are often filled with water. A water-filled sand and gravel pit is referred to as a post-mining lake and is an important feature of the landscape with distinct functions. Large water surface creates a new ecosystem, which often includes endangered species of animals or plants. Of course, these areas are also attractive in terms of recreation, i. a. swimmers, fishermen or other water sports. Also the post-mining lakes can act as a natural water reservoir.
On large reservoirs, bank abrasion and bank stability are important factors. The banks of post-mining lakes are not very stable mainly due to the material they are made of – sand and gravel. Waves interacting with such unstable banks only increase bank abrasion. Fine soil particles are washed out of the banks and carried away. There is a risk of landslides, which are a danger especially if the lake is used for recreation. To prevent this, the banks of post-mining lakes need to be stabilized. Bank stabilization has three basic principles - technical, biological (vegetation) and biotechnical (a combination of the previous two). When stabilizing, it is important not only to prevent erosion, but also to utilize the most natural processing possible, that's why biotechnical solutions are often implemented (Šlezingr, 2005).
As already indicated, the post-mining lakes have a huge recreational potential. From a locality to which the public previously did not have access to, it changes into a place with recreational opportunities for citizens from the surrounding area. The challenge with the management of such areas lies in finding the right balance between allowing people to recreate while still sustaining the ecosystem functions of the post-mining lake. This process is linked to the above-mentioned biotechnical bank stabilizations. Their purpose is to revitalise the lake to its natural appearance and at the same time make it a safe place for recreation.

Material and methods
In this article we present a unique low-cost approach how the stability can be improved. The data come from a post-mining lake where the following experiment was carried out during 2019-2021 as

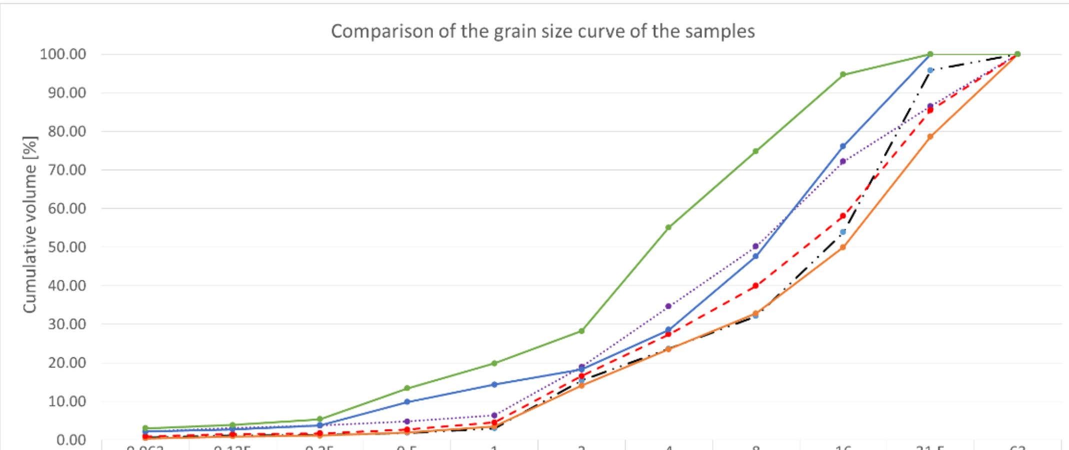
part of a project supported by the Internal Grant Agency of the Faculty of forestry and wood Technology of Mendelu in Brno (IGA). The former mining site is situated near Hulín city, in the Zlín region. The reservoir is located in the Morava river floodplain. The water area is more than 60 ha with steep banks. The so-called “wet sand and gravel mining” took place in the mining-lake.
The basis of the bank stabilization experiment was sloping, followed by direct bank stabilization at the abrasion platform. There we expect the damage of water erosion to happen. Three experimental segments were created to simulate for bank erosion observation. All segments were sloped to 1:10, 1:5 and 1:2. In segment A, the bank was provided with a wooden palisade and weed plantings. Segment B was stabilised with willow cuttings and as a supplement with reed stabilisation. Segment C was partly stabilised with a gravel layer and with willow cuttings.
To prove the functionality of bank stabilization, the grain size distribution curve analysis was performed. The analyses were performed on pre- and post-stabilization soil samples. A sieve analysis was performed on each sample. This analysis consists of removing the sample of the finest particles and then sieving it through a system of different mesh size sieves. A grain size distribution curve is then formed from the sample treated this way. A hydrometer test was also performed on samples from the post-stabilization period. This test consists of measuring the sedimentation of fine particles (under 0.063 mm).
The bank stability was treated as one of the most important limits to the recreational potential of the lake. The recreational potential was assessed using a SWOT analysis, which included a number of factors related to this issue.

Results

The monitoring of the site

The visual monitoring of the experimental site on segments A-C proved that the sloping of the bank in the ratio 1:10, 1:5 and 1:2 towards the bank ensured the lowest run-up of the wave with gradually reducing its momentum and erosion potential. It turned out to be a very efficient way to achieve slope stabilisation. We found that the waves did not reach the steepest slope section by the former abrasion cliff (resulting in no more destruction caused by waves). This specific structure of sloping was named the “half-bowl shape” and we expect this to be a very effective way to handle unstable banks on this kind of habitat.

The granulometry analysis



	0.063	0.125	0.25	0.5	1	2	4	8	16	31.5	63
PL2PŘ	0.66	1.20	1.32	1.83	3.02	15.43	23.64	32.14	53.86	95.82	100
PL2Z1	0.39	0.93	1.12	1.97	3.53	14.11	23.54	32.86	49.99	78.67	100
PL2P	2.19	3.12	3.78	4.83	6.41	18.95	34.63	50.21	72.22	86.52	100
9	0.98	1.55	1.74	2.69	4.52	16.61	27.39	39.95	58.07	85.46	100
A1	2.21	2.80	3.85	9.84	14.39	18.27	28.56	47.61	76.16	100.00	100.00
A2	3.05	3.86	5.42	13.38	19.88	28.24	55.08	74.86	94.73	100	100

Fig. 1: Comparison of the grain size distribution curve of the samples from the shores (PL2PŘ-9 were taken in 2019, A1 and A2 were taken in 2021).

The comparison of the grain size distribution curves of the individual samples (Fig. 1), we can see a markedly finer-grained composition in the soil samples taken after bank stabilization. We can conclude that this method of stabilization was useful to mitigate the wash out processes of the fine soil material.

The evaluation of the recreational potential

One of the main goals of this article was to evaluate the use of the recreational potential of the post-mining lake and connect it to the importance of the bank stability.

Tab. 1: SWOT analysis of the recreational potential

STRENGHTS	**WEAKNESSES**
Good transport accessibility	Erosion
Multifunctional area	Steep shores
Species diversity	
OPPORTUNITIES	**THREATS**
Bank stabilisation	Parking spaces capacity
Stabilization measures	High attendance
	Endangerment of animals and plants

The main strength is the multi-functionality of the area. Swimmers, fishermen, bird watchers, ordinary tourists and cyclists, as well as water sports, will all find their place here. The location is also easily accessible from the surrounding urban areas; in addition, it is connected to the natural park Záhnilické ponds. This however poses one significant risk - overloading the site with attendance. Due to its location, the post-mining lake can be expected to be a tourist destination all year round. Too many visitors could endanger and disturb the rare species of plants and animals that might dwell in the locality. Due to the unstable sand and gravel, they could also cause further erosion, which is important to prevent. At present, the main risk for visitors is the steep sloping of banks of the reservoir as well its shoreline. Not far from the shore, the bottom falls sharply and thus creates an obvious danger for the inexperienced visitor. This problem, as well as the potential risk of landslides, is being addressed by bank stabilization and other measures and was indicated as the most important weakness in the SWOT analyses (Tab. 1).

Discussion

The transformation of post-mining sites into areas satisfying both public recreation and ecological needs is a common and expectable challenge that follows nature resources exploitation and reshaping of the landscape (Słonina et al., 2019). Wave run-up behaviour and research on reservoirs is being studied (Hager and Evers, 2020) as well as the role of coastal vegetation on the shoreline protection (Gedan et al., 2011; Zhao et al., 2021). Considering the stabilisation methods we recognised that most appropriate technique was a 1-2 m narrow reed belt combined with a 5-7 rows wide stand of willow shrubs. Planting of willows on the site was also one of the key means to ensure the long-term slope. Another benefit of the added biological stabilisation was the initiation of natural succession processes which resulted in effective, yet semi-natural bank stabilisation. Interestingly, the gravel layer in segment C did not perform significantly better; rather it limited the speed of the natural regeneration of the willows as compared to segments A and B. However, it has to be noted that in specific cases, bare banks can be considered as important for appearance of endangered species (Brus et al., 2020) such as bee-eaters (*Merops apiaster*).

In this paper we outline the possibilities of increased safety for wide range of recreational users. Considering recreation on post-mining sites, we feel insufficient knowledge about the conditions of wheelchair users (Jakúbisová, 2014) is available. Since the usual sloping of banks after technical restoration is 1:1 to 1:2 it is too steep for wheelchair users as reported from forest environment and geocaching (Fialová et al., 2018; Fialová, Matušková, 2020). The half-bowl sloping might server as one of the best-practice solutions combining i) the bank/shore protection against water erosion, ii) speeding-up the succession as a natural habitat iii) enhancing the recreational potential for all sorts of users and groups.

Conclusion

The post-mining lakes have a great recreational potential as well as the potential for ecological ecosystem functions. As a result, rare and endangered species of animals and plants can dwell there. Visitors have a wide range of recreational possibilities, but at the same time recreation in mining areas carries certain risks. One of them is the threat to the ecosystem by excessive attendance; the other is the threat to visitors due to low bank stability. Bank stabilization measures can be used to mitigate this second problem and if located properly along the shoreline might be used to direct recreants to specific parts of the lake thus helping with the problem of excessive recreation as well. The lakes are a valuable artificially created ecosystem and deserve further research.

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Souhrn

Potěžební jezera mají velký rekreační potenciál i potenciál pro plnění ekologických funkcí. Díky tomu zde mohou žít vzácné a ohrožené druhy zvířat a rostlin. Návštěvníci zde mají široké možnosti rekreace. Rekreace v důlních oblastech však s sebou nese určitá rizika. Jedním z nich je ohrožení ekosystému nadměrnou návštěvností; druhým je ohrožení zdraví návštěvníků zejména kvůli snížené stabilitě břehů. Ke zmírnění druhého problému lze použít stabilizační opatření, která mohou být při správném umístění podél pobřeží, použita k nasměrování rekreantů do konkrétních částí jezera. Tím lze take pomoci s problémem nadměrné rekreace. Potěžební jezera jsou cennými uměle vytvořeným ekosystémy a zaslouží si další výzkum.

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THE USE OF FRUIT TREES IN AGROFORESTRY - A CONTRIBUTION TO IMPROVING THE DIVERSITY OF AGRICULTURAL LANDSCAPE AND ITS CULTURAL SERVICES

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Abstract
The paper is focused on the use of fruit trees in agroforestry which falls into the category of alternative farming. In the first phase of the assessment, the possibilities of using fruit trees in agroforestry systems were specified with regard to the type of land, especially on arable land and permanent grasslands to which extensive orchards and gardens have also been assigned. While in arable land, linear planting is considered inside or on the edge of soil blocks, in permanent grassland it is mostly scattered planting within plots. In the case of extensive orchards and gardens, it is a combination of linear and scattered plantings. In the second phase, the categorization of soil-climatic conditions of Slovakia was performed from the point of view of the requirements of individual fruit trees. Adapting the choice of fruit trees to habitat conditions is a basic precondition for their planting on arable land or permanent grassland to be beneficial both for increasing the ecological stability of the agricultural land and for diversifying agricultural activities. It should be recalled that weather fluctuations, including the occurrence of longer periods of drought, especially in lowland areas, will significantly determine the real benefits of integrating fruit trees into agroforestry systems. Although habitat conditions allow for a more even distribution of productive cultivation of fruit trees in the form of agroforestry on agricultural land, to factors that also determine the expansion of fruit trees belong tradition, technological equipment, including post-harvest processing of fruit and, of course, supplier-customer relations. The application of agroforestry on agricultural land can also be perceived as a contribution to enhancement of cultural ecosystem services of agricultural land which creates the basic preconditions for agri-tourism development.

Key words: agroforestry systems, fruit trees, arable land, permanent grasslands, agri-tourism

Introduction

Climate change is accompanied by the occurrence of extreme weather fluctuations, which ultimately affect growing conditions throughout Europe. Individual countries and their agricultural and forestry organizations are thus responding to extreme droughts, floods and other consequences with various recommendations and measures. In terms of mitigation and adaptation measures, the FAO has identified agroforestry as one of the most powerful tools in the context of climate change (Buttoud, 2013).

Agroforestry systems are also coming to the forefront of interest Slovak farmers. These systems offer a wide range of alternative land management, which combines tree cultivation with one or more forms of agricultural production or animal husbandry. In particular, fast-growing woody plants intended for biomass production are used. On the contrary, fruit trees, which have a long tradition in our country, are used much less. Fruit tree crowns, which have been developing for decades, protect the soil from temperature and moisture fluctuations, and the deep root system can supply the tree with nutrients even during the dry season. While tree lines and fruit tree alleys reduce wind speed, the underground root system stabilizes the soil.

The most widespread explanation of the concept of agroforestry and the possibilities of applying this system was developed in the 80s of the last century (The International Centre for Research in Agroforestry - ICRAF). As stated by Dawkins (1997), agroforestry is the collective name for land management and use systems and technologies in which perennial trees are purposefully grown with agricultural crops or animals, in different spatial and temporal arrangements. In general, it is a matter of landscape and economic management, in which the ecological and economic components should be balanced (Sádlo et al., 2005, 2008). At the same time, it can be stated that agroforestry represents the management of agricultural or forest land in various configurations, using both agricultural and forestry technologies (Sutuma, 1996). Kotrba (2014) characterizes agroforestry as agroforestry systems, in which agricultural production and cultivation of woody plants are combined only on agricultural land. In other words, agroforestry is the integration of trees with agricultural crops and / or livestock, taking advantage of economic or ecological interactions (Sinclair, 1999, Ehrenberger, 2014).

It follows from the above that this is not a new concept, only the improvement of the original foundations of agricultural production in the field of soil, biological, microclimatic and economic disciplines. From an economic point of view, agroforestry is today considered a tool that expands the range of products with the maximum use of timber, which has a multipurpose use.

Material and methods

The starting material for this paper is the design of the national project "Economically efficient and environmentally acceptable agriculture", prepared in 2017 by the Central Coordinating Body of the Office of the Deputy Prime Minister for Investment and Informatization. The aim of that project is based on the need to significantly increase the economic efficiency of sustainable land management in relation to the production, environmental and socio-economic requirements of agricultural, food and forestry production. It also includes stage 1.8 "*Agroforestry (agroforestry) systems for combined production and efficient use of agricultural land*", which aims to develop models and methodologies for establishing agroforestry systems for the conditions of Slovakia and to prepare the proposals to amend national legislation for the application of agroforestry systems.
In the first part of this paper, the possibilities of using fruit trees in agroforestry systems were specified with regard to the type of land, especially on arable land and permanent grasslands (Table 1).

Tab. 1: Basic typology for the use of fruit trees in agroforestry on agricultural land

Fruit trees on arable land (AGRISILVICULTURAL)	**Fruit trees on permanent grasslands including extensive orchards and gardens (SILVOPASTORAL)**
Linear plantings of fruit trees inside soil blocks	Planting of fruit trees in meadows and pastures combined with livestock grazing
Linear plantings of fruit trees at the edge of soil blocks such as windbreaks, tree lines, alleys, hedges	Planting of fruits trees in permanent grasslands, gardens and use of extensive orchards in combination with grazing of livestock

In the second part, the soil-climatic conditions of Slovakia were categorized from the view of the requirements of individual fruit species, using the system of soil-ecological units - BPEJ (Džatko, Sobocká et al., 2009). The result of the evaluation was the creation of a four-level categorization of soil-climatic conditions in terms of the suitability of their cultivation.

Results and discussion

Based on the above approach, the suitability of conditions for growing fruit trees within the agricultural land of the Slovak Republic was defined, while the selection of site conditions was focused on those that create a basic precondition for achieving fruit yields in the required quality and achieving of cultivation profitability. The suitability categories of soil and climatic conditions for growing fruit trees are summarized in Table 2.
Although agricultural land in Slovakia allows profitable cultivation of the vast majority of varieties of fruit species, there are also localities where the cultivation of fruit species is not suitable (Zone 4). The assessment of Slovakia's soil and climatic conditions through the real possible production of fruit cultivation is based on the well-known fact that the highest yields and thus also the economic profitability can be expected in the lowlands as with increasing altitude the production potential of soils decreases.

Tab. 2: Categories of suitability of soil-climatic conditions for the use of fruit trees in agroforestry

Zone 1 very suitable	- the area of the very warm region (00, 01, 03-04) of the warm lowlands (Nt) - optimal conditions with respect to all soil-ecological parameters - growing the most demanding varieties of fruit trees
Zone 2 suitable	- Lowlands including warm to moderately warm climates (02, 04-05) lowlands (N) - one parameter of BPEJ is less suitable but regular and high-quality fruit yields can be achieved by suitable agrorechnics - cultivation of demanding varieties of fruit trees
Zone 3 less suitable	- hilly areas covering moderately warm to moderately cold climate (02,05, 06-08) hilly (P) - two or more parameters from BPEJ are less suitable - growing less demanding varieties of fruit trees
Zone 4 inappropriate	- areas of highlands in the climate zone slightly cold to cold, slightly humid and very cold humid climate (08, 09, 10) – highlands (V) in very rugged territory and highly sloping terrain - unsuitable for intensive cultivation - growing fruit trees only as an additional ingredient

Assumptions of the application of fruit trees in AFS on arable land

The perspective of the use of fruit trees on arable land lies mainly in linear plantings inside soil blocks in combination with cereals, root crops, vegetables or honey plants (medicinal, aromatic and spice plants). Linear plantings along the edges of soil blocks can be used to reduce wind and water erosion, or to separate soil blocks to enhance the biodiversity. Linear plantings can simultaneously provide fruit production.

In combination with the cultivation of fruit trees with agricultural crops in one area, the use of trendy growing shapes and more powerful varieties is required, which is stated in the "*Pomology of the second half of the 20th century and the first years of the 3rd millennium*" (Hričovský et al., 2008). The non-native tree hazel (Corylus colurna L.), almond (Amygdalus communis / Prunus dulcis Mill.), and alder flycatcher (Amelanchier alnifolia L.) also have good adaptability to drought.

Agroforestry systems on arable land, whose production potential has a higher production potential compared to permanent grasslands, allow the use of current, but also more demanding fruit trees, such as hybrids (Juglans regia L.), whose gene pool diversification can improve not only fruit yields but in particular to contribute to the wood biomass indicator. The royal hybrids Juglans nigra × Juglans hindsii have acquired drought resistance from Hinds' walnut and great growth from black walnut (Bakay, 2021).

In addition to walnut hybrids, hybrids of the chestnut (Castanea sativa Mill.), such as marons, "Belle Epine" and "Bouche Rouge" varieties, appear to be a promising tree for agroforestry, not only on arable land, due to their versatile use (Pekárová, 2021).

High ecological and economic potential is also offered by the planting of multi-purpose fruit trees which separate agricultural land from watercourses provided that herbaceous vegetation is also present, which increases the efficiency of nutrient capture when soil erosion occurs.

Integrated production under the rural development program is a promising platform within which agri-silvicultural systems on arable land using fruit trees could be supported.

Assumptions of the application of fruit trees in AFS on permanent grasslands

The use of fruit trees in meadows and pastures (the so-called AFS system) with the parallel breeding of livestock (e.g. grazing sheep, goats, cows) seems to be promising in the conditions of climate change.

Tradition fruit trees are suitable for extensive cultivation, as they have the ability to survive in often unfavourable soil and climatic conditions.

These are mainly local and regional varieties, in the case of apple and pear trees a branch in the shape of a half-trunk (approx. 1.6 m) and in the case of cherries partly also a high stem at a trunk height of 1.8 m with a two-year-old crown. In the extensive conditions, it is advisable to follow other principles as well. It is suitable to plant high-stem species on large areas, resp. solitary fruit tree species, such as black / white mulberry (Morus nigra / alba L.), domestic apple (Malus domestica), or forest apple (Malus sylvestris L. Mill.).

For smaller areas, it is advisable to plant, for example, black bass (Sambucus nigra L.), dogwood (Cornus mas L.), honeysuckle (Cydonia oblonga Mill.), blackthorn (Prunus spinosa L.), hawthorn (Crataegus laevigata) or hazel (Carylus avellana L.).

To use all benefits of agro-forestry system it is possible to plant hedges or tree lines, which can create a natural transition from the forest environment to agricultural land. Of the low-demanding and at the same time resistant fruit trees, it is possible to mention bird cherry (Cerasus avium L. Moench.), medlar (Mespilus germanica) or mirabelle.

The target number of fruit trees should be up to 100 trees per ha with scattered or regular distribution on the cultivated area and edges (Lojka et al., 2020). The creation of a group of fruit trees serves as a vegetation cover for animals in unfavourable weather. In order to ensure a balance between trees and grazing, it is necessary to keep the crown airy and at the same time allow enough solar energy to create grass and herbaceous biomass under the treetops. The greater distance between the trees reduces the occurrence of diseases and pests, while apple seedlings and planks are naturally more resistant to weather fluctuations.

One of the advantages of the silvopastoral system is the use of cut tree shoots as animal feed that prefers them. From a practical point of view, it is not necessary to prepare these plots before tree planting because grass cover remains. However, in the first years after tree planting is to secure trunk protectors against animals. Extensive uses of fruit trees, combined with the permanent grassing of agricultural land, have a positive effect on the biodiversity of plant and animal communities, while supporting soil quality. Organic farming under the rural development program is a promising platform within which silvopastoral systems using fruit trees could be supported.

The growing interest in natural resources (soil, water) is forcing us to participate more actively in land management. However, natural resource and landscape management require diversified management approaches. The implementation of strategic goals in the field of sustainable growth is not possible without sustainable regions. Sustainable regions are significantly linked to rural population retention, as the associated economic activities have a primary impact on the environment.
Given the many vital functions of land for society and man, suitable areas for agriculture, forests, recreation and tourism should be used efficiently. As state Bujnovský et al. (2009), the use of agricultural soil as space for recreational purposes and tourism has till now the limited importance because the development of agri-tourism is less dependent on soil parameters. For these activities are usually attractive pre-hilly and hilly areas. However, the application of agroforestry on agricultural land can also be perceived as a contribution to increasing the attractiveness of agricultural land in terms of agri-tourism development, because some cultural biotic ecosystem services related to "Phsical and experiential interactions with natural environment" and "Intelectual and representative interactions with natural environment" defined by the classification of ecosystem services CICES v. 5 (Haines-Young and Potschin, 2018), may be positively influenced by the development of agroforestry.

Conclusions

As in the case of sustainability, as well as in connection with the adaptability of the agroforestry system, clear criteria have not yet been set according to which the individual systems would be evaluated and compared with each other. The evaluation or setting of measurable indicators from the environmental point of view and the subsequent setting of subsidy schemes in the agricultural sector is also difficult.
As the use of large-scale mechanization is lower in agroforestry systems, it is assumed that this form of farming in Slovakia will appeal mainly to medium-sized farms and family farms, which can help not only maintain biodiversity but also contribute to diversification of agricultural products and elimination of possible risks associated with monoculture crop production. Agroforestry systems they can contribute to the development of beekeeping and also partially compensate for the current deficit in the food processing sector. Nevertheless, in this context, it is recalled that agroforestry systems are not an alternative to conventional agriculture.
The implementation of agroforestry through fruit trees in combination with other agricultural crops or the grazing of livestock on a single plot can contribute to restoring the natural ecological balance to the agricultural land and to gradually improving the business environment in agriculture. In the conditions of climate change and the occurrence of drought, the priority should be given to fruit species that will not only be able to survive, but also contribute to increasing production and non-production functions in the landscape. Optimal soil and climatic conditions within the agricultural land make it possible to include fruit trees in the agroforestry system. As stated by ŠARAPATKA (2008), the increase in the number of fruit trees within the production areas of agricultural land can be seen as a contribution to increasing the biodiversity of the agricultural environment.
Although site conditions allow a more even expansion of productive fruit growing in the form of agroforestry on agricultural land, factors that probably also determine their increase in cultivation include tradition, technological equipment, including post-harvest processing of fruit, as well as supplier-customer relations. As tree planting requires long-term land use, problems with land ownership or lease is another area that needs to be kept in mind when expanding agroforestry in Slovakia.

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Souhrn
Agrolesnictví jako specifická forma hospodaření se dostává v současnosti do popředí prostřednictvím liniových výsadeb dřevin nebo krajinných prvků. V našich půdně-klimatických podmínkách jsou největším potenciálem pro agrolesnické systémy extenzivní výsadby ovocných dřevin, přičemž je třeba zohledňovat jejich víceúčelové využití. Implementace agrolesnictví prostřednictvím ovocných dřevin může přispět k navrácení přirozené ekologické rovnováze do obhospodařované země. Posuzování specifických možností ovocných dřevin lze vnímat jako příspěvek ke zkvalitnění kulturních ekosystémových služeb, což vytváří základní předpoklady i pro rozvoj agroturistiky.

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THE USE OF WASTE TIRES IN RECREATIONAL AREAS AND THEIR IMPACT ON THE ENVIRONMENT

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Abstract
Hobby recreation is most often associated with activities in the countryside, consisting of plant cultivation and cottage farming in personal recreational facilities. These are often called „a second home“ which the owner together with adjacent land in personal ownership has to care for. Vacationers often make use of different means to minimize manual labour to maintain their gardens nice. One of them is the use of waste tires and products made from them. Presuming that a tire is a durable and harmless material, they apply it to the soil (rubber granulate) or use it as planting pots for growing vegetables. Such a waste tires or granulate can also appear to be a design element that can help minimize time spent in garden maintenance (water retention, weed control etc.). Although the tire seems to be a very practical product and material, it is also a waste that can be hazardous to the environment and human health due to its composition. This study evaluated the effect of waste tires microparticles using a 28-day subchronic phytotoxicity test (repeated container experiment with substrate and determined microparticle proportions of 0%, 5%, 25%, 50% and 75%) using selected plant species: *Lepidium sativum* L. and *Sinapis alba* L. The evaluation of the test showed in several cases increased phytotoxicity of the substrate after prolonged exposure of microparticles in the soil.

Key words: Phytotoxicity, pot experiment, microplastics, recreation

Introduction

The landscape, as a part of the earth's surface with a characteristic relief, includes cultural and natural elements that are influenced by man (Nassauer 2012; Act No. 114/1992 Coll. On nature and landscape protection). With the growing interest in living in recreational areas, it can be expected that the tendency of human impacts on the landscape and the environment will be set in a negative direction. One of the many impacts is the waste production. Waste tires WT (hereinafter "WT") are an example of waste whose production has been growing every year. Due to this fact we can see WT in nature in the form of illegal landfilling (Šourková et al., 2021a).

However, over the years, human attitude to the issue of have gradually changed, and in recent years we have seen efforts to reuse them (Baessler, 2022; Zafara, 2022; Wolken 2021). WT thus become quite widely used in domestic conditions, especially in recreational areas, e.g. for replacing flower pots for growing plants, for strengthening banks of driveways, or replacing vegetable mulch with rubber, etc.

Grant (2022), for example, states that the use of rubber mulch from WT has many positive properties: material resistance, moisture retention and weed permeability compared to the use of conventional bark mulch.

The whole tire, on the other hand, can be used to create mini-gardens for growing vegetables and plants. Here, too, there are several advantages. These mini-gardens are not demanding on water and fertilizers. Thanks to their black color, they absorb more sunlight – the soil heats up faster and the heat stimulates plant growth (agrifarming.in).

Due to these properties, products made from WT are marketed by retailers as a durable, safe and non-toxic material for use in the gardens of holiday homes (Brown 2019; Chalker-Scott, 2018). The question remains whether products made from WT are really safe and non-toxic to human health and the environment.

The tire must be seen as a complex product composed of many components and combined ingredients. (Prokešová, 2021). The main components (approx. 50%) are rubber polymers (synthetic and natural), carbon black (approx. 30%) and plasticizers (approx. 15%). Furthermore, the tire is composed of steel, textiles and chemical additives (accelerators, vulcanizing agents, antidegradants and activators), thanks to which it has its unique properties (Šourková et al., 2021a; Senin et al., 2016; Wik and Dave, 2005). The composition of the tire itself seems to be problematic and arguable for application to plants or growing vegetables. Another reason is the degradability of the tire, which over the years releases toxic microparticles containing polycyclic aromatic hydrocarbons and heavy metals,

thus contaminating soil and plants (Leifheit et al., 2021; Šourková et al., 2021a; Šourková et al., 2021b; William and Shenker, 2016; Wik and Dave, 2005).
The aim of this study is to evaluate the development of the toxicity of microparticles released from WT in soil, after a 6-month period.

Materials and methods

As part of the monitoring of the long-term effect of microparticles released from WT, a repeated subchronic toxicity test (so-called container experiment) was performed with predetermined procedures according to the standard ČSN EN 13432 – Determination of ecotoxic effects on higher plants (ČSN EN 13432). The substrate used in this experiment was already prepared in the study Šourková et al., 2021b, according to the European standard, which determines its given composition. It is a mixture of peat, standardized soil and silica sand. Microparticles from WT were applied to the substrate in proportions of 5%, 25%, 50% and 75% (in three replicates), including a control sample without microparticles – a total of 30 terracotta test containers. The seeds of *Lepidium sativum* L. and *Sinapis alba* L. were exposed to microparticles for 28 days and regularly watered with distilled water (DW). At the same time, the number of germinated seeds/growing plants was monitored.
After a set time, the root growth inhibition (IR) results of the plants were interpreted. IR values (%)> 110 indicate stimulation, IR values <90 indicate inhibition (phytotoxicity) and values in the range 90–110 are classified as no effect (non-phytotoxic) (Šourková et al., 2021b; Šourková et al., 2020; Baran and Tarnawski, 2013). The determination of IR (%) was given according to Equation (1):

$$\mathbf{IR = (N_T/Nc) \times 100\ [\%]} \quad (1)$$

where N_T is the germinated seeds/growing plants in the test substrate and N_C are the germinated seeds/growing plants in the control substrate.

The experiment was terminated by dissecting the plants from the substrate. The substrate was kept in cold conditions. After 6 months, individual substrate samples, with predetermined proportions of WT microparticles (0% – control substrate without microparticles, 5%, 25%, 50% and 75%) – a total of 30 samples, were left for 3 days at room temperature 20 ± 2 °C and then reinserted into individual pots. To test the phytotoxicity, seeds of *Lepidium sativum* L. and *Sinapis alba* L. were incorporated into a substrate containing WT microparticles. For 28 days, the substrate was watered with DW and the number of germinated seeds/growing plants was monitored. After the specified time, the results were interpreted according to Equation 1.

Results and Discussion

The results were compared with the standard ČSN EN 13432 to interpret the experiment with subchronic toxicity. The initial value for comparing the results is the number of germinated seeds/growing plants in the control sample, without the addition of microparticles, i.e. IR = 100%. If the IR indicator falls below 90%, it can be stated that this is a sample having phytotoxic effects on plants (ČSN EN 13432).
The classification according to Baran and Tarnawski (2013) is used to evaluate the condition of other samples whose indicator showed values above 90%. This indicates that an indicator showing values above 110% (IR (%)> 110) classifies a sample with stimulating effects on plants. Indicator values in the range of 90–110% are classified on the basis of germinated seeds/growing plants as non-phytotoxic (no effect).
The range of IR values in the subchronic toxicity experiment for 28 days was between 61%–92% (out of control, IR = 100%), see Figure 1. Based on the results of the study, it was found out that substrates containing 5% of microparticles were the only ones to show no effect (non-phytotoxic/no effect). on *Sinapis alba* L. (IR = 92%) and *Lepidium sativum* L. (IR = 91%). Substrates containing 25%, 50% and 75% of microparticles were evaluated as phytotoxic based on IR values of germinated seeds/growing plants of *Sinapis alba* L. and *Lepidium sativum* L. Thus, we can state that with increasing amount of microparticles released from WT, the adverse impact on plants increases due to the action of phytotoxic substances (Šourková et al., 2021b; Block et al., 2019).
The same experiment was carried out by Šourková et al., 2021b. Figure 1 presents the results of this study and compares it with the study performed in 2021, where the subchronic phytotoxicity of WT microparticles was evaluated 28 days after incorporation into the substrate. To monitor the further development of phytotoxicity, the soil with the microparticles, was left (aging of the soil sample) in a cooling box for 6 months. Subsequently, the medium was used to test the phytotoxicity and to monitor possible changes in IR values. *Sinapis alba* L. (I.) and *Lepidium sativum* L. (I.) represent the final

growth inhibition values in the study Šourková et al., 2021 and *Sinapis alba* L. (II.) And *Lepidium sativum* L. (II.) represent final values in this study.

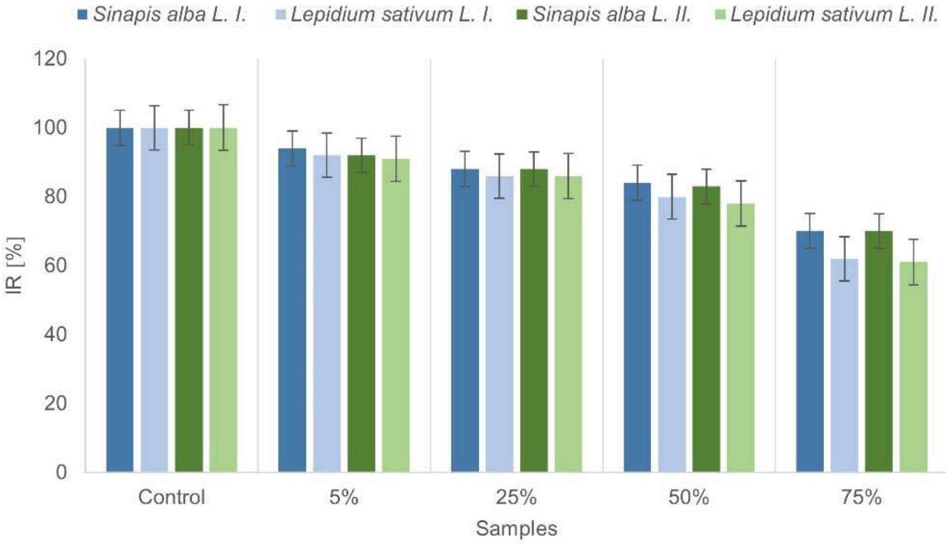

Fig. 1: Final growth inhibition values *Sinapis alba* L (I.) and *Lepidium sativum* L. (I.) in experiment by Šourková et al., 2021b and *Sinapis alba* L (II.) and *Lepidium sativum* L. (II.) after repeated testing (after 6 months).

It was found that the long-term occurrence of WT microparticles shows a slight increase in phytotoxicity (growth inhibition), i.e. a decrease in IR values, in some samples. Specifically, these are samples of substrates with 5% of microparticles with *Sinapis alba* L., where growth inhibition increased by 2.1%, and substrates with 50% of microparticles with *Sinapis alba* L., where there was an increase of 1.2%. Then there are samples of substrates with *Lepidium sativum* L. with a 5% proportion of microparticles, where the growth inhibition increased by 1.1%, and with a 50% proportion, where there was an increase of 2.5% and with a 75% proportion of microparticles, which showed an increase in growth inhibition by 1.6%. The other samples showed the same values as in the experiment carried out 6 months ago.
The use of WT in recreational gardens and also outside of them may be associated with an increased risk to the environment. Systematic research into the impact of WT on individual components of the environment is needed. In addition to existing standards and regulations, a quantitative analysis of the environmental impacts of tires over the whole life cycle is extremely important for understanding sustainability in the tire industry. Further research is required.

Conclusion
The aim of this study was to evaluate the development of the toxicity of microparticles released from WT remaining in the soil for 6 months. Based on the results of this research the phytotoxicity of a substrate containing 25%, 50% and 75% of microparticles was demonstrated, therefore it is not appropriate to use the products from WT or the WT themselves as a decorative element in gardens or for growing plants and vegetables.

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Souhrn

Tato studie hodnotila dopady využití odpadních pneumatik a výrobků z nich v zahradách rekreačních oblastí. Pomocí subchronického testu toxicity byl zhodnocen vývoj působení mikročástic z odpadních pneumatik v substrátu, připravený v laboratorních podmínkách. Bylo zjištěno, že chronická přítomnost mikročástic v substrátu, stále uvolňuje látky, které působí toxicky na pěstované rostliny. Tyto částice s sebou tak mohou nést rizika pro životní prostředí i zdraví člověka.

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TOURIST POTENTIAL OF WEISSHUHN'S RACE IN ŽIMROVICE IN THE OPAVA REGION

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Abstract
The aim of the paper is to point out the issue of navigation canals as potentially attractive tourist destinations. There are a number of these structures in the Czech Republic, but many do not receive as much attention in terms of tourist promotion as they deserve, given their cultural, historical and technological value. Weisshuhn's race in Žimrovice has been operating continuously since 1891. It was chosen as an example as it represents not only a unique water management facility, but also a regional attraction with a tourist potential, the evaluation of which is the subject of this paper. The evaluation of the race itself is based on a detailed assessment of the construction technology and its comparison with similar structures in the Czech Republic, including consideration of other aspects relevant in terms of tourism.

Key words: Industrial heritage, navigation canal, race, water management, Weisshuhn

Introduction

Water management structures are popular tourist destinations. The waterworks conditioned the development in their surrounding and either directly or indirectly influenced the landscape character. Also they are often technically unique. Therefore, these objects often have considerable tourist potential. An example of such a water management system is the Weisshuhn’s paper mill canal in Žimrovice (henceforth ‘race in Žimrovice’) near Hradec nad Moravicí, Opava district, Czechia (Fig 1).
The paper mill with the water management system was built by a prominent industrialist Carl Weisshuhn (1837-1919), who gained a wealth of experience with wood processing, paper production and water propulsion on his trips abroad and in his previous business activities in the region. He operated several mills, sawmills and wood cutting plants along the Moravice River. He also contributed to the development of Jánské Koupele spa resort and participated in the construction of railways and roads. His unrealised plan was to build a sam near Kružberk, where the dam was actually built a few decades later ((SOkA Opava, Sonnek L., nezpracovaný fond, karton 44, kronika ; Jirásek a kol., 2019; Weisshuhn, 2001).
The unique water management system, consisting mainly of the upper and lower weir, and the paper plant are still operating. Nevertheless, they are not of much interest. Therefore, the aim of this paper is i.) to describe the technology of the water management system based on reconnaissance and historical research, ii.) to evaluate its tourist potential, and iii.) to compare it with similar hydrological structures in Czechia.

Materials and methods

The database of CzechTourism, the Czech Statistical Office and the web portal of Moravian.Silesian Region were used as a source of input data. As for map materials, the Base map of the Czech Republic 1 : 10 000, the tourist map of Mapy.cz map application, historical topographic maps and ortho-maps from the 1950s were used. Historical research of the paper mill’s hydraulic complex was based on the excerption of archival materials, in particular the Provincial Archive in Opava and the State District Archive in Opava.
The mapping o the weir’s sections, related objects and description of their current state were conducted by detailed field survey in the period 2019-2021. The survey was carried out during the full operation, but also during the period of repairs of weir’s banks and bottom when the weir’s trough was drained. The evaluation of the weir in terms of its potential for monument protection was realised using the methodology introduced by Ryšková et al. (2021).

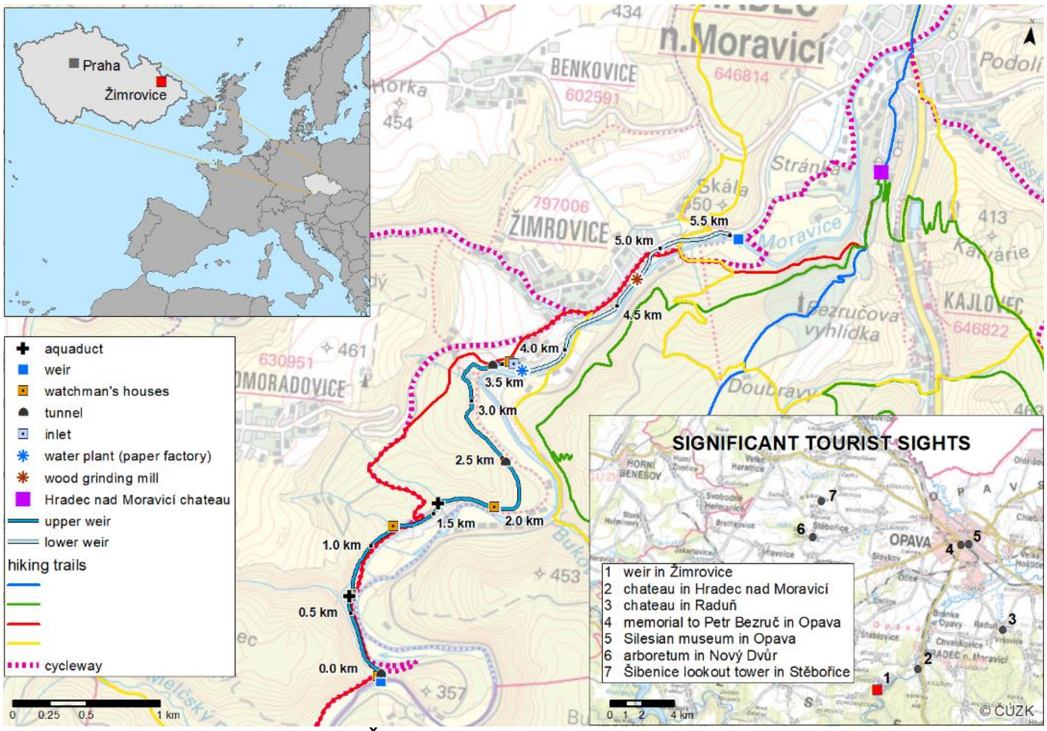

Fig. 13: The course of the race in Žimrovice, location of important water management facilities, localisation of other tourist sights in the Opava region.

Results

History and description of the functional unit of the race in Žimrovice

The construction of the functional unit of the paper factory and the hydraulic structure started in 1890 and completed a year later. The race, about 3.6 km long, runs along the left bank of the Moravice River. Water is taken into it above the weir in the neck of and incised meander of the Moravice River about 3 km upstream from the paper factory. On the race there are 3 tunnels broken in the rock and 2 aqueducts over minor tributaries of the Moravice River. The riverbed has a rectangular to trapezoidal shape and is usually 4-5 m wide. It was originally lined with stone (Fig. 2A), part of the trough is on the bedrock. At the end of the race there is an outlet for crushed ice and dirt (Fig. 2B) as well as a relic of the opening of the connection of the wooden gutter to the floating wood with an outlet to the paper factory warehouse. There are also watchmen's houses along the race. At the end of the upper race there is an intake cone, from which the shaft (slope 22 - 23.5 m, water flow 4 m^3/s) originally led to up to 8 Girard turbines from the Zurich company Escher, Wyss & Co. (SOkA Opava, Sonnek L., nezpracovaný fond, karton 44, kronika). Two of them were replaced by Francis turbines in 1906. From the turbines, the water was led through a tale race emptying into the Moravice River.

The tale race soon had to be lengthened due to impoundment. Therefore, the race can be divided into parts above (upper race, functional) and below (lower race, non-functional) paper mill. In this arrangement the length of the whole system has been approximately 5.5 km. Between 1912 and 1921, a wood grinding mill was established on the lower race (SOkA Opava, OÚ Opava, inv. č. 873, karton 1052). However, its operation was not profitable, and later was shut down. But the race was used for the propuslsion of a hydroelectric power plant supplying the paper factory with electricity.

The turbines in the paper factory underwent reconstructions in 1926-1927. The original Girard and Francis turbines powered by water from the upper race were replaced by two modern and more powerful Francis turbines from Českomoravská Kolben with a Siemens Schuckert generator with an output of about 2 x 560 kW (SOkA Opava, Sonnek L., nezpracovaný fond, karton 44, Historie Olšanských papíren, 1.díl). These devices have been working in the factory since then (Fig. 2C).

Due to the fact that the race has been in operation since its inception (i.e., for over 130 years), it requires demanding regular maintenance (Fig. 2D). The current owners of the paper factory and the entire hydraulic structure strive for its regular repairs and cleaning with an emphasis on maintaining the authentic appearance and materials used. A local stone is used for repairs. Both aqueducts and several short sections of the race in exposed steep places, which were disturbed at higher water levels, have been concreted to ensure both their function and safety.

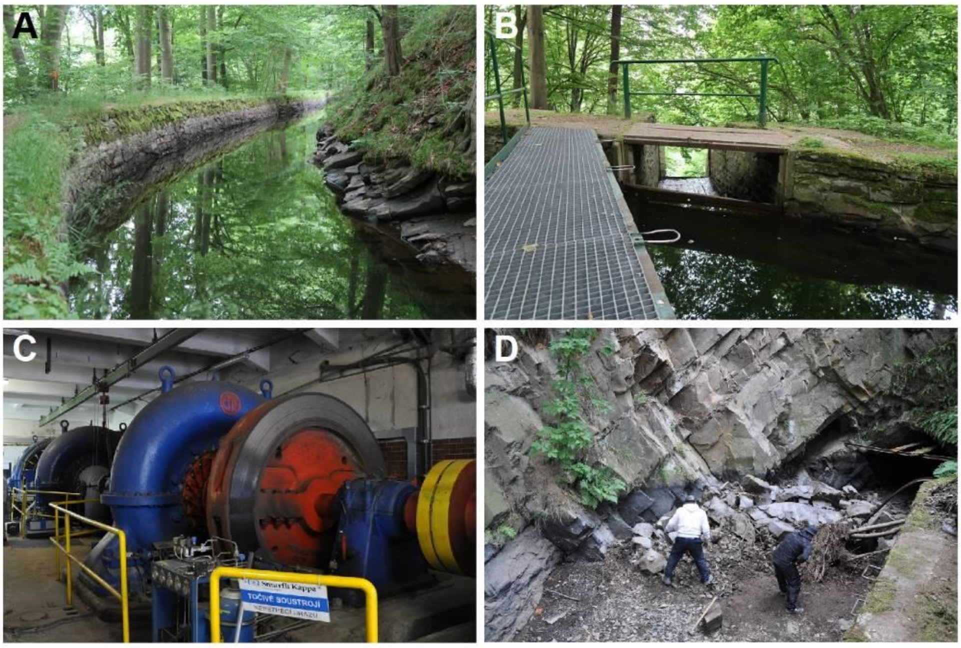

Fig. 2: A) stone masonry race; B) side outlets for discharging dirt and crushed ice; C) the original Francis turbines and generator from 1926 still in operation; D) ongoing maintenance of the race body.

Tourist potential of the paper race

The upper race represents an important landscape element, which is sensitively set in the original natural environment. The wider surroundings of the race are a popular destination. The canal is located in the north-eastern part of the Moravice Nature Park dominated by the picturesque valley of the Moravice River. The park is interlaced with cycling and hiking trails.

The race retains its original appearance and form, and along its route, several other buildings have also been preserved that were used for its operation. Along almost the entire race route there is an unmaintained but clear footpath, which in some sections follows a marked hiking trail and a cycleway. It is possible to start the walk from the weir on the Moravice River, above which the race begins. Its first section, right after the gate, goes through a rock tunnel. (Fig. 3A). The watchman's houses along the race are all preserved, although in an altered form (Fig. 3B). The so-called inspectional holes can are found in the tunnels (Fig. 3C). Thexy were used to prevent the tunnels from blockage during the timber navigation. The route of the upper race is 3.6 km long and it is possible to come over two aqueducts almost to its end at the intake object (Fig. 3D). There are also semi-functional wooden sluice for brash-ice and alluvial dirt and a relic connecting a wooden gutter for wood into the paper factory (Fig. 3D).

In recent years, as public awareness of technical monuments has increased, the paper mill has attracted more and more people. This is also evidenced by the fact that according to a 2014 MF Dnes survey, the race became the most outstanding uniqueness of the Moravian-Silesian Region. Proof of this trend is the fact that in 2014 the upper paper race became the most remarkable uniqueness of the Moravian-Silesian Region according to the MF Dnes survey (IDNES, 2014) and surpassed the urban heritage reservations of Nový Jičín, Příbor and Štramberk. Interestingly, the Ema heap in Ostrava ranked 3rd in this survey.

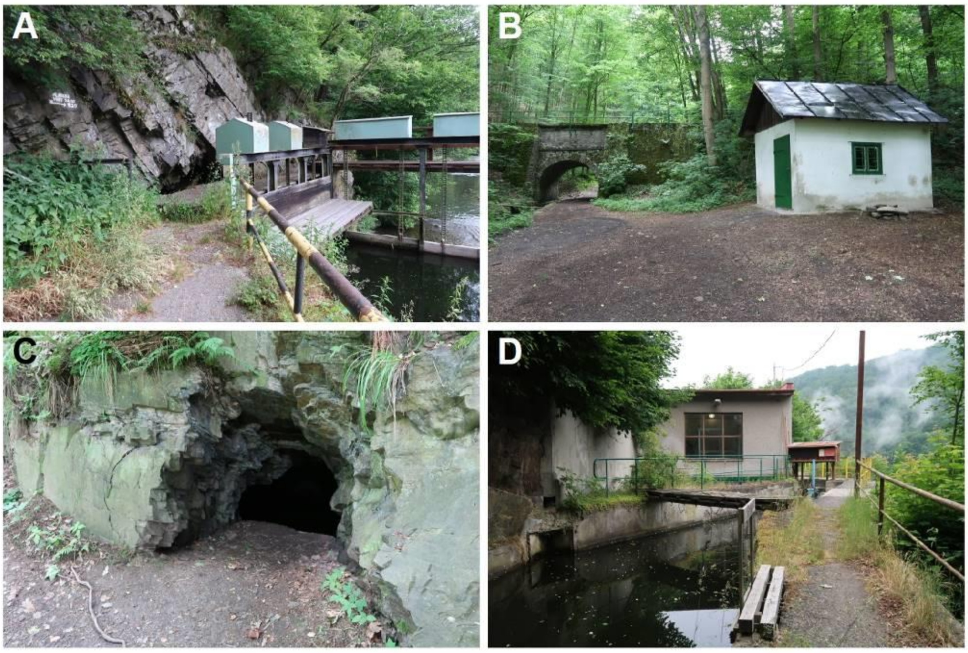

Fig. 3: A) the original floodgate above the weir on the Moravice river and the beginning of the first race tunnel. The left part of the picture shows the water level during the flood in the spring of 1929; B) one of the watchman's houses and an aqueduct; C) viewing hole at one of the race tunnels; D) inlet object to the turbines, in the left part of the picture there is a visible relic of the connection of the wooden gutter, which led to the wood warehouse in the paper mill.

Comparison of the tourist potential of the paper race with selected tourist destinations

Water management structures have recently received increasing attention. Many of them have been declared cultural monuments. According to the Natiaonal Heritage Institute (NHI) database (2022), there are currently 17 navigable canals in the Czech Republic, of which 3 have the highest degree of protection as national cultural monuments – Schwarzenberg Canal in Šumava, Blatenský Trench in the Krušné hory Mts. and the Dlouhá Stoka Canal in the Slavkov Forest. An interesting fact is that 13 of the listed canals were protected before 1958, the remaining 4 were declared a cultural monument only after 2000. According to data from the CzechTourism database (2021), waterworks are among the frequently visited tourist destinations throughout the Czech Republic. The database includes a total of 34 water management facilities, which in 2020 were visited by 266 000 tourists. The most visited sight was the Dlouhé Stráně Pumped Storage Power Plant, a unique hydraulic structure near the village of Loučná nad Desnou (ca. 100 km off the Žimrovice race), with more than 88 000 visitors a year. Another frequently visited object is the Wesselsky watermill near the town of Odry (18 km southwest of the race), which was visited by almost 4 000 visitors..

Since the race is located in close proximity to the town of Hradec nad Moravicí and near the city of Opava, attention was paid to this area, which is very well accessible and there is a number of cultural and natural attractions and sights. According to the CzechTourism database (2021), there are 6 monuments/sights in the immediate vicinity of the race (Figure 1), which in 2020 were visited by more than 130 000 visitors in total (Table 1). The most important destination is the State Castle Hradec nad Moravicí, a national cultural monument located ca. 4 km off the race, which was visited by over 55 000 visitors.

Discussion

The Žimrovice race is an ingenious water management facility, built more than 130 years ago in challenging terrain. Given its technical, historical and cultural attributes, its importance is comparable to that of much better known water management structures such as for example the Schwarzenberg canal or the Blatná canal, which are protected as national cultural monuments. Efforts have been underway since the early 1990s to declare the race a cultural monument to ensure its historical preservation. According to the experts of the National Heritage Institute, the reason for this is the lack of documents in the applications for monument protection and problems related to the delimitation of plots in the land registry. Despite these circumstances, the owner strives for sensitive maintenance and carry out the necessary repairs so as to preserve as far as possible the original character (i.e., material and design). At the same time, however, functional and safety issues need to be taken into account, which sometimes requires interventions such as replacing the original material (stone) with concrete.

Tab. 1: Number of visitors in selected destinations (source: CzechTourism, 2021).

Destination	**Cadastral area**	**Number of visitors in 2020**
Státní zámek Hradec nad Moravicí	Hradec nad Moravicí	55 706
Státní zámek Raduň	Raduň	29 060
Arboretum Nový Dvůr	Stěbořice	23 384
Historická výstavní budova Slezského zemského muzea Müllerův dům	Opava	14 317
Rozhledna Šibenice	Stěbořice	10 000
Památník Petra Bezruče	Opava	217

Declaring the weir a cultural monument would provide the owner with the tools for effective care (such as subsidies or expert advice). Also, it would undoubtedly help to support tourism, the focus of which is the nearby chateau in Hradec nad Moravicí and the attractive nature in the area. It would certainly be useful to create an educational trail connected to the system of hiking trails.

Conclusion

The race in Žimrovice is undoubtedly one of the unique water management structures in the Czech Republic, whose economic, historical and cultural significance for the entire Opava region was significant. Despite this, the Žimrovice race does not receive the attention it certainly deserves, in comparison with similar structures in Czechia and tourist destinations in the immediate vicinity of the race. The results of detailed archival research and field research have shown a great tourist potential of the race in the context of historical and industrial value, as well as natural wealth of this area.

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Souhrn

Weisshuhnův papírenský náhon (1891) patří bezesporu mezi unikátní vodohospodářské stavby v České republice, jehož ekonomický, historický a kulturní význam byl velmi silný pro celý region Opavska. I presto se této stavbě nevěnuje taková pozornost, jakou by si určitě zasloužila, ve srovnání s obdobnými stavbami v České republice a turistickými cíli v nejbližším okolí. Z výsledků podrobného

archivního bádání a terénního průzkumu je jasné, že samotná stavba náhonu má velký turistický potenciál. Zařazení náhonu mezi památkově chráněné objekty by bezesporu napomohlo k jeho propagaci a zvýšení zájmu turistů. Nejen však technologická hodnota, ale současně hodnota okolního přírodního prostředí, představují velký potenciál této lokality k turistickému využití.

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TOURISTS' PERCEPTION OF ROMANIA'S SALT RESOURCES. CASE STUDY: PRAID SALT MINE

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Abstract
The development of tourism has produced the entry into the tourist circuit of new objectives, as is the case for salt mines. Praid Salt Mine is one of the most important objectives that uses the salt resources in Romania, through intense flows of tourists, who arrive in the area for health benefits or leisure activities. To conduct the study, the reviews provided by visitors on the Google platform were analyzed. The central objective of the study was to identify the main dysfunctions, the satisfaction rate of visitors, the main positive points of the Praid Salt Mine, for a sample of one hundred reviewers. The aim of the study is to increase the level of awareness regarding the need to insert tourist objectives in a tourist circuit as authentic as possible, but adaptable to the requirements of visitors, as the online environment has made it easier to get feedback from a large mass of people. The study reveals that most visitors are satisfied with the experience they had in the Praid Salt Mine and feedback can be a starting point in the process of rethinking the marketing opportunities to create a new updated brand, to get even more visibility and benefits.

Key words: tourism, natural resources, sustainability, environment, social media

Introduction

Natural resources have been introduced more and more in the tourist phenomenon, through the growing interest of people in escaping from the urban daily life, with the main purpose of relaxation. Precisely for this reason, tourist flows increase on weekends or in the summer season to forests, rural areas, national parks, nature reserves or even salt mines. The salt resources are extremely important, first of all for their use in the food industry or other related industries, but also by capitalizing on the former salt mines for tourist or cultural purposes, as is the case of the Praid Salt Mine. By using salt resources, health benefits can be combined, by inhaling aerosols loaded with salt particles, and the possibility to obtain impressive income from selling local food, promoting the local brand, but also by selling souvenirs with the signs of Praid Salt Mine. The attraction of the tourists towards the Praid Salt Mine is justified by the large flows of tourists who arrive on the territory of Praid during the summer season, for therapeutic purposes, who visit the salt mine at least once, for the purpose of relaxation or health. An important advantage of Praid Salt Mine is the combination of entertainment activities for adults, such as ping-pong tables, restaurants or even playrooms, along with special playgrounds for children, the opportunity to visit the church within the salt mine, such as and the opportunity to taste local products from local vendors. (Morea et al., 2016; Teodorescu et al., 2020; Teodorescu et al., 2021; Wu et al., 2015)

Material and methods

The research was conducted by analyzing the perception of tourists who previously visited Praid Salt Mine and provided a personal review through the Google Reviews platform, where they could provide a number of stars between 1 and 5 stars, as well as personal comments on previous experiences. . The study proposed to identify the most recent sample of one hundred people with positive reviews and one hundred people with negative reviews, after which the main advantages mentioned by the reviewers were identified, the most important disadvantages, but also the number of stars they have offered in the most recent one hundred comments. The graphics were created using the Microsoft Office bundle, especially Microsoft Excel, while the localization map was created using inkScape 0.91 software.

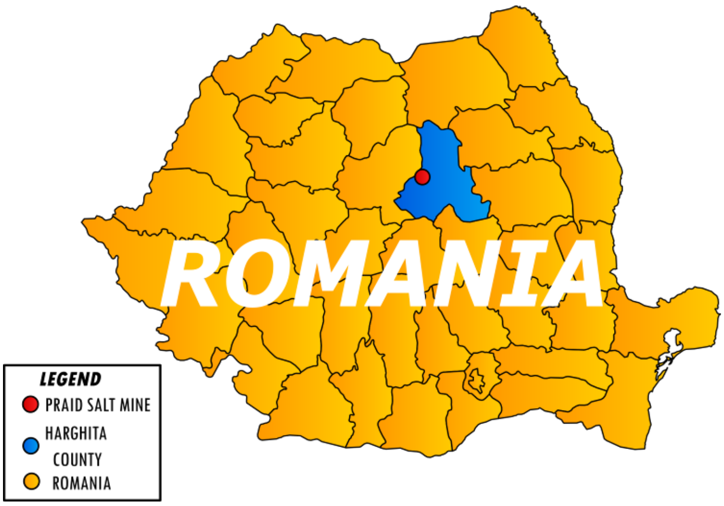

Fig. 1: Localization map of Praid Salt Mine (at local, regional and national level)

Results and Discussions

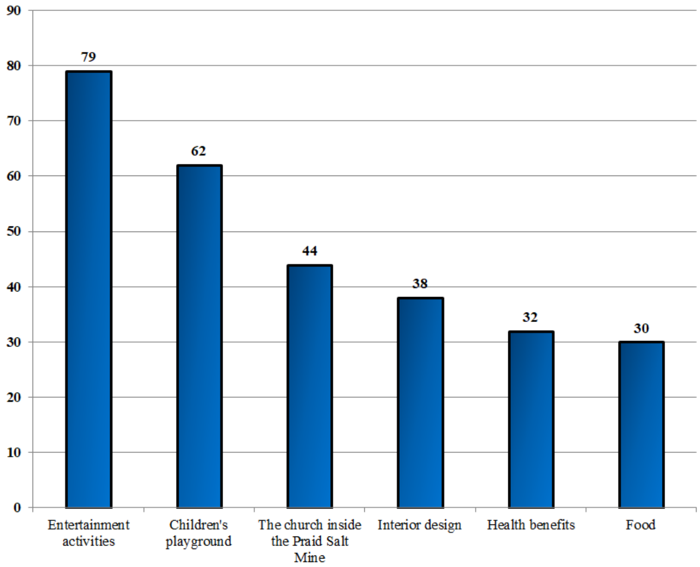

Fig. 2: The main advantages of Praid Salt Mine, according to tourist reviews
Source of data: Google Reviews

79 tourists specified that the leisure activities inside the Praid Salt Mine offer the character of entertainment to the tourist objective, among which the ping-pong tables, playroom, rest area or restaurant, while for 62 of them they were extremely satisfied that they had could offer an interactive activity to children, through the playground organized for them. The cultural objectives are extremely important for 44 tourists, who pointed out that the main plus of the Praid Salt Mine is the church inside, and 38 tourists appreciated the way the Praid Salt Mine is organized, as well as the fact that you can achieve diversified and complex activities that can provide a long time to relax. Only 32 of the tourists who gave reviews through Google Reviews reported that the health benefits were the main plus of the visit to the salt mine, while 30 of the reviewers specified that the food deserves a positive mention. (Figure 2)
The most mentioned dysfunction of the Praid Salt Mine is the overcrowding, which is manifested both in the transport from the surface to the interior, and the overcrowding in the salt mine, manifested by very long waiting times to purchase products, to allow children to enter playgrounds or to get a place in the rest area. At the same time, 71 of the tourists who offered reviews specified that the prices are high for transport, which has an average cost between 5 - 8 euros, but also for the purchase of products inside the Praid Salt Mine, with an average food price of 5 euros per product. Not only organizational or overcrowding aspects can offer unpleasant experiences, but also the interaction with the some staff of Praid Salt Mine or with other tourists, who often do not have the most appropriate attitude, by throwing garbage on the floor, by talking extremely noisy, non-compliance with the waiting

line for the purchase of products or services etc. 14 of the tourists indicated that they would like more local products inside the Salt Mine, as the large number of non-authentic products decreases the value of the local brand, for which many tourists also arrived in Praid. 6 of the tourists specified that they would like the exit or entry routes in Salina Praid to be much easier to identify and follow. (Figure 3)

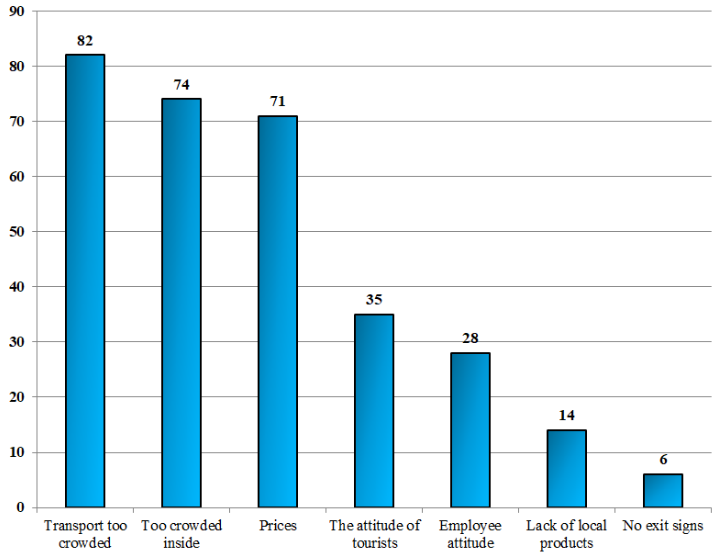

Fig. 3: The main disadvantages of Praid Salt Mine, according to tourist reviews
Source of data: Google Reviews

Most of the tourists who visited the Praid Salt Mine were satisfied, as 78% of the respondents gave the maximum rating for the services, products or experiences they purchased or lived within the tourist objective, while at the opposite pole we can identifies only one person per hundred reviews who was not at all satisfied with what she experienced or purchased at the Praid Salt Mine. 16% of the one hundred respondents who gave ratings to the salt mine encountered small malfunctions, but which did not completely affect the experience within the tourist objective, such as the long waiting time in queues or for the bus to the surface, the overcrowding within the bus to the inside of the salt mine or the high transport prices. In total, only 5% of respondents gave an average rating, consisting of two and three stars, represented by people who encountered significant dysfunctions, but who managed to benefit from the advantages of Praid Salt Mine, during the short visit. (Figure 4)

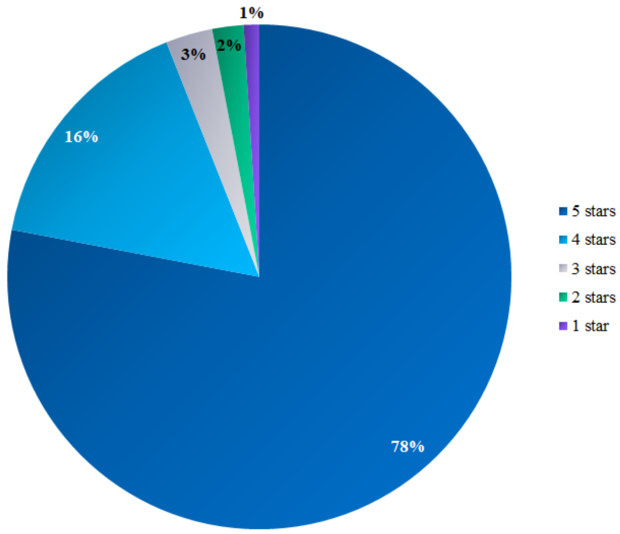

Fig. 4: The number of stars offered by tourists on Google Reviews for a sample of one hundred people
Source of data: Google Reviews

Conclusion

Salt resources are extremely important for tourism, especially when local products, culinary experiences or the hospitality of the locals are promoted, which produces a customer loyalty for a tourist objective that is not in a very active change. It is important to mention that the main way in which tourists would return to salt resources would be the health benefits or a large number of leisure activities that they could re-experience, in case of a new visit. The study met all the proposed objectives, by identifying the main advantages of Praid Salt Mine, namely the large number of activities, the presence of a playground for children, good food, the mix with cultural tourism through the church inside the salt mine, but also health benefits. The study also led to the identification of the main disadvantages, among which the most mentioned being the overcrowding during the transport to the salt mine and also inside it. The study also identified the degree of satisfaction of tourists with the services and products of the Praid Salt Mine, with an average of 4.68 stars per one hundred reviewers, which places the Praid Salt Mine in the top of the most important tourist objectives in Romania related to natural resources. In conclusion, Praid Salt Mine can be an important model for other former areas that have exploited natural resources, such as other salt mines or former coal mines, which could enter into the tourist circuit and could be presented and promoted for a new niche of tourists, who would really appreciate their beauty and uniqueness.

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Souhrn

Rozvoj cestovního ruchu vedl ke vstupu nových cílů do turistického okruhu, jako je tomu v případě solných dolů. Solné doly Praid jsou jedním z nejdůležitějších cílů, které využívají zdroje soli v Rumunsku, a to prostřednictvím intenzivního přílivu turistů, kteří do oblasti přijíždějí za účelem zdravotního prospěchu nebo volnočasových aktivit. Za účelem provedení studie byly analyzovány recenze poskytnuté návštěvníky na platformě Google. Hlavním cílem studie bylo na vzorku sta recenzentů identifikovat hlavní dysfunkce, míru spokojenosti návštěvníků, hlavní pozitiva solného dolu Praid. Cílem studie je zvýšit úroveň povědomí o potřebě vložit turistické cíle do turistického okruhu co nejautentičtěji, ale přizpůsobit se požadavkům návštěvníků, protože online prostředí usnadnilo získání zpětné vazby od velké masy lidí. Ze studie vyplývá, že většina návštěvníků je spokojena se zážitky, které v solném dole Praid zažili, a zpětná vazba může být východiskem v procesu přehodnocování marketingových možností pro vytvoření nové aktualizované značky, aby se ještě více zviditelnila a získala výhody.

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TRANSFORMED LANDSCAPES IN CZECHIA – OPPORTUNITIES FOR THEIR "NEW" RECREATIONAL USE

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Abstract

The paper is based on the ongoing project of the Ministry of Culture NAKI II: Heritage of Extinct Landscapes: Identification, Reconstruction, Accessibility, which is worked on by experts from the entire geographical section of the Faculty of Science, Charles University. As part of the project, we have already analyzed a total of 40 territories of variously transformed landscapes throughout Czechia. Many of them are currently at least partially intensively used by human society, especially for recreational purposes – the Giant Mountains, Central Povltaví, Novomlýnské reservoirs or Most. We will pay more attention to the last-mentioned territory in this article. Most area in the last 200 years has undergone fundamental changes in terms of the micro and macrostructure of the landscape. From agricultural land in the 19th century, through lands affected by intensive brown coal mining and industry in the 20th century, to the currently partially reclaimed land, which is gradually "returned" to nature and the general public, precisely through the conversion of former mining areas into areas suitable for tourism. Over the last 200 years, the landscape of Most area has undergone not only a physical change in structure, but also a change in use and function.

Key words: Development, Change, Tourism, Reclamation, Most

Introduction

The presented research comes from the results of the project of the Ministry of Culture of the Czech Republic NAKI II Heritage of Extinct Landscapes: Identification, Reconstruction, Accessibility. As part of this project, which began in 2018, 40 areas (see Fig. 1) of interest were analyzed across the entire territory of Czechia from the beginning of the 19th century to the present. This project aims to identify, document, and reconstruct the cultural heritage and values of different types of landscapes throughout Czechia. Another goal is to present the diversity of cultural landscape heritage on the example of extinct landscapes and contribute to the creation of conditions for its systematic preservation, presentation, and use by the professional and lay public and relevant institutions, for example, in the field of landscape protection or territorial development. Researchers from the Geographical Section of the Faculty of Science of Charles University from the Department of Applied Geoinformatics and Cartography, the Department of Social Geography and Regional Development, and the Department of Physical Geography and Geoecology participate in the above research. Each locality of interest is comprehensively analyzed based on physical geographical data (environmental quality, relief, climatic conditions), socio-economic data (population, agriculture), and cartographic data (aerial photography, old maps). If we focus on the researched time period, we will find that in the research we monitor the transformation of the landscape from its pre-industrial form, through the industrial and to the current one, ie post-industrial. Of course, we have also not forgotten to monitor the development of human society, which currently has a dominant influence on the shape of the landscape.

This paper focuses on the presentation of landscape development in the city of Most area. It was a landscape intensively used for agriculture, through a landscape heavily affected by surface mining of brown coal. The landscape gradually returned to nature and human society through various types of reclamation, here often directed for recreational purposes.

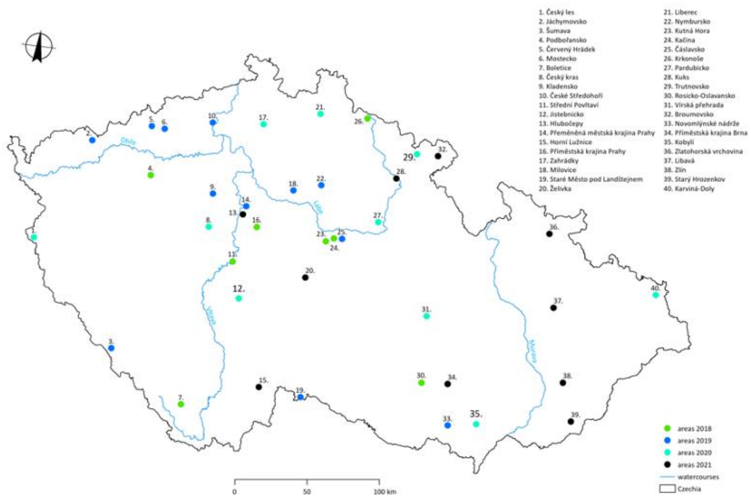

Fig. 1: Model areas of the project: Heritage of Extinct Landscapes: Identification, Reconstruction, Accessibility

Materials and methods

We chose the landscape west of the city of Most as an area of interest. Although the landscape is still primarily used industrially, many regions of the post-mining landscape have been transformed into areas close to nature – water areas, grasslands, or forests, which are also suitable for recreational use. The landscape in Most regions has been studied since the first half of the 19th century. The state of the landscape was based on the Imperial Imprints of the Stable Cadastre dating from 1842. These cadastral maps were digitized.

In addition to these maps, maps of the present landscape have also been created. The data showing the current landscape of Most come from the RÚIAN database (Register of Territorial Identification of Addresses and Real Estate), managed by the Czech Surveying and Cadastre Office (ČÚZK). The data from this database had to be validated based on aerial photography.

The state of land use was monitored in 7 categories based on the LUCC Czechia Database (more about Database see Bičík, et al. 2010). These are arable land, permanent crops (orchards, vineyards, gardens, and hop gardens), permanent grasslands (meadows and pastures), forest areas, water areas (including watercourses), built-up areas, and other areas (mines, dumps, roads, railways, landfills, etc.). Furthermore, as part of finding out the broader connections and relationships in the landscape, data on the development of the number of inhabitants and houses, the economic structure, and old and contemporary photographs of the locality of interest were worked on. In September last year, a field survey was conducted, in which aerial photos were taken using a drone (Fig. 2). All work in digitizing maps of the stable cadastre and data from the RÚIAN database and aerial imagery was performed in ESRI programs (ArcMap or ArcGIS Pro).

Fig. 2: Drone view above the model area of Most (autodrome, Lake Matylda and Lake Most).

Results

The landscape around the city of Most has undergone an intense change in the last 175 years of landscape and society development. During the first half of the 19th century, it was an intensively farmed landscape. Along with the industrial development of the area, the population also grew. In 1869, about 50.000 inhabitants lived in 6.000 houses in the research area. The landscape consisted mainly of areas of arable land and permanent grassland. As an example of the pre-industrial landscape of Most, we present an example of 3 cadastral areas in the locality of interest (Souš, Holešice and Třebušice), see Fig. 3. Therefore, the landscapes can be assigned primarily to a productive, in this case, an agricultural function, supplemented by a residential function.

The population of this area grew until 1930, when approx. 175.000 inhabitants in 16.200 houses lived here. We have other data about the population in 1950, namely 140.000. Between these two years (1930 and 1950), the population decreased, mainly due to the displacement of Czech Germans after World War II. The population grew until 1991 when it reached a maximum of 185.000 inhabitants. Since then, the number has been steadily declining due to the gradual reduction in mining and industrial production intensity in the area.

During the socialist period, the intensity of lignite mining increased steadily. New coal quarries, associated industrial enterprises, and new lignite-fired power plants were built here. The relatively close to nature agricultural landscapes in the first half of the 19th century has thus become a landscape heavily used by humans, mainly due to the extraction of brown coal. Therefore, the total share of other areas in the landscape increased, particularly mining areas, dumps, sludge ponds, and industrial and power plant areas. A sad example is a liquidation of the original city of Most and the exposure of its new form to the southeast, below Hněvín Castle. The newly created lake Most is currently located in the original locality of the city of Most, where mining has taken place since the 1970s. Like many others in the area (Lake Matilda), this lake was created by the subsequent reclamation of former mining areas and is currently used for a wide range of recreational purposes. Overall, the former areas of individual mines in the Most region are being transformed by reclamation, especially into forest, grass, water, and, to a lesser extent, agricultural areas. These newly created islands of nature currently serve mainly for recreational purposes – the already mentioned lakes or the Autodrome Most. The landscape has now primarily a recreational and residential function.

The change of the landscape and its use is evidenced by the following picture Fig. 3 and table Tab. 1, which contains data on the use of the landscape in the example of 3 cadastral areas in the detailed locality of interest.

Tab. 1: Land use changes between 1842 and 2019 in the detailed area

Land use category	% in 1842	% in 2019
arable land	72.47	3.32
permanent cultures	0.41	0
permanent grasslands	17.82	13.01
forest areas	2.92	34.88
water areas	2.57	4.18
built-up areas	0.39	0.38
other areas	3.41	44.23

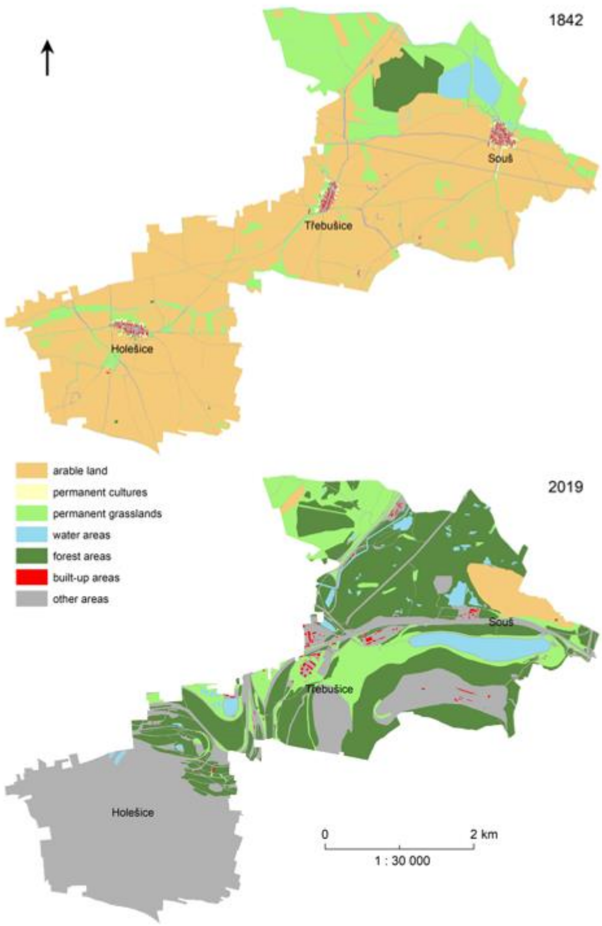

Fig. 3: Map of the detailed area in Mostecko – Land use in the pre and post-industrial era

Discussion

Our research identified the main changes in the landscape and their causes. In the case of Most, it is mainly a change of arable land to other areas. If we compare this trend with other regions studied in Czechia, a similar development occurred mainly in localities that humans heavily use (Prague and its surroundings, or to a lesser extent Karviná). If we focus, for example, on the border areas of Czechia, then we also encounter a decrease in arable land. However, borderland areas are gradually grassed, and in the increasing time scale, afforested. Here, for different reasons than in Most area, especially due to the displacement of Czech Germans, mostly in the 40's and 50‘s in the last century. And in the 90‘s due to subsidies for grassing and changing farming style in less favorable conditions for agriculture and centralization of agricultural production, especially in fertile areas in the Elbe region, South Moravia and the Moravian valleys. Overall, the landscape in the Most region can be described as one of the most changed in the whole of Czechia due to the intensive human pressure on nature in the past.

Conclusion

This paper aims to present a part of our research interested in the changes in various landscapes in Czechia from the first half of the 19th century to the present. Most area were chosen as the territory, which has gone through the last approximately 175 years of intensive landscapes and society development. We focused on transforming micro and macrostructure of the landscape and finding the causes of these changes. We tried to identify the area's functions in its pre (agricultural, residential) and post-industrial (mining, recreational, residential) periods. In the future, hand in hand with declining lignite mining and subsequent reclamation of mining areas, it is possible to anticipate an increase in nature-friendly areas (forest, grassland, water areas) and their use primarily for recreational purposes. All other outputs from the project Heritage of Extinct Landscapes: identification, reconstruction, access can be found on the project website http://zaniklekrajiny.cz/.

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Souhrn
V průběhu řešení projektu NAKI II Ministerstva kultury České republiky – Dědictví zaniklých krajin: identifikace, rekonstrukce, zpřístupnění mezi lety 2018 až 2022 bylo analyzováno celkem 40 různých krajin po celém území Česka. Krajiny byly rozděleny do celkem 9 typů, dle jejich přeměny (např. postmontánní krajiny, příměstské krajiny atd.). Krajiny jsou zkoumány různými vědeckými přístupy a metodami. Krajina je tak zkoumána na základě fyzickogeografických dat (klimatické podmínky, ochrana přírody atd.), socioekonomických dat (údaje o vývoji počtu obyvatelstva, domů, ekonomické struktuře, vývoji půdního fondu) a kartografických dat (staré mapy, letecké snímkování). Zkoumáme, jak se krajina v průběhu času měnila a z jakých důvodů docházelo k její transformaci. V uvedeném příspěvku demonstrujeme náš výzkum na příkladu vývoje krajiny a společnosti na Mostecku, kde se hlavní funkce krajiny změnila z produkční (zemědělství) na postprodukční (rekreace).

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USING THE KNOWLEDGE OF WRITTEN SOURCES FOR NATURE CONSERVATION AND RECREATION IN THE FORESTS OF THE DRAHANY HIGHLANDS

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Abstract
Drahany Highlands is a landscape with underground caves, dry valleys, depressions and plateaux. This area, inhabited since prehistoric times, has been used economically since the 13th century. Based on the analysis of a wide range of archival sources, the paper presents the historical economic activity of humans in the forests of the Drahany Highlands at three selected sites. The majority of economic activity involved the extraction of timber and other raw materials; for a certain period of time in the Middle Ages the landscape was deforested and used for agriculture. In addition to export, wood was in demand for the processing of other raw materials – glassworks, lime works, iron mills, etc. Information about these, supplemented by knowledge of the boundary stones, ethnographic material, and the everyday life of the local inhabitants, will be used in other fields and will increase the interest of the general public in visiting the sites of former human economic activity. The archival sources testify also to the transformation of the local original diversity of forest species (mainly beeches, oaks, hornbeams, birches, poplars, and firs) into unsuitable 19th century spruce monocultures. This offers an alternative to the return of the original species composition of the Drahany Highlands forests.

Key words: Restoration of the original species diversity of forests, economic and recreational potential of the landscape, anthropogenic activities, leisure activities

Introduction

The recreationally attractive Drahany Highlands, including the Moravian Karst, most of which was declared a protected landscape area in 1956, with its underground caves, dry valleys, forests, sinkholes and plateaus, was one of the first areas in Central Europe to be popularised for tourist and recreational use since the 17th century. However, evidence of human settlement in the area is much older. Humans first reached the area in prehistoric times. From the 13th century, the landscape was exploited on a larger scale, sometimes, unfortunately, turning into insensitive, intensive exploitation and even devastation. Mapping the cultural heritage of human economic activity in the forests of the Drahany Highlands has become the subject of interdisciplinary research under the NAKI II project No. DG20P02OVV017, whose beneficiary since 2020 is Mendel University in Brno (MAHOLE 2022).

Material and methods

The research was carried out in three selected localities, designated as SOUTH (near Pozořice), WEST (southeast of Blansko near Klepačov and Olomučany) and NORTH (near Sloup and Holštejn). The sites in question were chosen with regard to their different natural conditions and historical development. Archival sources also served as an important source of information for the research, which is the focus of the present paper.

Archival materials are still a rather neglected, albeit very valuable and inspiring source of knowledge for the history of our forests. They provide, among other things, knowledge that can be used for various aspects of the past of forests, nature conservation and recreation. Although there is the methodology for the processing of archival material on the historical use of forest estates (SUCHÁNKOVÁ et al. 2021), working with traditionally used types of archival documents (e.g. deeds, land registers, cadastres, forest management plans, and maps), its use in the above-mentioned NAKI II project No. DG20P02OVV017 quickly showed its limitations and neglected a number of important sources, such as municipal and school chronicles (MARÁZ 2022). Within the framework of the NAKI II project DG20P02OVV017, a broadly conceived heuristic of written and map sources, extended also by research in domestic archival funds primarily unrelated to the issue (e.g. ZAOO, Vs Ruda nad Moravou, inv. No. 734 *Belehnungs-Protokoll über die beim Dorf Ollomutschan im Betrieb stehenden Grubenfeldmaassen*), in the funds of the National Heritage Institute, the regional office in Brno and Kroměříž (map funds), and in foreign archives (Hausarchiv der regierenden Fürsten von und zu Liechtenstein in Vienna or Kriegsarchiv and Haus- Hof- und Staatsarchiv Österreichisches Staatsarchiv in Vienna). A wide and varied range of documentary and map sources were thus analysed, providing valuable insights.

Results and Discussion

It may be surprising at first sight that the study of often centuries-old archival historical documents can provide insights for the field of recreation and landscape conservation. However, not only is this the case, but it is also happening to an even greater extent than one might expect, as this paper seeks to demonstrate.

The beginnings of intensive human economic activity in the landscape of the Drahany Highlands date back to the 13th century. At that time, as part of the process of colonisation associated with the establishment of new settlements were completely deforested. Subsequently, villages were founded on these sites, whose inhabitants were engaged in agricultural activities. It is clear, however, that the landscape and climate here cannot provide ideal conditions for agriculture, so many villages disappeared again after about two centuries of existence, not by force but simply because agriculture was not sufficient to support the people. In the localities we surveyed, these are the extinct villages of Bohdalůvka (site NORTH) and Polom (site CENTRE). Their cadastre was then reforested.

The forest has always played an important role in the economy of our ancestors in the Drahany Highlands. Especially in times of great demand for wood, which was used not only as a building material for export (e.g. for shipbuilding as far away as Hamburg or for the production of telegraph poles and formwork for mines), as a raw material for the production of paper pulp (Molenburk, p. 13), but also as a basic raw material for the production of charcoal in the mills, which were widespread in the Drahany Highlands in the past. In 1680-1684, for example, the consumption of firewood was so great that whole areas of the forests around Olomučany succumbed to it. Charcoal and wood found their outlets as fuel in the surrounding machine mills, steam sawmills (e.g. in Adamov), glassworks (e.g. in Olomučany), limeworks (around Sloup), hammers, and ironworks (e.g. Nové Hrady, Blansko) (Olomučany, p. 386).

The mentioned data also testify to the rich mining and quarrying activity, when limestone, alum and iron ore were quarried in the forests of the Drahany Highlands (Klepačov, p. 10; Olomučany, p. 386), as evidenced, among others, by mining and cutting plans (MZA, D 16, inv. No. 363 and 565). In addition to these, we also have valuable written sources for the mining and processing of minerals, especially for the lime industry in the NORTH site. The municipal chronicles have left us with valuable knowledge about production processes, lime prices, but also about export routes, customs and songs of the local lime farmers, which is a welcome source of information for the study of their everyday life, ethnography and musicology, among other things. The local lime production was directed to Prostějov and Tovačov, Konice and Jevíček or Olešnice and Kunštát and their surroundings. The work was carried out in such a way that the limestone was brought to the kilns in winter. The working period started before St. Joseph’s Day and ended at the Martin feast with a break for hay and harvest. The lime trade was traditionally carried out by peasants from selected farms in individual villages. There were a considerable number of limekilns, and in Molenburg alone, there were 12 kilns at the end of 1923; previously there had been more, perhaps 15 (Molenburg, pp. 14-17).

The high consumption of wood caused the mass clearing of the original species-rich forests and their replacement by spruce monocultures, which offered faster wood production. However, they are much more susceptible to bark beetle calamities and logging. The beginnings of the transformation of the original species-rich forests into spruce monocultures can be traced in our forests from the end of Maria Theresa’s reign. The transformation of the species-rich forest into spruce monocultures in the Drahany Highlands is also well documented in archival sources. In our three study, there is a valuable comparison provided for the NORTH, CENTRE and SOUTH sites and concerning written and map sources from domestic archives and the Hausarchiv der regierenden Fürsten von und zu Liechtenstein in Vienna in a continuous time series of the 18th – 20th centuries. They show that in the 1860s the local forests were mixed with a predominance of deciduous trees (oaks predominated in most of the area, supplemented by hornbeams, birches, aspens, poplars, and firs), and around 1830 they were beech-fir in character (MZA, F 82, inv. No. 1172; Vienna, HRFL, HA 1370). According to the Mollenburk chronicler, fir trees still dominated most of the local forests in the 1890s (Mollenburk, p. 13), but spruce trees were increasingly planted, and pine trees can still be found among the conifers, although less frequently than spruce. At the end of the 19th century, spruce monocultures dominated the Drahany Highlands as well, and they have persisted to the present day (Molenburk, p. 13; MZA, F 31 No.5857). The unfortunate consequence of these monocultures consists in various calamities, especially the bark beetle, which our forests have been struggling with especially in the last two decades. And what is the solution to this situation today? By capturing the original rich diversity of the more suitable mixed forest with a predominance of broadleaved trees, which has irretrievably disappeared, the archives offer us a suitable alternative for replanting for the future in order to prevent further bark beetle calamities.

It should be mentioned, however, that it is not only the rich original diversity of trees that has disappeared and has been preserved only in archival sources. The archival sources also contain evidence, including pictures, of boundary stones that were placed in the forests of the Pozořice estate when its boundaries were redrawn in 1830. They bore an inscription in the abbreviated form *H:P:F:v:L: 1830 N. 1-37* (always indicating the serial number of the stone from 1 to 37), executed in a stylised capital, with a painting of the princely crown, all of which alludes to the Liechtensteins, the owners of the estate, more precisely to John II of Liechtenstein, under whom the demarcation was realised (Vienna, HRFL, S 188, unfoliated). Today, these boundary stones are no longer found in the landscape, but they are visually attractive objects that could be used, for example, on the information boards of today's hiking trails.
In addition to industry, i.e. the aforementioned production of charcoal, iron, glass and quicklime, the forest was also of economic importance to the ordinary humans. Again, mainly village and school chronicles tell us of domestic animals grazing in the wood, raking leaves, needles and twigs for bedding, collecting boxwood, and harvesting grass in it. The specific feature of the forest in the Moravian Karst is undoubtedly the underground caves. Even their stalactite wealth, now admired by visitors, has unfortunately become the subject of exploitation, or rather unimaginable devastation. Both the owners of the estate and the ordinary inhabitants of the surrounding villages have been involved in it. There are numerous examples from sources and literature of stalactites being sold on pilgrimages, and during the Baroque reconstruction of the Lednice Castle in 1686, a so-called grotto was created – an artificial stalactite cave in the castle basement with stucco decoration of artificial stalactites, in which original stalactites brought from the Moravian Karst were also planted. In the Sloupské Caves, in 1775, two narrow stone blocks were cut from a large stalactite formation, which after polishing found use as stone slabs set into wooden tables, which are part of the furniture of the Rájec Chateau, or in the 19th century, stalactites from the Moravian Karst served as a source of limestone for the fountain in Rájec nad Svitavou. A great plundering of stalactites took place in the Sloupské Caves in 1878. At the end of the 19th century, the caves were also plundered for relics of prehistoric animal bones, which were sold by cave diggers. In order to prevent further devastation, the mayor of Sloup had a new official entrance to the caves built and the older "wildly" created ones were filled in. Subsequently, the caves could only be visited in an organised manner for a fee with a guide (Sloup, esp. pp. 5, 7, 10-11; BALÁK, 2019, pp. 87 and 89).

Conclusion

The presented findings can be used in the protection of the landscape of the Drahany Highlands and the gradual return to the restoration of the biodiversity of trees in their forests, which would prevent further bark beetle calamities in the future. At the same time, the greater species diversity of the local forests with a higher proportion of deciduous trees would certainly be a greater attraction for tourists than the current spruce monocultures. A number of other information mentioned above could also be used for tourism and recreation. This could be in the form of information boards with texts about the former human management in the local forests, supplemented by interdisciplinary research on relics of anthropogenic activity, especially mill sites, lime kilns, glass and ironworks, relics of former shafts or vanished medieval villages. These boards should be supplemented with pictorial material in the form of maps, depictions of former boundary stones, entries in economic books and their iconographic decoration (e.g. miners in period ceremonial mining uniforms and depictions of period work in the mines in ZAOO, Vs Ruda nad Moravou, inv. No. 734). This would enrich the relaxing leisure activities of visitors to the forests of the Drahany Highlands with unpretentious and interesting educational content. This would also be helped by the fact that the local relics of anthropogenic activity have the advantage of their close proximity to the current forest hiking trails. It would certainly be worth considering, for example, the creation of a new nature trail aimed at documenting the traces of the vanished world of old relics of anthropogenic activity in the forests of the Drahany Highlands.

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Abbreviations

MZA = Moravský zemský archiv v Brně:
D 16 = Báňské ředitelství Brno.
F 31 = F 31 Lichtenštejnská lesní zařizovací kancelář.
F 82 = F 82 Velkostatek Pozořice.
SOkA Blansko = Státní okresní archiv Blansko:
Klepačov = Archiv obce Klepačov, Kronika obce, inv. No. 80.
Molenburk = Archiv obce Molenburk [now Vysočany], Kronika obce, unprocessed.
Olomučany = Archiv obce Olomučany, Kronika obce, inv. No. 51.
Sloup = Archiv obce Sloup, Kronika obce, inv. No. 119.
Vienna, HRFL = Hausarchiv der regierenden Fürsten von und zu Liechtenstein in Wien:
S 188 = Waldregulierung Im Bereich der Herrschaften Plumenau, Eisenberg und Posoritz, Inv.-Nr.: S 188.
HA 1370 = Wirtschaftsstatus der Herrschaft Posoritz, Inv.-Nr.: HA 1370.
ZAOO = Zemský archiv v Opavě, pobočka Olomouc:
Vs Ruda nad Moravou = Velkostatek Ruda nad Moravou.

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Souhrn

Článek pojednává o reliktech hospodářské činnosti člověka v lesích Drahanské vrchoviny ve světle archivních pramenů projektu NAKI II č. DG20P02OVV017.

Zaobírá se produkcí dřevěného uhlí v milířích, skla, vápna a železa, zmiňuje exploataci lesů Drahanské vrchoviny od 13. století, mnohdy vedoucí k devastaci porostů i krápníkových jeskyní. Pozornost je věnována zániku původního lesa a vysazování smrkových monokultur, náchylných ke kůrovcovým kalamitám.

Poznatky naleznou využití v enviromentálním vzdělávání, obnově lesní biodiverzity a mohou přispět k edukativnímu rozměru turistických tras.

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UTILIZATION OF LANDSCAPE AND CULTURAL VALUES IN THE STRATEGY OF TOURISM DEVELOPMENT IN THE FOOTHILLS OF THE RYCHLEBSKÉ MOUNTAINS

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Abstract
The foothills of the Rychlebské Mountains, together with the rest of the Jeseník district, are the scene of radical socio-economic changes which, after the end of World War II, shaped the region by expelling most of the original German population. After the suppression of economic activity of the population, which transformed the original forested form of the landscape into the agricultural and industrial stronghold of the First Republic, tangible and intangible heritage remained in the landscape referring to important milestones of our state, which, thanks to this article, will not be forgotten. In recent years, this area has met with increased interest from tourists. The aim of the article is to point out the forgotten cultural values associated with the defunct settlements and its original inhabitants. Against this background, a tourism development strategy can be built, which will help the distribution of tourist destinations in a wider area of interest and at the same time offer the potential for everyday relaxation and education.

Key words: Sudetenland, defunct settlements, changes in the cultural landscape, settlement Zastávka, Jesenik region

Introduction
The Rychlebské Mountains (Polish – Góry Złote, German – Reichensteiner Gebirge) is a small mountain range of an area of 276 km^2 in the Javorník Promontory, in the north-west area of the Jeseník District, on the border with Poland. It is not just the character of the local nature, which remains unaffected by developed tourism, that is a reason for visiting and holidaying in this north-east corner of the Czech Republic, but also the cultural-historic legacy of the original German settlements, as represented by the extinct settlement of Zastávka (German – Stillstand) for example. This settlement met the same fate as many others in this region and can be used as an example to remind ourselves of the troubled history of the entire region and its impact on today's world.
In order to understand the reason for the dynamic development of the Jeseník Region (and likewise the remainder of the so-called "Sudetenland" – the region intoday's Czech Republic with a predominantly German population from the mediaeval ages until 1945 – 1947, usually border areas), we have to travel back to the 13th century, when colonisation of the foothill regions of the Jeseník and Rychlebské mountains was instigated by the bishops of Vratislavice (Macháček, 2011). Over the course of history, these settlers, who were mostly of German origin, transformed a landscape of mixed forests into an economically flourishing area, the so-called "Wealthy Sudetenland" (an area covering the north-west and north-east borders of the Czech Republic).
Rising nationalistic tendencies resulted in the Sudetenland separating from the Czechoslovak Republic in 1938, when the protectorate of Bohemia and Moravia was created, and joining the Third Reich (Knopp, 2002). After Nazi Germany was defeated, nationalist tendencies turned against the Germans, who, with a few exceptions, were forced to leave Czechoslovakia. Nearly three million of the Germans living in this region met this fate. The Jeseník Region, specifically, had a population of just under 72 thousand in 1930, only 41 thousand remained at the beginning of the new millennium (Macháček, 2011).
There are several reasons why the region deteriorated so rapidly during the nineteen fifties and has not yet recovered. The main factor was the reduced population, which was supposed to be partially compensated by the arrival of Czechs and ethnic minorities. However, the newly settled inhabitants had no motivation to remain in the area. Life in border settlements was much harder than in the interior of the country. The difficult local living conditions were tolerable for residents while they were able to work and live on their land. However, this connection to the land was forcibly cut by communist collectivisation in the nineteen fifties. This meant that the Rychlebské Mountains were nearly depopulated after one hundred years. This ended a century of industrial development of the Jeseník Region, which established itself as an economically prosperous Czechoslovak stronghold in the second half of the 19th century thanks to Adolf Rayman's enterprises. His son Adolf integrated other successful companies by establishing the Regenhart & Rayman enterprise. This world-renowned

company exported linen cloth to West Europe and America and employed approximately 1500 people in the Jeseník Region. The subsidiary Moravolen was established after nationalisation, and this company was terminated when the communist era ended. The kaolin quarry with attached kaolin processing plant in Vidnava met a similar fate. This company employed 3,000 people from the second half of the 19th century. During prosperous times the company also exported products and material throughout Europe (Zajonc, 2015). In the second half of the 20th century, we were witnesses to the sad transformation of a prosperous stronghold of the First Republic into a district with a high unemployment rate (the highest in the Czech Republic in 2009), with a limited job market and below-average wages.

Another element that steadfastly remained in the region throughout centuries of adversity and was effectively removed in the second half of the 20th century was people's connection to the place they lived in. Their emotion was reflected in a personal connection to the soil and their property, respect towards the work carried out by their forefathers and the desire to have a home in the Rychlebské Mountains. This desire was manifested for example in the Tančírna (Dancing House) building in Račí údolí, where inhabitants from Javorník and the surrounding area came to enjoy some culture from 1907 until the end of the 2nd World War (Brachtlová, 2005). Towards the end of the 19th century, tourism began developing in the region hand-in-hand with the cultural element. The Moravian Silesian Sudetenland Mountain Association, which was established in 1881, is credited with laying the foundations of today's hiking routes in Hrubý Jeseník and the Rychlebské Mountains, as well as building hiking chalets (the oldest is called Švýcárna and dates from 1829) or the iconic Zlatý Chlum observation tower above Jeseník, which dates from 1899 (Kovalčík, 2010).

Tančírna, along with most landscape elements and entire villages in the Jeseník Region, were abandoned when their founders left in the second half of the 20th century and many structures disappeared completely. This trend is common practically throughout the Sudetenland area. However, an initiative to develop the recreational and educational potential that permeates this region, originated in the Jeseník Region at the beginning of the 21st century. The objective of this initiative is to present the history of the Jeseník Region as a potential tool for re-discovering a connection to the place you live in. This connection is crucial for maintaining many isolated locations, which are facing the same issues as the Jeseník Region in today's globalised world, which lead to the outflow of the young generation, the group of people with the greatest potential to develop these areas. This is why it has never been more important to seek and find answers to the question of why people should live in the border areas and endeavour to maintain and develop values generated by a tumultuous historic development that has no counterpart in the interior. The activities of Hnutí Brontosaurus in the abandoned village of Zastávka, development of which our paper will focus on, can be considered the ideal platform for the aforementioned dialogue.

Materials and methods

Historical maps documenting development of the settlement, its surrounding area and changes to the landscape over just under the last 200 years, included geo-referenced imperial prints from the stable cadastre of Moravia and Silesia from 1836 (Archives of the Central Archive of Surveying and Cadastre, www.cuzk.cz) and aerial survey images from 1953 and 1964 (VGHMÚř Dobruška, © MO ČR). The current appearance of the landscape was provided by an orthophotomap (© ČÚZK, www.cuzk.cz) available via the WMS viewing service. The vector layer showing the cadastral area of the village of Uhelná from the cadastral map data file (© ČÚZK, services.cuzk.cz) was used for the context of administrative integration. ArcGIS Desktop software was used to connect coordinates to the background data and prepare map documents.

Results and Discussion

It is evident from the map documents (Fig. 1) that the first half of the 19th century was a period of prosperity for Zastávka. The settlement had a permanent population of 71 in 1836. This number fell to just under 40 in the first half of the 20th century. In 1946, after the original German inhabitants had been displaced, a failed attempt was made to restore the settlement and the settlement was officially shut-down in 1963. Of the original 12 buildings in 1836, only the foundations and the ruins of several buildings remained at the beginning of the new millennium (Macháček, 2011).

Fig. 1: Zastávka and its surrounding area in 1836, 1953, 1964 and 2020

Zastávka would have shared the fate of extinction and obscurity with another 13 settlements in the Jeseník District, if Hnutí Brontosaurus had not taken it under its wing at the beginning of the 21st century. Volunteers from this organisation cleaned up the area of the settlement and established facilities for recreational-educational events here over the last 15 years, as we can see on the aerial image of the detail of part of Zastávka (Fig. 2). These events are intended to provide a platform for people who are interested in spending their free time at the modest facilities of Zastávka, where they can work to establish and maintain the permanently sustainable development of this site. The remainder of the time is filled with lectures on environmental topics, outings, or team-building events focusing on cooperation between the participants and development of the team itself. By appropriately interpreting development of the concept of the activities of Hnutí Brontosaurus, it is possible to integrate the educational and recreational activities of the professional and lay public and development of tourism in the Jeseník Region.

Fig. 2: Detail of part of the settlement now used by Hnutí Brontosaurus (1953, 2020)

However, the aforementioned model is applicable to any location offering added value in the form of the historic or landscape aspect. The initiative to use these locations as a platform for holding recreational and educational events, which would interest the general public in spending leisure time in a unique natural environment (the Rychlebské Mountains for example), with an educational element, is then crucial in these areas. The professional public would be interested in an alternative environment for holding conferences on topics connected to the venue. However, the content should include the return to the values that accompanied the rise and prosperity of these isolated locations, such as the Rychlebské Mountains, in some form. The remainder of the content depends on the target group of participants. EU funding calls, focusing on development of rural areas and education, can be used to establish new facilities.

Conclusion

The purpose of this paper is to specify the relationship between historic events in the Jeseník Region and the current issue of the geographically uneven development of the society of western countries. A society whose population is concentrated in urbanised areas, may be more effective, but this effectiveness comes at the price of uneven distribution of tangible and intellectual capital, which concentrates work and leisure opportunities into agglomerations with a high population density through positive feedback, at the cost of stagnation of the population in the rest of the country. This phenomenon can be considered the main catalyst for the outflow of the younger generation from rural areas, with the subsequent reduction of the competitiveness of these areas.

The topic of developing tourism in isolated locations and potentially creating the motivation to live in these locations and establish the local economy is a set of complex issues, the solution to which cannot be found in a single specific event or project. It is therefore all the more important to ask what specific actions could contribute to resolving this issue and to initiate a dialogue on this topic with the general public and the professional public. Multi-day stays in isolated locations, for instance in the Rychlebské Mountains, combining recreational and educational elements with support of development of tourism at the location these are held, is a suitable platform for this dialogue.

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Souhrn

Rychlebské hory prošly v posledním tisíciletí dramatickým vývojem. Z neobydlené lesnaté části vratislavského biskupství se v rámci procesu velké kolonizace stala prosperující část Zemí Koruny české a později První republiky. Z důvodu převažující části německého obyvatelstva však po konci 2. světové války byla oblast vysídlena a s jeho obyvateli odešla z kraje iniciativa zde budovat, inovovat a rozvíjet, která byla odjakživa závislá na vztahu lidí k místu, kde žijí. Řada drobných sídel v pohraničí zcela zanikla a ty zbývající se z důvodu vysokého průměrného věku bude zejména v budoucnosti potýkat s nedostatkem produktivního obyvatelstva. V hledání způsobu, jakým odlehlé lokality udělat znovu atraktivní pro mladou generaci, nám může pomoci příklad zaniklé osady Zastávka, v jejímž zázemí Hnutí Brontosaurus realizuje rekreačně-osvětové akce. Jejich přenos na nové lokality se jeví jako vhodný nástroj podpory konkurenceschopnosti pohraničních regionů a rozvoje místního cestovního ruchu s pozitivním dopadem na společnost jako celek.

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UTILIZATION OF GOOD PRACTICE OF TORRENT CONTROL IN RECREATIONAL EDUCATION IN THE VEĽKÁ FATRA NATIONAL PARK

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Abstract
In the article we present the possibility of using an example of good practice of torrent control in recreational and leisure education of the public and university students. For this purpose, we chose the torrent control Jelenec in the Hornojelenecká valley in the Veľká Fatra National Park. Hornojelenecká valley is one of the most beautiful and most visited recreational locations in the Veľká Fatra National Park. This valley forms a natural watershed of the Jelenec torrent with a historical torrent control, which was established in 1926-27 and has reliably fulfilled its function for 95 years. Based on field measurements, we analyzed the runoff characteristics of the watershed and the discharge characteristics of the torrent in an effort to present the results of research in recreational tourism and university education. The main goal is to raise awareness among the general public about the importance of integrated forestry measures to protect the landscape from flash floods and erosion in recreational education. We evaluated the capacities of flow profiles in relation to T-year discharges and the functionality of various types of transverse objects. On the information boards, we explained the implemented solutions from a technical, ecological and environmental point of view.

Key words: touristic activities, leisure education, landscape protection

Introduction

The modern education of the society has undergone great changes in recent years. Commonly accessible information technologies consistently bring wide possibilities of obtaining professional and scientific information from domestic and foreign sources. This fact can be considered a great advantage, but on the other hand, it is necessary to disseminate relevant knowledge and bring concrete solutions not only to university students and professional sphere but also to the general public, e.g. through popular activities such as tourism and non-formal recreational education. Vocational training on recreational and educational trails, focusing on the management of flood risks, erosion and their adverse consequences, is an important opportunity to involve the general public in solving these tasks. Negative human activities and climate change, which together affect the deterioration of runoff in the country, contribute to increasing the likelihood of floods and their adverse effects. Integrated forest ameliorations, including torrent control, provides positive examples of successful solutions to these important societal challenges. An important European document on flood risk assessment and management is Directive 2007/60/EC of the European Parliament and Council from 23 October 2007 (https://eur-lex.europa.eu/legal-content/SK/ALL/?uri=CELEX:32007L0060). We consider it right to leave the upper sections of the torrents in the protected areas untouched from the point of view of nature and landscape protection. On the other hand, the protection of piedmont villages and towns from flash floods and erosion requires the implementation of the necessary forestry-technical amelioration measures. In the article we present an example of good practice in solving the floods and erosion control on the example of the Jelenec torrent in the Veľká Fatra National Park which was built in 1926/27. Torrent control Jelenec performed its function well for over 95 years (JAKUBIS, JAKUBISOVÁ 2017, 2020).

Materials and methods

As an example of the possibility of informal recreational education, we chose the torrent control Jelenec in the Hornojelenecká valley in the Veľká Fatra National Park (Fig. 1). The first systematic motorrent control of a mountain torrent in Slovakia was built in this valley in 1926-1927. The impetus was a great flood on May 30th, 1925, which destroyed the entire valley. During torential rain fell in 3 hours 75 mm of precipitation (SKATULA 1973). The Hornojelenecká valley with the Jelenec torrent stretches on the south-eastern slopes of the Krížna massif (1,574.3 m a.s.l.). The mouth of the valley and the closing profile of the watershed is located below the settlement of Horný Jelenec by the state road I/59 in the direction of Banská Bystrica-Donovaly. The characteristics of the Jelenec watershed and torrent are given in Tab. 1 and Tab. 2.

Fig. 1: Hornojelenecká valley in Veľká Fatra National Park

Tab. 1: The characteristics of the torrent basin Jelenec (part 1)

A_w (km^2)	H_{minw} (m a.s.l.)	H_{maxw} (m a.s.l.)	ΔH_w (m)	$H_{øw}$ (m a.s.l.)	L_{tr} (km)	L (km)	L_t (km)	L_{th} (km)
9.58	582	1,532	950	931	21.08	5.51	26.59	5.84

Explanatory notes to Tab. 1: Aw – watershed area; H_{minw} - minimal altitude of the watershed; H_{maxw} – maximal altitude of the watershed; ΔH_w – absolute height difference of the watershed; $H_{øw}$ – mean altitude of the watershed; L_{tr} – total length of tributaries; L – length of main stream; L_t – total length of watercourses in the watershed; L_{th} – length of thalweg.

Tab. 2: The characteristics of the torrent basin Jelenec (part 2)

H_{mint} (m a.s.l.)	H_{maxt} (m a.s.l.)	ΔH_t (m)	A_f (km^2)	$f_{\%}$ (%)	L_d (km)	$S_{øt}$ (%)	$S_{øw}$ (%)	B_w (km)	w_w/ℓ_w (-)
582	1,400	818	7.47	77.97	14.80	14.84	37.23	1.64	1:3.56

Explanatory notes to Tab. 2: H_{mint} – minimal altitude of the torrent; H_{maxt} – maximal altitude of the torrent – source; ΔH_t – absolute torrent height difference; A_f – forested watershed area; $f_{\%}$ – forested watershed in %; L_d – legth of the divide; $S_{øt}$ – mean gradient of the torrent; $S_{øw}$ – mean slopes gradient of the watershed; B_w – mean width; w_w/ℓ_w – width/lenght ratio of the watershed.

The causes of disasters in this locality can be traced to massive deforestation as early as the 13th and 14th centuries. Deforestation reached a catastrophic extent in the second half of the 15th and especially in the first half of the 16th century. In addition, the damage to the local naturally occurring young forest stands was caused by avalanches. Damage to forests was also caused by cattle herds kept by the locals for their livelihood. Cattle mainly destroyed the natural regeneration of the forest, but the damage was also caused by local settlers, who founded the wooden fences used for wintering cattle. Thus began the degradation of the soil surface, the loss of its infiltration capacity, the acceleration of surface runoff, surface and groove erosion, etc. The valley has been affected by several disasters in the past. The largest was the avalanche that fell on the settlement of Rybô on February 6, 1924 and killed 18 people (JAKUBIS, JAKUBISOVÁ 2021).
We performed measurements of geometric and hydraulic characteristics on 18 experimental flow profiles (sections) (Tab. 3). Cross sections were drawn and parameters for sizing flow profiles were calculated. The results served as a basis for educational goals on nature trails in the recreational activities of visitors to this often visited area. We have proposed explanations from a technical, ecological and environmental point of view on the educational boards.

Fig. 2: Weir and sills in Jelenec torrent in the immediate vicinity of the hiking trail

Fig. 3: Reinforced bed of Jelenec torrent in the immediate vicinity of recreational path

Results

Basic characteristics, bankfull discharges Q_{bf} and T-year discharges Q_T of the Jelenec torrent flow profiloes are given in Tab. 3

Tab. 3: Basic characteristic, bankfull discharges Q_{bf} and T- year discharges Q_T of the Jelenec torrent flow profiles

FP No.	Section (km)	A_{fp} (m^2)	v ($m.s^{-1}$)	Q_{bf}	Q_1	Q_2	Q_5	Q_{10}	Q_{20}	Q_{50}	Q_{100}
				($m^3. s^{-1}$)							
1	0.000 – 0.035	3.20	2.09	6.67	2.87	4.41	**6.47**	8.16	10.00	12.58	14.71
2	0.035 – 0.575	5.95	3.58	21.30	2.97	4.46	6.53	8.24	10.10	12.70	**14.85**
3	0.575 – 0.725	5.25	4.37	22.94	2.94	4.41	6.47	8.24	10.00	12.65	**14.71**
4	0.725 – 0.775	7.00	3.48	24.34	2.91	4.37	6.40	8.15	9.90	12.52	**14.55**
5	0.775 – 0.925	5.60	2.58	14.46	2.89	4.34	6.36	8.09	9.83	12.43	**14.45**
6	0.925 – 0.945	4.80	3.68	17.69	2.90	4.35	6.38	8.12	9.86	12.48	**14.51**
7	0.945 – 1.060	4.80	4.56	21.88	2.87	4.31	6.32	8.04	9.76	12.35	**14.36**
8	1.060 – 1.100	4.80	3.55	17.03	2.87	4.30	6.30	8.02	9.43	12.32	**14.33**
9	1.100 – 1.300	3.12	2.34	7.31	2.84	4.26	**6.25**	7.95	9.65	12.21	14.19
10	1.300 – 1.850	3.58	4.26	15.25	2.43	3.64	5.34	6.80	8.25	10.44	**12.14**
11	1.850 – 2.050	3.58	3.33	11.93	2.38	3.57	5.24	6.66	8.09	10.23	**11.90**
12	2.050 – 2.200	3.32	4.22	14.01	2.31	3.46	5.08	6.46	7.85	9.93	**11.54**
13	2.200 – 2.230	3.08	4.32	13.29	2.30	3.45	5.06	6.44	7.81	9.88	**11.49**
14	2.230 – 2.275	2.80	3.70	10.36	2.29	3.44	5.04	6.42	7.79	**9.86**	11.46
15	2.275 – 2.600	3.30	7.20	23.77	2.19	3.29	4.82	6.13	7.45	9.42	**10.95**
16	2.600 – 2.810	2.20	3.71	8.16	2.17	3.25	4.77	6.07	**7.37**	9.32	10.83
17	2.810 – 2.825	2.65	4.36	11.15	2.15	3.24	4.75	6.05	7.34	9.28	**10.80**
18	2.825 – 3.325	2.08	3.89	8.10	1.87	2.80	4.11	5.23	6.35	**8.03**	9.34

Explanatory notes to Tab. 3: FP – flow profile; A_{fp} – flow profile area; v – mean flow velocity; Q_{bf} – bankfull discharge (total capacity of flow profile); Q_1 - Q_{100} – annual discharges. Comment: Bold marked data means T-annual discharges, which safely flows through the flow profile (section).

We analyzed the runoff characteristics of the watershed and the discharge characteristics of the bed of Jelenec torrent. We evaluated the capacity of the adjustment flow profiles (bankfull discharge) in relation to T-year discharges. We have proved that the discharge capacity of the flow profiles at the vast majority of the length of the Jelenec torrent control (3.33 km) is sufficient for a discharge of Q_{100}. Roughly marked data in Tab. 3 means T-year discharges, which safely flows through the flow profile (section). In some sections, the capacity of the flow profiles ranges from Q_5 to Q_{50}. In these sections, on the information boards we propose to increase the capacity of the flow profile through longitudinal reinforcement of the bed with a lower roughness (smooth wood, stone), possibly we suggest increasing the total flow profile area through natural stone wall. At the same time, we designed information boards for transverse objects along the torrent control Jelenec (belts, sills, weirs, dams) with an explanation of their construction elements and meaning.

Discussion

In both professional and lay discussions, we often encounter negative views on the use of technical elements in flood protection of the landscape. However, such discussions must always be accompanied by an important issue, which concerns taking responsibility for the loss of life and the great economic damage that can cause flash floods and erosion. As part of tourist and recreational activities, the general public, on the example of the Jelenec torrent, can understand the need for such measures to protect settlements in the foothills and in some parts of large protected areas.

Conclusion

Society-wide important issues of flood and erosion control should be part of the education not only among professionals but also in the general public. One of the possibilities for disseminating professional knowledge on this issue is recreational education. On the tourist trails, through educational boards, experts are able to explain in an appropriate form the issue of optimal management of integrated and systemic flood and erosion control of the landscape. All users of individual parts of the watersheds must strive to ensure safe drainage of flood discharges through the foothills , also by means of technical modifications of the flow profiles of the torren ted using nature-friendly measures. The main reasons for the popularization of recreational and educational education in the field of torrent control in the foothills using sensitive proposals are:

- dense settlement of the foothill areas of Slovakia and thus the threat of foothill villages and towns by flash floods and erosion;
- protection of lives and health of people, dwellings, infrastructure, civil engineering, industrial facilities, etc .;
- leaving the upper parts of the river basin free from human intervention in accordance with nature and landscape protection requirements.

Management of torrent Jelenec provide a good example of a sensitive approach in flood and erosion control in protected areas.

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Souhrn

Odborné vzdělávání na rekreačních a naučných chodnících se zaměřením na management povodňových rizik, jakož i snižování rizika bystřinné eroze a jejích nepříznivých důsledků je reálným a žádoucím úkolem zapájení společnost do systémové ochrany krajiny před povodněmi. V příspěvku uvádíme možnost využití příkladu dobré praxe hrazení bystřin v rekreačním a volnočasovém vzdělávání široké veřejnosti. Za tímto účelem jsme zvolili hrazení bystřiny Jelenec v Hornojelenecké dolině v Národním parku Velká Fatra. Tato dolina je na Slovensku jednou z nejkrásnějších a nejnavštěvovanějších rekreačních lokalit s bohatou historií. Hrazení bystřiny Jelenec bylo realizováno v letech 1926-27 a svou funkci spolehlivě plní již 95 let. Na základě terénních měření jsme analyzovali odtokové charakteristiky povodí a průtokové charakteristiky bystřiny ve snaze prezentovat výsledky výzkumu v rámci rekreačního vzdělávání široké veřejnosti. Hlavním cílem je zvýšit povědomí veřejnosti o významu integrovaných lesnických opatření na ochranu krajiny před přívalovými povodněmi a erozí v rámci volnočasového vzdělávání. Hodnotili jsme kapacity průtokových profilů ve vztahu k N-letým průtokům a funkčnost různých typů příčných objektů. Na informačních tabulích jsme vysvětlili realizovaná řešení z technického, ekologického a environmentálního hlediska.

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VARIOUS FUNCTIONAL STRUCTURES OF WOODY VEGETATION - A BASE OF THE PROPOSAL OF NEW FUNCTIONAL LANDSCAPE

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Abstract
The article presents the results of a case study, which was processed in the catchment area of the water source Nová Ves u Pohořelic owned by BVaK, a.s. The mentioned area consists of about 20 ha of floodplain landscape on mostly Quaternary sediments. The site, originally covered with mature coniferous forest, was deforested due to the drought, which had an immediate effect on the quality of the water in the water source, especially by a significant increase in nitrogen content. The purpose of the study was to design such a structure of the landscape, consisting mainly of elements of woody vegetation, which, by its existence, will ensure the re-achievement of the ordered water quality. The article presents the principles of this proposal, which are based mainly on the ecological possibilities of the proposed tree species and their use for remediation of undesirable substances in water, as well as the proposal itself.

Key words: Catchment area of water source, Woody vegetation functions, Bioremediation, Nová Ves u Pohořelic

Introduction
The area is located in southern Moravia, approximately 25 km south of Brno (Czech Republic). It is a fenced water source area located near the settlement of Mariánský Dvůr, about 3 km southeast of the town of Pohořelice. The altitude ranges from 176-179 m above sea level, the area is flat with a slight slope to the east. In the past the area was forested, mainly with spruce and pine, today most of the area is not forested. Deforestation has occurred in several stages over the last 6 years. The reason for this has been the decline of coniferous stands, mainly due to bark beetle infestation. Today, deciduous trees, groups of original coniferous trees and most of the rest of the area is overgrown with dense vegetation. There is a mixture of grassland and scrubby woody vegetation. The total area of the site is 20.24 ha. The surrounding land consists of fields, forest, occasional groves, and there are also several ponds in the vicinity.
On the basis of the analysis of available relevant documents and extensive field work, a solution for restoration of the area of interest was proposed (Kupec et al., 2022). Due to the specific functions required of the vegetation, the knowledge of phytoremediation, which refers to a series of technologies that use photoautotrophic vascular plants to remediate sites contaminated with inorganic and organic contaminants, was applied (Reichenauer and Germida, 2008).

Materials and methods
The concept of the solution for the revegetation of the water source area is designed in such a way that the proposed vegetation structures help to improve the chemical state of the water drawn from the area, or in such a way that they permanently guarantee the removal of certain elements (especially nutrients) from the soil and thus prevent the potential mixing of surface water with the water of the aquifer of the water source area. The basic principle used for this in the proposal is bioremediation. Bioremediation simply means the removal of certain substances from one medium (water, soil) into another medium (biomass) and the subsequent disposal or transport of this biomass away from the remediated site. The principle of bioremediation is that plants (herbs, woody plants) consume certain substances (e.g. nutrients) for the construction of their plant tissue, taking up these nutrients through water they obtain from the soil environment. If plants or parts of plants are then removed from the site, these substances are not returned to the environment and their concentrations in the soil (soil colloids) decrease in the long term.
The second principle of the solution for revegetation of the water source area is the creation of a green wall, the aim of which is to slow down the flow of subsurface water in the direction of the hydraulic gradient by means of both a mechanical root wall and the suction pressure of the root systems (which significantly slows down the subsurface flow) of the proposed tree species in this wall.
The third design principle is the use of tree species that are native to the site, taking into account the history and current condition of the site and, in particular, the expected impacts of climate change.

The final principle used in the design of the revegetation of the water source area is to maximize the use of the current vegetation on the site and its successional potential in the context of both the potential technology for managing this succession and in the context of the design of the site as a whole (functionality, aesthetics).
A case study containing the formulation of the target state of the vegetation of the water source area and the technological basis for planning the implementation of its restoration was prepared using GIS and CAD software.

Results

The solution concept consists of access to the site through a service road network and a proposal for segmentation of the area according to the structures of woody vegetation, including their purpose and goal (Fig. 1).
The road network consists of the unbound roads with operational reinforcement (main roads) and unpaved tracks. The existing main access road (Trasa I) is 360 m long and has operational reinforcement (aggregate). The access roads allowing approach to the interior of the area (Trasa II, III) are designed for a total length of 748 m, with operational reinforcement (aggregate). Detailed access roads (Trasa IV to XIV) provide access to the core of the water source area and are designed as unpaved (grass cover) for a total length of 2,340 m + 106 m of the unpaved section of Trasa I. The extraction tracks are designed primarily to provide technological access to individual woody vegetation structures for a total length of 1,044 m, grassed cover (Linka I to XII). The cumulative length of the road network is 4,598 m (access roads and tracks).
Segment A - Line planting (1.17 ha). The target condition is perimeter planting of the northern, western and southern boundaries. This is a combined linear plantation consisting of poplar and oak (*Populus alba, Quercus petraea*) with addition of pioneer shrubs. The main road (Trasa I) will be accompanied with the alley of cherry trees. The purpose is to divide the site and provide a service corridor for maintenance of the fencing.
Segment B – Coppice remediation stand (4.29 ha). This consists of sections of poplar (*Populus alba, Populus nigra*) altered with sections of ash (*Fraxinus excelsior*). The central section adjacent to the woodland is based in a linear mixture of oak, elm and ash (*Quercus petraea, Ulmus minor, Fraxinus excelsior*). The segment is constructed of trees with replacement potential - the stand is maintained as a low coppiced stand. The biomass of the stand will be used to export nutrients from the subsurface soil water, the root system will serve as a wall to slow the flow of soil water in the direction of the hydraulic gradient.
Segment C – Forest steppe (3.76 ha). Transitional plant community between extensive communities of natural succession and the intensive coppice remediation communities. Another purpose is to provide habitat for small game and specially protected insect species (praying mantis). The target condition is a meadow with solitary woody plants or groups of woody plants and shrubs (*Pinus sylvestris, Crataegus monogyna, Ligustrum vulgare, Prunus insititia, Pyrus pyraster, Quercus robur, Rhamnus cathartica, Rosa canina*), divided by an extraction tracks.
Segment D - Controlled succession stand (7.35 ha). The purpose is to provide permanent cover of the subject parts of the site with shrub or tree type vegetation. Shrub plantations in the north-eastern part of the site – closed canopy stand fragmented with autochthonous species (*Cornus mas, Cornus sanguinea, Crataegus monogyna, Ligustrum vulgare, Prunus insititia, Rosa canina, Rubus sp., Sambucus nigra, Viburnum opulus*). In the south-eastern and eastern part of the area, there is a higher stand of forest trees dominated by poplar (*Populus alba*) at the canopy and oak (*Quercus petraea*) and the corresponding shrub species in the forest floor.
Segment E – Forest stand (0.75 ha). The segment is located in the eastern part of the site and is covered by forest with a mixture of autochthonous species (*Fraxinus excelsior, Quercus robur, Prunus avium*) with shrub cover (*Cornus sanguinea, Ligustrum vulgare*). The target condition is the transfer to holding designated for forest functions (PUPFL) and management according to Act No. 289/1995 Coll., on forests.
Segment F – Cherry-tree orchard (0.42 ha). The segment will serve as an aesthetic element near the water pump station building. It will be logically connected to the cherry-tree plantation along the access road. It will be a fruit-bearing aesthetic element with cherry tree planting and the use of native tree forms of *Prunus insititia*.
Segment G - Power Line Protection Zone (0.15 ha). The target condition of the segment should meet the requirements for power line operation. Currently there is a rich tree and shrub cover (*Cornus sanguinea, Crataegus monogyna, Euonymus europaea, Ligustrum vulgare, Prunus insititia, Pyrus pyraster, Quercus robur, Rosa canina, Rubus caesius, Sambucus nigra*).

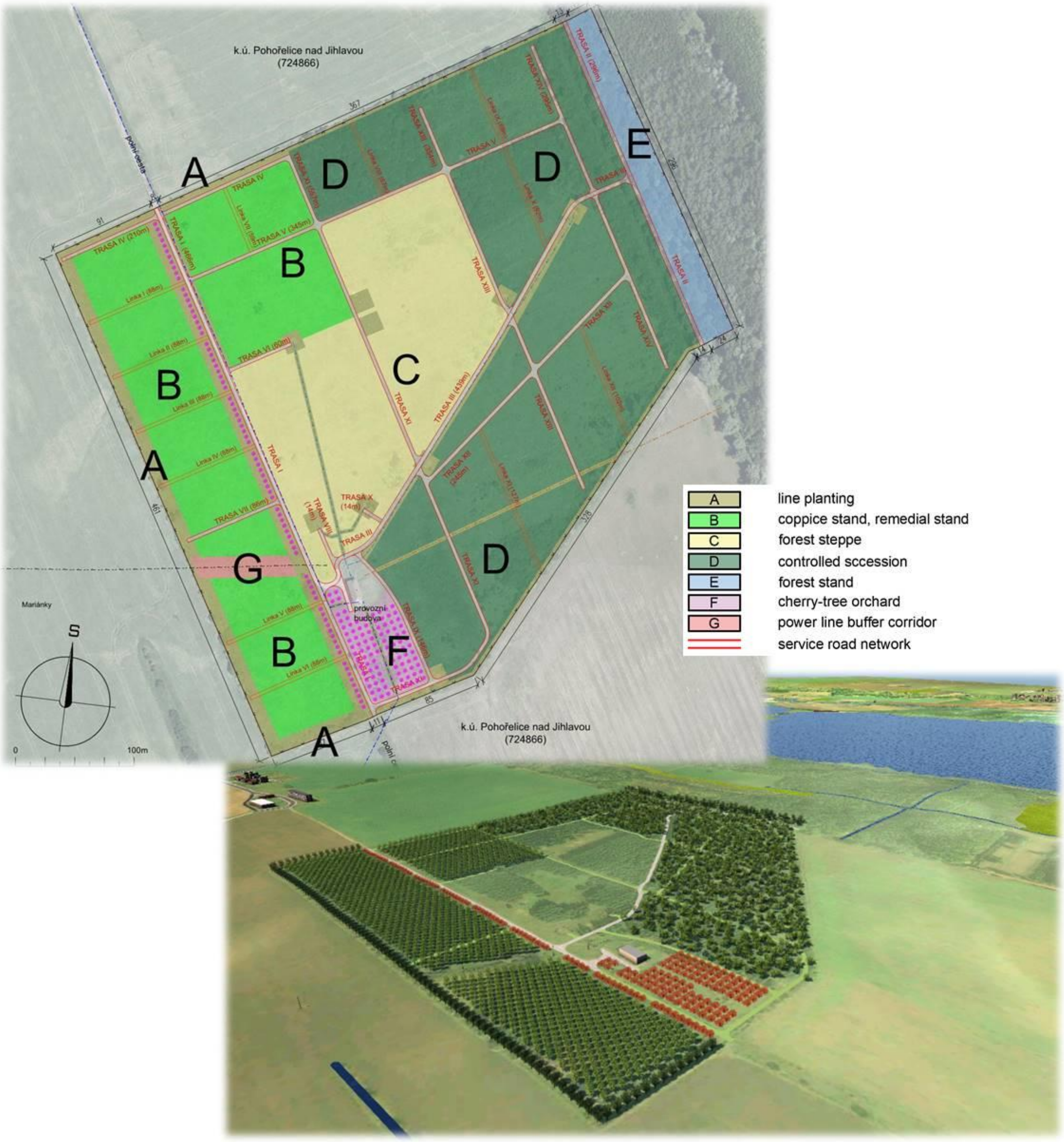

Fig. 1: Functional structures of woody vegetation and service road network

Discussion

The concentration of nitrates in natural waters is increasing as a result of population growth and agricultural activity (Hubačíková et al., 2020). The primary function of the vegetation on the revitalized site is bioremediation, in our case phytoremediation or phytodegradation. This takes place in plants via rhizobacteria, takes time and allows plants to use nutrients for growth, integrate contaminants into their cellular structures or metabolize contaminants directly (Reichenauer and Germida, 2008). Ancona et al. (2019) report that in the case of poplar trees (whose coppicing capacity is used in the proposal), pollutants accumulate mainly in root systems during bioremediation. The remediation purpose of stands requires a specific approach to the design of the species composition of the stands. For example, only biennial straight-rooted material in a 1.5×1.5 m spacing will be used for the area planting of trees in Segment B. The quantity of planting material in the segment amounts to 4,450 pcs/ha. Planting of approximately 18,000 trees is proposed throughout the area, which will be carried out after mechanical preparation of the site. Successful remediation of the vegetation is dependent on consistent post-planting care and implementation of the proposed management plan for the entire site. However, the potential attractiveness (aesthetic quality) of the site has been taken into account in the overall revegetation concept, although the assessment of aesthetic quality, particularly of natural features, is an inherently subjective task (Junker and Buchecker, 2008). The restoration of the area was designed in accordance with the principles of ecological integrity - sites with poorer levels of ecological integrity are perceived as less aesthetically appealing compared to sites that abound with higher levels of ecological integrity (McCormick et al., 2015). The cherry-tree orchard is then a special part of the proposal, which will act as a dominant feature of the area once the cherry trees have grown back (Deutscher, 2014). Later in the growing season, it can support the aforementioned ecological integrity of the area by increasing the food and habitat supply for animals. The public's aesthetic perception of revitalization projects is strongly positively related to the extent to which the revitalization meets public needs (Junker and Buchecker, 2008), and therefore we hypothesize that the site would be perceived overwhelmingly positively in a qualitative aesthetic investigation. Addition of utility structures at the site would be appropriate to increase recreational potential (Vallecillo et al. 2019). The site is accessed by a service road network approximately 4.5 km in length; no other types of structures are proposed (Hrůza and Procházková, 2017). It has also been found that although in some cases ecosystem restoration may lead to reduced recreational opportunities, revegetation represents an increase in functional diversity as well as more opportunities to experience nature, which may be the ultimate revegetation goal (Funk et al., 2020).

Conclusion

The case study of the revegetation of a catchment area focuses on the application of bioremediation knowledge. Optimally designed species composition and structure of vegetation will play a key role in reducing nutrients in the soil horizon and improving subsurface water quality.

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Souhrn

Článek prezentuje výsledky případové studie, která byla zpracována v povodí vodního zdroje Nová Ves u Pohořelic. Lokalita, původně porostlá vzrostlým jehličnatým lesem, byla v důsledku sucha odlesněna, což se bezprostředně projevilo na kvalitě vody ve vodním zdroji, zejména výrazným zvýšením obsahu dusíku. Cílem studie bylo navrhnout strukturu krajiny, tvořenou především prvky dřevinné vegetace, která svou existencí zajistí opětovné dosažení požadované kvality vody.

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VEGETATION OF VINEYARDS – REGARDING THE RISK OF FIRE AND IMPORTANCE FOR TOURISM

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Abstract

Vineyards are an important tourist element in the cultural landscape. The vineyards also include other types of plants. The aim of the paper is to evaluate the species composition of vegetation in terms of the potential risk of fire. The evaluation of vegetation took place in the cadastre of four wine-growing villages (Hlohovec, Horní Dunajovice, Moravský Žižkov, Sudoměřice). The wine-growing villages belong to the Morava wine-growing region. The vineyard vegetation has a diverse range of species. Based on our evaluation, 87 species were found in the monitored localities. Among the found species, there were 17 species of grasses. Grass biomass in vineyards increases the risk of fire. Vegetation in the vineyards is a potential risk for the outbreak and spread of fire.

Key words: vineyards, vegetation, fire risk, tourism

Introduction

Herbaceous vegetation in inter-rows protects the soil from water erosion, enriches the soil with organic matter and prevents rinsing of nutrients both on the soil surface and their leaching to the lower horizons of soil (Retallack 2010). There are a number of ways to care for vineyards. The most important methods concern weed control, soil protection and soil water management. The differences in vineyard management must take into account the age of the vines, the design of the vineyards, the type of soil and the production area (Martinson, Hellman, 2015). Tourists are attracted to the vineyards as well. Tourism is closely tied to vineyards and wine production in several locations.

As a result of increased tourism, arson attack has increased by as much as 26 %, and in Spain, it is almost 55 %. This situation is accentuated by poor urban planning that allows the embedding of communities within or in the vicinity of forested areas, classified as wildland-urban interface (WUI), with little public understanding, participation in forest protection, and infrastructure measures (Goldammer, 2013; WWF, 2019). The increased threat of fire has led to several measures, including changes in vegetation management (Porter et al., 2021). The paper aims to evaluate vegetation species composition regarding the potential risk of fire.

Materials and methods

The evaluation of vegetation took place in the cadastre of four wine-growing villages (Hlohovec, Horní Dunajovice, Moravský Žižkov, Sudoměřice). The wine-growing villages belong to the Morava wine-growing region, located in a maize production area with a hot and dry climatic region. The average annual temperatures in this area are 8 - 10 ° C and the average annual precipitation is about 500 - 600 mm.

The system of floristic inventory of found species was used to assess the vegetation. The evaluation took place in July 2017 and 2018. The scientific names of individual plant species were determined according to the Pladias database (Pladias, 2020).

It was possible to go through some areas of the vineyards on our designated paths. During this route, all found plant species were recorded. At the end of the pass, the following species were evaluated using a simple three-point scale:

3 - numerous species with a dominant occurrence (dominant species)

2 - common species with abundant occurrence only in some places of the vineyard (subdominant species)

1 - rare species with a small and rare occurrence

The found species were divided into groups according to their biological properties and their relation to fire risk.

Results

During the monitoring of vineyards in selected localities, 87 species of plants were found. Table 1 shows the numbers of plant species found in the monitored vineyards. Species are further divided according to selected criteria.

Tab. 1: Number of species in vineyards found in monitored localities

Wine-growing villages	Viniční trať	Perennial grasses	Annual grasses	Perennial dicots	Annual dicots
Moravský Žižkov	Stará hora	4	3	10	12
	Sahara	3	4	14	11
Sudoměřice	Staré hory	5	3	17	8
	Vápenky	4	1	14	6
	Díly za zahradou	4	3	11	6
Hlohovec	Šulaperk	4	5	12	15
	Stará hora	3	5	15	11
	Dělice	2	1	11	10
Horní Dunajovie	Stará hory	3	2	7	4
	Frédy	3	2	13	10

Perennial grasses represent the first group of species. Such species are: *Arrhenatherum elatius, Calamagrostis epigejos, Dactylis glomerata, Elytrigia repens, Fallopia convolvulus, Festuca pratensis, Festuca rubra, Lolium perenne, Poa pratensis.*

The second group consists of annual grasses. The occurring species are: *Bromus hordeaceus, Bromus sterilis, Bromus tectorum, Digitaria sanguinalis, Echinochloa crus-galli, Hordeum murinum, Setaria pumila, Setaria viridis.*

The third group are perennial dicots. Species as *Agrimonia eupatoria, Achillea collina, Achillea millefolium, Artemisia absinthium, Artemisia vulgaris, Carduus acanthoides, Centaurea jacea, Cichorium intybus, Cirsium arvense, Convolvulus arvensis, Crepis biennis, Crepis tectorum, Daucus carota, Echium vulgare, Falcaria vulgaris, Galium album, Glechoma hederacea, Hieracium pilosella, Inula hirta, Lathyrus tuberosus, Linaria vulgaris, Lotus corniculatus, Malva neglecta, Malva verticillata, Medicago falcata, Medicago lupulina, Onobrychis viciifolia, Pastinaca sativa, Picris hieracioides, Plantago lanceolata, Plantago major, Potentilla arenaria, Reseda lutea, Salvia nemorosa, Salvia pratensis, Securigera varia, Silene latifolia, Taraxacum* sect. *Ruderalia, Trifolium aureum, Trifolium pratense, Trifolium repens, Vicia cracca* were found in there.

The fourth group are annual dicots. The occurring species are: *Amaranthus powelli, Amaranthus retroflexus, Arenaria serpyllifolia, Atriplex patula, Capsella bursa-pastoris, Cerastium arvenxe, Consolida regalis, Conyza canadensis, Epilobium ciliatum, Erigeron annuus, Erodium cicutarium, Geranium dissectum, Geranium pusillum, Geum urbanum, Chenopodium album, Chenopodium hybridum, Chenopodium pumilio, Lactuca serriola, Mercurialis annua, Panicum miliaceum, Polygonum aviculare, Portulaca oleracea, Senecio vulgaris, Solanum nigrum, Trifolium arvense, Trifolium incarnatum, Tripleurospermum inodorum, Viola arvensis.*

Discussion

In Europe, the main causes of fires are meteorological conditions, especially the warm and very dry summer months. In addition to climatic conditions, unused pastures with large amounts of dead grass biomass also increase the fire risk (Mohamed et al., 2020). The biomass of some grasses produces substances that allow spontaneous combustion. Grass biomass burns quickly during fires, resulting in high temperatures that burn other species, including trees (Dillon et al., 2021).

Grasses represent a significant source of risk for fire (Ryspekov et al., 2021; Winkler et al., 2021). Grass species are an important part of vineyard vegetation in Moravian vineyards (Lišková et al., 2016; Maxianová et al., 2016; Ragasová et al., 2019).
Dicotyledonous species (including vines) produce biomass that allows fires to continue. Dicots are often intentionally sown. Their various ecosystem functions are evaluated positively (Ragasová et al., 2021).
Vineyards are important for the development of tourism in the regions. Increased tourist raises the risk of fire, particularly during the summer. The vineyard vegetation's species composition has the ability to cause the fire to erupt and spread farther. Vegetation management plays an important role here.

Conclusion

Vineyards have an essential role in the cultural environment as a tourist attraction. The vineyards also include other types of plants. The vegetation of the vineyards is very rich in species. Based on our evaluation, 87 species were found in the monitored localities. Of the species found, 17 were grass species. Grass biomass in vineyards increases the risk of fire. Vegetation in the vineyards poses a risk of the outbreak and spread of fire.

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Souhrn

Vinice jsou významný turistický prvek v kulturní krajině. Součástí vinic jsou i další druhy rostlin. Cílem článku je zhodnotit druhové složení vegetace z pohledu potenciálního rizika vzniku požáru. Hodnocení vegetace vinic probíhalo v katastru čtyř vinařských obcí (Hlohovec, Horní Dunajovice, Moravský Žižkov, Sudoměřice). Vinařské obce patří do vinařské oblasti Morava. Vegetace vinic je druhově velmi bohatá. Na základě našeho hodnocení bylo nalezeno 87 druhů ve sledovaných lokalitách. Z nalezených druhů bylo 17 druhů trav. Biomasa trávy ve vinicích zvyšuje riziko vzniku požáru. Vegetace ve vinicích je potenciálním rizikem pro vznik a šíření požáru.

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VIEWPOINT GEOSITES AND THEIR POTENTIAL FOR GEOEDUCATION AND GEOTOURISM

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Abstract
Viewpoint geosites are locations which allow observation of the surrounding landscape and comprehension of geodiversity (or Earth history recorded in rocks, structures and landforms) visible from this locality. The sites themselves don't have to be attractive from the Earth-sciences point of view, so they may be both natural (e.g. rock outcrops, mountain tops) and man-made objects (e.g. watchtowers, view terraces). These sites represent a very important resource for geotourism and geoeducation as they allow understand landscape, its history and relationships between its components. In this paper, we present examples of viewpoints from Podyjí National Park (both natural and man-made structures) that allow to observe geodiversity of the area. For an effective management and rational use of these specific and important sites, it is necessary to identify their characteristics and potential, so the guidelines for inventorying and method for assessment their potential are proposed. These procedures can contribute to the development of geotourist and geoeducational activities and above all, they enable better understanding of geodiversity's position within landscape and justify its conservation and sustainable use.

Key words: Geodiversity; Inventory; Assessment; Landscape; Viewshade analysis

Introduction
The viewpoints has been always perceived as fascinating sites from where the landscape (including its non-living and living components and cultural aspects) could be observed. Already in the past and in the early development of tourism, they represented a favourite destinations of tourists and visitors. However, within the geodiversity and geoheritage studies, they rather stood aside in comparison with "traditional" geosite-oriented research and they obtained only limited attention and have been explored rather in a conceptual way (Migoń and Pijet Migoń 2017, Mikhailenko and Ruban 2019).
Generally, the issues of viewpoint geosites are often discussed in relation to perception of the landscape (Giusti et al. 2013). Reynard (2004) briefly mentions the viewpoint geosite in Encyclopedia of Geomorphology, Pereira and Pereira (2010) distinguish "panoramic viewpoints" as a category of geosites, introducing them as sites from which large landforms can be best perceived. According to Migoń and Pijet Migoń (2017), viewpoint geosites are understood as localities which offer a wider look at the surrounding landscape and hence, better understanding of its history, spatial relationships between rock types and landform categories (i.e. geodiversity), and ongoing environmental change. Viewpoint geosites may be classified as following: **1) Sites with an intrinsic value**: usually natural viewpoints, attractive from Earth-science point of view, e.g. hill, rock outcrop, mountain, rim. They are often included in geosite inventories and assessed by methods used for classical geosites (existence of a view or scenic beauty of the site's surrounding are evaluated within added values as an "aesthetic value" or "scenic value" and increase the overall value of the site). **2) Sites without any intrinsic value (or a very low intrinsic value)**: sites where different geodiversity and landscape elements can be observed, but the sites themselves are not attractive from Earth-science point of view, e.g. bridge, the roof of a building or any other construction (Figure 1).
Viewpoint geosites are very important for geoeducation especially in the fields of general geology, geomorphology, land use patterns and landscape interpretation (Rodrigues 2013, Migoń and Pijet Migoń 2017). There are several studies that include the assessment of viewpoint geosites, but usually, this type of geosite is not in the centre of attention (Pereira and Pereira 2010, Tessema et al. 2021). Practically, assessment of geotourist and geoeducational potential of geosites can contribute to balance the geotourism/education needs with nature conservation (Kubalíková et al. 2021). This paper represents a pilot study where we apply a set of criteria on selected viewpoints in Podyjí National Park to assess their geotourist potential. This is accompanied with an analysis of visibility. Based on this, effective management and specific activities can be designed.

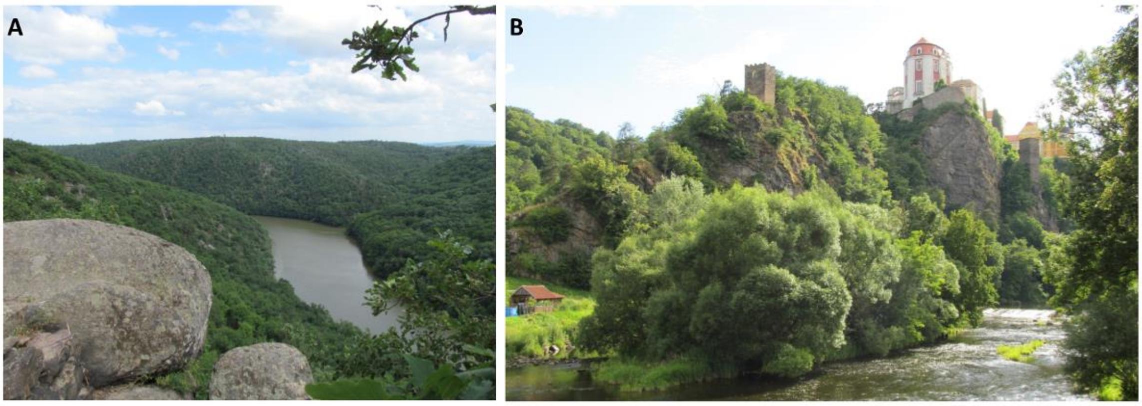

Fig. 1: A – Viewpoint geosite with high intrinsic value: Králův stolec (a rocky outcrop above the Dyje River showing the specific forms of granite weathering); B – Bridge in Vranov as an example of viewpoint geosite with no intrinsic value, but offering a representative view on Bíteš ortogneiss promontory with visible plastic deformations (folds, faults etc.) and with important geo-cultural aspect (a suitable landform for building a fortress and castle)

Methods and study area

The first step when recognising the potential of viewpoint geosites for geotourism and geoeducation, is inventorying, mapping and describing the proper sites. For the qualitative assessment of geotourist and geoeducational potential, selected criteria already proposed and discussed by Migoń and Pijet-Migoń (2017) and Mikhailenko and Ruban (2019) were used. The semi-quantitative approach has been be also proposed and applied (see Results).

Podyjí National Park is situated in the SW part of the South-Moravian Region in the Czech Republic. The canyon-like valley of the Dyje River is deeply incised into the original peneplenized surface and forms the axis of the study area between the towns of Znojmo and Vranov nad Dyjí. The area has been used by humans since Medieval times (border castles, forts, agriculture, wineyards, use of water resources). Due to Iron Curtain established after WWII, the economic activities in the area were limited, so the natural values were preserved. In 1991, National Park was declared. Geologically, the study area is built of Bíteš orthogneiss, two-mica schist of the Lukov unit and granite of the Dyje Massif. The main landforms are represented by fluvial landforms (incised meanders, alluvial plains and terraces), cryogenic landforms (frost cliffs, blocky accumulations, debris flows, rock towers) and anthropogenic landforms, e.g. mill races, agricultural terraces, defensive military constructions or castle moats (Kirchner 2016). In the study area, 35 viewpoints were identified (Figure 2).

Results

As a case study, two viewpoint geosites were chosen for evaluation: Devět mlýnů and Elias' Chapel. Table 1 presents brief characteristics of these sites and assessment of their geotourist and geoeducational potential based on selected criteria.

The description and assessment are accompanied by analysis of visibility (Figure 3). Fig. 4 then presents examples of geodiversity elements that may be observed from a geosite viewpoint.

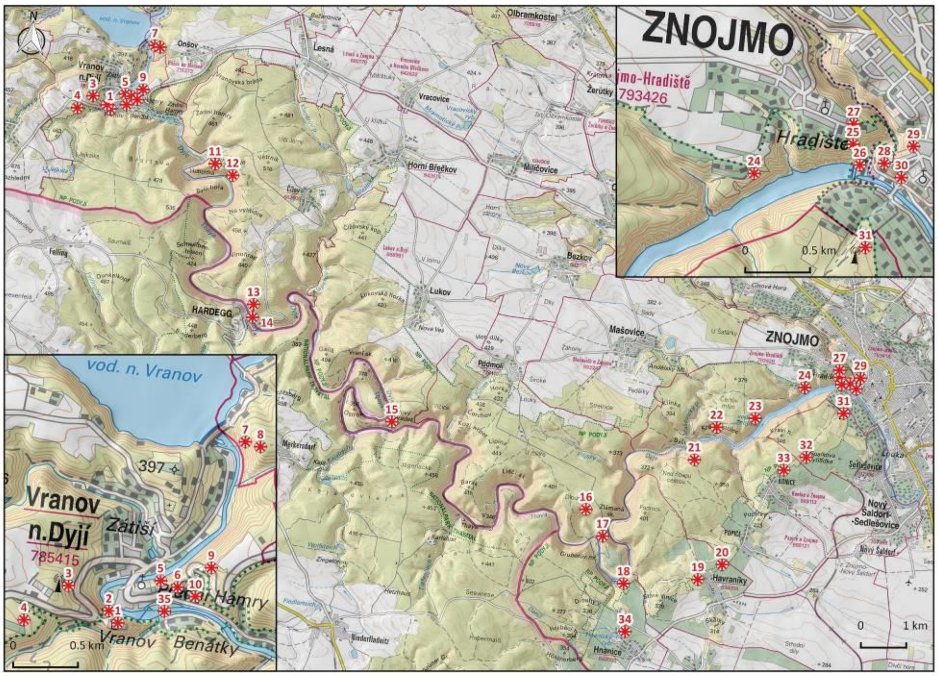

Fig. 2: Viewpoint geosites at Podyjí National Park: 1 – Vranov zámek, 2 – Halamasskova vyhlídka, 3 – Tanečnice, 4 – Nad Felicitinou studánkou, 5 – Švédský příkop, 6 – Mniszkův kříž, 7 – Claryho kříž, 8 – Claryho okruh, 9 – Nejsvětější Trojice, 10 – Vyhlídka zamilovaných, 11 – Obelisk, 12 – Pašerácká stezka, 13 – Hardeggská vyhlídka, 14 – Vyhlídka u splavu, 15 – Nový Hrádek, 16 – Železné schody, 17 – Šobes, 18 – Devět mlýnů, 19 – Havraníky, Sv. Cyril a Metoděj, 20 – Havraníky Nad kaplí, 21 – Sealsfieldův kámen, 22 – Králův stolec, 23 – Dlouhá řeka, 24 – Nad lomem, 25 – Eliášova kaple, 26 – Krammerova villa, 27 – Sv. Antonín Paduánský, 28 – Znojemský hrad, 29 – Znojmo, museum, 30 – Vyhlídka pod hradbami, 31 – Kraví hora, 32 – Špalkova vyhlídka, 33 – Konice, sever, 34 – Hnanice, kaplička, 35 – Bridge in Vranov.

Tab. 1: Viewpoints description and assessment based on selected criteria

Viewpoint:	Devět mlýnů	Elias' Chapel
Characteristics		
Coordinates	48.8107919N, 15.9812075E	48.8564908N, 16.0384539E
Characteristics of the site	rock outcrop on the right bank of the Dyje Valley, accessible via marked path	situated on the steep hill on the left bank above the Znojmo Reservoir
Criteria for assessment		
1. Panoramic view: up to 90° (1 point), 90-180° (2 points), 180-270° (3), 270-360° (4)	180-270° (3 points)	180-270° (3 points)
2. Diversity or number of Earth-science elements visible from viewpoint (1 point for each element, max. 5 for each subcriterion)		
2a. geology (lithology, tectonics, stratigraphy...)	lithology (granite) (1 point)	lithology (granite) (1 point)
2b. geomorphology (cryogenic landforms, glacial landforms, karst, fluvial landforms…)	deeply incised valley, peneplenized surface, meandering, frost cliffs, alluvial plain, block accumulations (5 points)	deeply incised valley, peneplenized surface, frost cliffs, meandering, gullies (5 points)
2c. hydrological components (water bodies, rivers…), soils	Dyje River (1 point)	Znojmo Reservoir (1 point)
3. Geo-cultural features: anthropogenic landforms incorporated in landscape, buildings from local material, small sacral objects (1 point for each feature, max. 3)	agrarian terraces (Šobes) (1 point)	agrarian terraces, castle, church, small chapels (3 points)
4. Overall landscape aesthetic (contrasts and structuration): 1 - low, 3 - average, 5 - high	high contrasts, varied landscape mosaic, deep valley (5 points)	high contrasts, varied landscape mosaic, harmonic environment (5 points)

5. Disturbing elements: 0 - elements affecting or obscuring the view (large constructions, industrial plants), 2 - several disturbing elements not obscuring the view, 4 - no disturbance	no disturbances (4 points)	the dam construction of Znojmo Reservoir, anthropogenic transformation of terrain and some buildings in the city of Znojmo (2 points)
6. Tourist and educational characteristics (use characteristics)		
6a. overall visibility: 1 - low (view obscured by trees or other elements), 2 - average (some obstacles), 3 - very good visibility)	several trees partly obscuring the view, but not very much (2 points)	no obstacles (3 points)
6b. readability of Earth-science elements: 1 - low (a need for explication or information provided on site), 2 - average (possible to read and recognize, usually with brief information), 3 - high (easy to read the features)	some geomorphological features need explanation or interpretation by a professional guide or information panel (2 points)	some geomorphological features need explanation or interpretation by a professional guide or information panel (2 points)
6c. safety: 1 - access at own risk, 2 - access with specific issues that may affect the safety (e.g. lack of the fences, poor paths), 3 - no safety issues	limited access for disabled persons, a visitor has to be careful when stepping at the terrace, not suitable for small children (2 points)	no safety issues (3 points)
6d. accessibility: 1 - accessible by walk, 2 - accessible by car (parking near the viewpoint), 3 - accessible by public transport	accessible on foot or bike, car can be parked approximately 1 km away (2 points)	accessible by car and public transport (parking in proximity, bus stop approximately 700 m far) (3 points)
6e. infrastructure: 1 - no infrastructure, only a path leading to the site, 2 - marked paths, information available e.g. on websites, 3 - well equipped site, tourist marked paths leading to it, information panels on-site	tourist marked path, the site is easy to find, information about the site available on internet or tourist maps, on site, there is no information about Earth-science elements (2 points)	tourist marked path, the site is easy to find, information about the site available on internet or tourist maps, on site, there is no information about Earth-science elements (2 points)
7. Current status: 1 - site not very attractive (damaged, overused), 3 - some disturbances (vandalism, destruction of tourist infrastructure), 5 - site managed well, even if visited frequently	site relatively well managed, but suffers from overcrowding during season (vandalism, littering) (5 points)	site managed well, not disturbed, not very frequently visited by tourists (5 points)
TOTAL SCORE	33	38

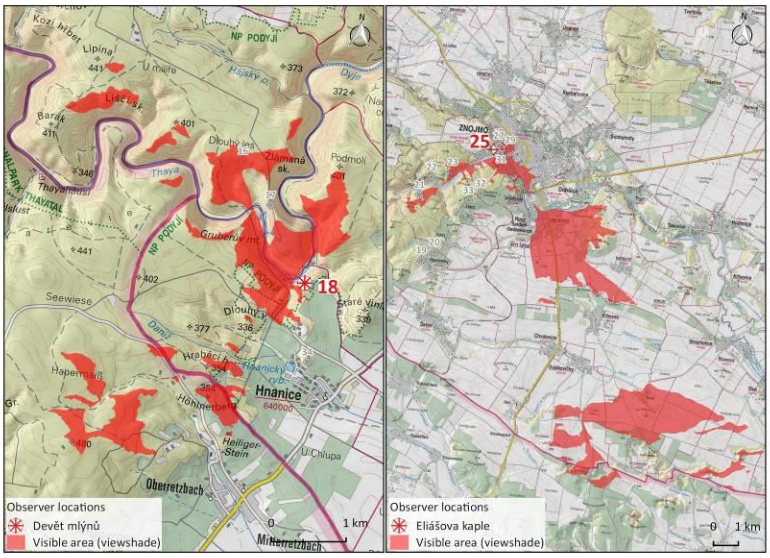

Fig. 3: Analysis of visible area of the Devět mlýnů and Elias’ Chapel viewpoint geosites (by using a viewshade method)

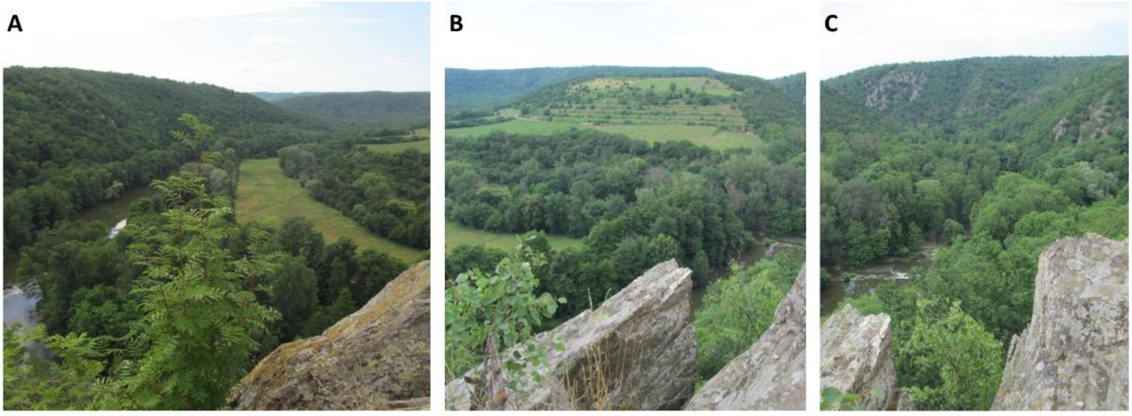

Fig. 4: Devět mlýnů viewpoint geosite and geomorphological features that can be observed: A – deeply incised valley into the peneplenized surface, alluvial plains; B – anthropogenic terraces (Šobes wineyard); C – river bottom, frost cliffs, block fields, rocky outcrops.

The numerical assessment enable a more objective assessment, however, the discussion of results make sense and is possible only when applied on a higher number of the sites. In this case, the numerical assessment is rather a pilot test of the proposed approach (or illustration). Thus, proper interpretation is out of the scope of this paper and it is a subject of further research.

Conclusions

The proposed method is aimed to assess the geotourist and geoeducational potential based on "view" criteria and other characteristics of the site (use characteristics and current status) regardless of the Earth-science value of the proper site. Thus, it may be used both for geosites with and without intrinsic values. Of course, for a complex estimation of geotourist and geoeducational potential of a viewpoint geosite, an evaluation of intrinsic characteristics should be done (i.e. classical geosite assessment based on already used geosite methods). The results of the qualitative and quantitative assessment help to recognize geotourist and geoeducational potential of particular sites, however, when planning and managing them, every site needs to be treated individually. The proposed assessment is rather indicative, but if applied and verified for higher number of viewpoints in different areas, it may contribute to the more effective management of geotourist and geoeducational resources with regard to geoconservation.

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Souhrn
Vyhlídkové geolokality jsou místa, která umožňují pozorování okolní krajiny a pochopení geodiverzity (nebo historie vývoje Země, zaznamenané ve skalních formacích, geologických strukturách a tvarech reliéfu). Samotné lokality nemusí být atraktivní z hlediska věd o Zemi. Může se jednat jak o přírodní (skalní výchozy, vrcholky hor), tak o uměle vytvořené objekty (rozhledny, vyhlídkové terasy). Tyto lokality představují důležitý zdroj pro geoturismus a geovzdělávání. Pro efektivní management a racionální využívání těchto lokalit byla navržena metodika hodnocení jejich geoturistického potenciálu. V zájmové oblasti bylo vybráno 35 vyhlídkových lokalit, podrobně zhodnoceny byly dvě: Devět mlýnů a Eliášova kaple, a to jak kvalitativními, tak numerickými metodami, přičemž numerické hodnocení je v tomto případě spíše pilotním testem navrženého přístupu a bude aplikováno v dalším výzkumu na větším počtu lokalit. Prezentované postupy mohou přispět k rozvoji geoturistických nebo geovzdělávacích aktivit a umožní lépe porozumět postavení geodiverzity v krajině a zdůraznit nutnost její ochrany a udržitelného využívání.

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WATER RETENTION MEASURES AS AN ELEMENT OF ADAPTIVE MEASURES TO TACKLE THE CLIMATE CHANGE IN THE CITY OF TREBIŠOV, SLOVAKIA

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Abstract
Many countries are currently facing environmental problems related to climate change. Adaptive measures that reduce landscape vulnerability and increase the adaptive capacity of natural and man-made ecosystems to the current or expected negative effects of climate change are a response to the demand for its mitigation. Selected adaptation measures can be implemented as a system of measures aimed at improving the hydroclimatic conditions of the landscape, especially by influencing its water retention function.
The paper focuses on the design of water retention measures in the area of the secondary school in the town of Trebišov, located in the Lower Zemplín region in Slovakia. The proposed water retention measures are implemented by retaining and draining rainwater during heavy rainfall from paved areas and collecting areas of roofs. The results of this study are newly built drainage pipe systems with the creation of retention structures of rain gardens, infiltration trenches, vegetation walls and rainwater collection tanks for watering, including permeable areas of vegetation blocks.

Key words: rainfall, vegetation wall, Lower Zemplín, rain garden

Introduction
Climate change, as a phenomenon of the 21st century, is becoming one of the biggest challenges of environmental policy (WEF 2018). Although the signs of climate change vary around the world and in the regions, its adverse effects on socio-economic and natural systems are increasingly significant and require an active solution (ME SR 2018). They are most pronounced in urban settlements, which are characterized by impermeable surfaces with a high concentration of human activities (Zeleňáková et al. 2015). This leads to a significant increase in air and surface temperature (ME SR 2018). Currently, more than half of Slovakia's population (approx. 53% of the total population) lives in cities (SO SR 2021). A solution that should ultimately prevent, or at least minimize the risks and negative consequences of climate change, is to combine mitigation measures (measures to reduce greenhouse gas emissions) with measures that reduce vulnerability and enable the adaptation of humans and ecosystems through lower economic, environmental and social costs (Andrejčinová et al. 2018).
Great emphasis is placed on the application of elements of green and blue infrastructure in the urban environment, which preserve the values and functions of native and nature-friendly ecosystems. Thus, individual settlements urgently need to plan and implement measures to mitigate impacts and adapt to climate change. There is a growing interest in natural water retention measures (Strosser et al. 2015), which can contribute to achieving the objectives of various European Union policies, e.g. EU Strategy on Adaptation to Climate Change, EU Biodiversity Strategy for 2030, EU Action on Water Scarcity and Drought, etc.
According to (Tešliar et al. 2020), the city of Trebišov also belongs to one of the cities in eastern Slovakia, which is included in the group of municipalities endangered due to the significant impact of climate change. It is assumed that in the future the most serious problems in the town of Trebišov will include heat waves, droughts, drinking water scarcity, floods, and loss of soil organic matter due to conventional land management. To mitigate these negative consequences, it is necessary to take partial steps in the city.
The aim of the paper is to design new, or to revitalize the existing water retention measures in the individual premises of the secondary vocational school in the town of Trebišov.

Material and methods
The town of Trebišov as the center of the Lower Zemplín region lies in the southwestern part of the East Slovakian lowlands. It is located at an altitude of 109 m above sea level, mostly on the right bank of the Trnávka stream, a tributary of the Ondava river. From a hydrological point of view, the territory of the Trebišov district belongs to the sub-basin of the Bodrog river. The whole Bodrog basin can be assessed as water-rich, rainfall-rich and with a relatively high runoff coefficient.The Trebišov district is mainly an agricultural region. The dominant features are fertile lands, orchards, green gardens, floodplain forests with nature reserves and picturesque hills with the scenery of the Slanské Hills,

which provide opportunities for recreation and relaxation. The Tokaj wine region is a part of this locality, which has excellent wines of the highest quality and great recreational potential (Junakova et al. 2020; 2021).
Revitalization and design of water retention measures is carried out in the area of a secondary school in the town of Trebišov (Fig. 1). The original state of the existing objects and the solved area is shown in Fig. 2.

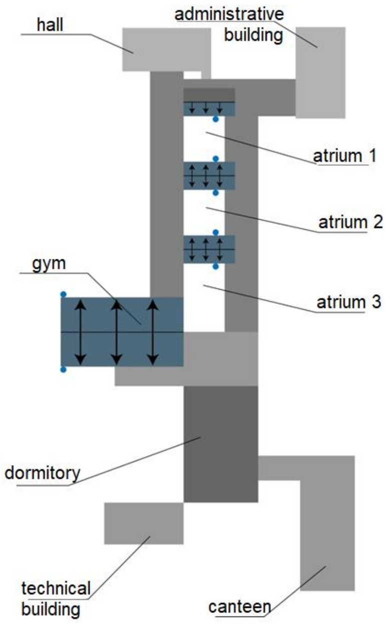

Fig. 1: Design of rainwater harvesting system from the roofs of the school (Note: The arrows show the slope of the roof)

The proposed measures are intended to retain and drain rainwater to the collecting underground tank, rain garden, and infiltration trenches from the roof and paved areas in the area of the school atrium and thus reducing the total amount of water flowing into the area during torrential rains. At the same time, the goal is to improve the fauna and flora in the solved area during the drought.

Results and discussion

Technical description of the proposed water retention measures

The proposed water retention measures consist of the following objects: rain garden, underground rainwater tank, vegetation blocks, infiltration trench and vertical vegetation wall.
The bio-retention rain garden is used to collect rainwater from the school roof and rain gutters in Atrium 1, as well as from other paved areas. The planned area of the garden is 19.0 m^2 with the shape of an ellipse with dimensions of 4x6 m. The realization of the bio-retention garden is preceded by the construction of a grassy area of the school Atrium 1 by the reconstruction of a paved concrete area. This object consists of individual branches of collecting pipes, which are connected to an underground rainwater tank, where rainwater flows gravitationally through the existing rain gutters of the school roof.
The underground rainwater collection tank with a capacity of 1500 L (determined according to the amount of rainwater and usable roof area) is an object partially engaged below ground level, which is used to collect and regulate rainwater during torrential rains from the school roof collection areas in Atrium 1, 2, and 3. Object consists of individual branches of collecting pipes, which are connected to existing rain gutters. Parts of this object are directly interconnected and at the same time the tank is connected to the rain garden, and/or infiltration trench. The water retained in the reservoir can serve as irrigation during the dry season. The tank is designed with a safety overflow.

Fig. 2: Original state of the existing objects in area of school: a) Atrium 1; b) Atrium 2; c) Atrium 3; d) Area in the western part of the school

Another proposed water retention measure in the area is the use of vegetation blocks, which serve to strengthen and protect grasslands burdened by walking and lightweight means of transport (bicycles). Their surface makes up more than 90% of the space for rainwater infiltration, while ensuring free circulation of water and air. Grass blocks make it possible to change paved areas to a green zone and their great advantage is the possibility of use immediately after installation.

Rainwater from the underground collection tank that retain rainwater from the collecting roof areas of the buildings and from the grassed areas will be taken by the infiltration trench. The proposed trench infiltration area in Atrium 2 will be a trapezoidal cross-section with dimensions of 9.0 m^2 (1.5x6.0 m). In Atrium 3, the area of the infiltration trench will have a triangular cross-section with an area of 10.0 m^2 and dimensions of 1.0x10.0 m.

The vertical vegetation wall in the Atrium 3 will consist of a panel construction with vegetation plantings of climbing plants with drip irrigation, the length of which will be 7.5 m. The wall will serve as a visual barrier and will use part of the retained rainwater. Various and well-proven plant species can be used for planting, such as *Hedera helix*, *Celastrus scandens* or *Parthenocissus quinquefolia*. The advantages of the system are the color diversity of the surface, increased biodiversity, increased utility value of the building, non-flammability, and the possibility of use as a double-sided green partition wall, screen or double-sided green hedge.

Conclusion

The main goal of adaptation to climate change is to reduce the vulnerability of the settlement environment to the adverse effects of climate change and to increase the ability of settlements to adapt to new, often extreme conditions. Rainwater management in urban areas can be based on the principle of retaining rainwater in the environment where it falls. The current practice is focused on the fastest possible drainage of rainwater from the urban area. Innovative solutions based on the artificial retention of rainwater in the city's structures in the rain-free period allow this water to be used to improve the city's microclimate, irrigation of parks, atriums or through recycling to other urban needs. There are several technological solutions available to improve the environment, which are often used in developed countries. Several systems can have alternative solutions and by connecting them it is possible to achieve a quality and pleasant environment, which is the aim of this study.

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Souhrn

Cílem adaptace na změnu klimatu je především snížení zranitelnosti sídelního prostředí vůči nepříznivým důsledkům změny klimatu a zvýšení schopnosti sídel přizpůsobit se novým, často extrémním podmínkám. Manažment dešťových vod v intravilánech měst lze založit na principu zadržení dešťové vody v prostředí, kde padne. Dosavadní praxe je orientována na co nejrychlejší odvedení dešťové vody z území intravilánů. Inovativní řešení založená na umělém zadržení dešťové vody ve strukturách města v období bez dešťů umožňují tuto vodu využívat ke zlepšování mikroklimatu města, závlahy parků, atrií resp. prostřednictvím recyklace na jiné potřeby míst. Pro zkvalitnění prostředí je k dispozici několik technologických řešení, která jsou ve vyspělých zemích často využívána. Několik systémů mohou mít alternativní řešení a jejich propojením lze dosáhnout kvalitního a příjemného prostředí, což je cílem i této studie.

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WETLAND RESTORATION OPTIONS WITH REGARD TO DIFFERENT OPERATIONAL REQUIREMENTS

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Abstract
One of the many possible landscape interventions for water retention in the landscape is the construction of natural small lakes - pools, a measure that is currently very common. At first sight, it is a relatively simple measure, in terms of legislation, design and implementation. However, there is often disillusionment, as there is a clash between the requirements of the individual public authorities with the nature conservation authorities and also with the water management options. Conflict can also arise over the actual function that the pools are ultimately intended to fulfil. Primarily preferred by experts, biodiversity, water retention, etc., can often clash with requirements for recreational use, especially if the feature is close to an urban area.

Key words: Water retention in the landscape, biodiversity, recreation

Introduction

Ponds occur in the landscape as natural depressions filled with water or artificially created by man. The pools are usually completely sunk below ground level, they do not have a dam or other technical equipment (drain, safety spillway), the maximum water level in the pool can be given by the level of the surrounding terrain. The outflow of water from the pond is solved in a way that is close to nature. The ponds (wetlands) are designed to meet the objectives of supporting nature protection, especially support and increasing biodiversity. They are not intended for fish farming or waterfowl. (NCA CR, 2014)

Wetlands provide important habitat for invertebrates, plants, and vertebrates (Gibbs, 2000, Hansson et al., 2005). Convention on Wetlands states the wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (UNESCO, 1994). From the point of view of nature and landscape protection in the Czech Republic, priority is given to amphibians whose needs are adapted to the required technical parameters of the wetlands. Thus, irregularly shaped and shallow potholes fulfilled by water are usually understood as wetlands.

Materials and methods

In the following section, two completed pond projects are described. The ponds were designed to meet NCA CR (Nature Conservation Agency of the Czech Republic) standards as far as possible, yet they are two very different solutions.

<u>Ponds Hastrman</u>

The area concemed is located in cadastral area Janovice u Polné, at an altitude of 603–607. The dominant soil units are gley to pseudogley modal. According to Quitt, the area belongs to the mildly warm MT3 climate area with an average annual air temperature of 7.0 ° C and a long-term average annual rainfall of 630 mm (Jihlava).

This is the area of the former pond, the body of the dam is evident, along which the 2L Na Hastrmanu forest road runs. At the foot of the dam, there are currently large individuals of sycamore and linden, which will not be affected by the construction. The locality is situated on the stream: Poděšínský potok, IDVT 10239008 (ČHP 1-09-01-010), administration: Lesy ČR, s.p. (Forest of the Czech Republic). In the past, land reclamation was carried out in the area of the former floodplain by surface drainage ditches, opening into an upright and sunken watercourse. Subsequently, a commercial forest was planted in the floodplain. At present, in the central part of the area, there is an overgrown vegetation of Alnus glutinosa, aged 5–10 years, in a forest fence, which drains a significant amount of water through transpiration processes.

<u>Ponds Sulíkov</u>

The area of interest is located in cadastral area Sulíkov outside the built-up area of the village. The two pools are designed as flow-through. In the place of the proposed ponds, a historically waterworks probably existed, an earth dam is evident. The building is located south of the village at an altitude of

560 - 567. According to the regional division of the relief of the Czech Republic, the Hornosvratecká Highlands lie in the geomorphological unit. According to Quitt, the area belongs to the mildly warm MT3 climate area with an average annual air temperature of 6.5 ° C and a long-term average annual rainfall of 670 mm. The number of the hydrological order in the examined area is 4-15-02-0430. The main catchment area of the monitored locality is the Danube, the sub-catchment area is the Dyje, the basic catchment area is the Svitava, catchment area IV. of the order is Petrůvka.

Results

Ponds Hastrman

Five ponds with different surface areas, depths and bottom diversification were designed. In the riverbed, before the inlet to the culvert, under the body of the dam, a small approximately 0.3 m high wooden sill air sill with a stone backfill was built. By raising the level, it ensures the filling of ponds and also the creation of zones with very low water depth - wetlands. The ponds are built as separate, separated from the stream, except for the largest pond in the northern locality of the area, which connects to the stream, but its deepest part will be separated from the part adjacent to the riverbed by a quarry stone dam.

The terrain was modeled to protect part of the alder stump from permanent flooding.

In the middle of the locality, the existing sunken and upright Poděšín brook was loosened in its route, by inserting six opposite arches. Thus, even in the zone with flowing water, more favorable conditions will be created for animals and plants tied to this type of ecotope.

Part of the landscaping of pond excavation is also the creation of reptiles, leaving part of the branches from the existing stands on the site, as a possible hiding place for the fauna. Furthermore, tree trunks were also left in the places, both in the area of transition from aquatic and dry environment, as well as in the aquatic environment and in the field. There will be solitary stumps in the pool area.

Ponds 1 to 4 are separate non-flowing irregular shapes, max. depth 0.5 - 1.5 m. Pond 5 is in the area near the dam of the former pond. The surface of the pond follows the level in the riverbed. The pond is divided into two parts by a transverse aggregate dam - a quarry stone throw up to 80 kg. The first part, following the stream, has a maximum depth of 1.0 m, the rear part has a maximum depth of 1.5 m. An overview of pond parameters is in Tab. 1

The ponds will be irregular in shape, the slopes with a maximum slope of 1: 3 to 1: 8 will gradually follow the terrain, the depths in the ponds will be divided with emphasis on large shallow water zones (littoral). View of the realized ponds Fig. 1.

Tab. 1: Parameters of Hastrman ponds

	Pool T1	Pool T2	Pool T3	Pool T4	Pool T5
Level area (m^2)	105	105	1290	63	735
Volume (m^3)	27	45	798	12	347
Depth (m)	0,3-0,8	0,6-1,0	0,8-1,5	0,5	0,3-1,5

Fig. 1: Ponds in the locality Hastrman, photo just after the realization (Pelikán 2021)

Ponds Sulíkov

Two flow-through pools are proposed, which are connected to the existing drainage pipe. The depth of the pools varies from 0.7 m to 1.7 m. Slope gradients will range from 1:1.5 to 1:7. The drainage pipe is located at a depth of 1.3 m below ground surface. This pipe has been excavated in the area of the pools and left in the area between the pools. The length of the drainage pipe between the pools is approximately 17 m. The newly created slopes after the landscaping will be left to natural succession. Planting of wetland plant species is proposed on part of the area. The total volume of excavated soil will be 835 m^3. View of the realized ponds Fig. 2. This excavated material has been used to level the site. A right-angled 'elbow' pipe connected to the original drainage system is used to drain water from the pools. This measure will raise the water level in the ponds to the desired height. This extension pipe is lined with up to 200 kg of quarry stone and shaped to support the stability of the pipe and for aesthetic reasons. Part of the slope of the lower pool is covered with a macadam cover of up to 100 mm fraction for aesthetic and environmental reasons. See Table 2 for the parameters of the pools.

Tab. 2: Parameters of Sulíkov ponds

	Pool T1	Pool T2
Level area (m^2)	213	140
Volume (m^3)	192	113
Depth (m)	0,5-1,7	0,3-1,0

Fig. 2: Sulíkov locality, before implementation, just after and about a year after implementation (Marková 2018, 2020, 2021)

Discussion

It is important to realize that ponds are not a stable habitat, they evolve and change naturally. Clogging occurs due to possible erosion of the bank, and in the case of flow-through sediments, they become clogged internally, mainly due to the death of biomass and its deposition at the bottom. The ponds are also gradually overgrown with wetland vegetation, so the free surface area is gradually decreasing. If the natural processes or human intervention do not restore them, the pools will gradually disappear due to natural succession. It is these natural processes that some people may perceive as undesirable in ponds. Especially if the ponds are located close to the urban area and become a center of extensive recreation for locals. The transformation of such a place into an overgrown wetland is then considered unattractive, and the extinct water area as a wasted investment. Although in terms of biodiversity, this transformation is very valuable. In more remote localities, even the general public is willing to accept this natural process. Hastrman is located more than 1.5 km from the urban area and is not accessible by any hiking trails, only by forest haul road (Procházková and Hrůza, 2018).

Although creation of wetlands may mitigate for the loss of wetland area, there is uncertainty about how effectively created wetlands replicate the functions of, or replace habitat provided by, natural wetlands (Brown et al., 2012, Zedler and Callaway, 2002). The boundary between a pond and a wetland cannot be fixed. Convention on Wetlands defines various features considered as wetlands whose other natural process is also possible drying. It should be noted that during long periods of no rainfall, wetlands with a predominantly surface water source may experience lowering of the water level and even temporary drying. Again, this phenomenon is often perceived negatively both by lay people and by professional grant bodies. Again, periodic drying provides the opportunity for considerable biodiversity for some organisms requiring alternation between aquatic and non-aquatic periods. This is not a reservoir where there is the possibility of maintaining a constant level due to handling facilities. In addition, the concept of very shallow wetlands with maximum allowable depth 1.5 m (instead of Ramsar Convention) may amplify the phenomenon.

Ponds are an important element for water retention in the landscape, reduce runoff from the catchment, improve the microclimate of the site (Huryna et al., 2014) and significantly support biodiversity.

Hastrman and Sulíkov ponds represents two different approach in the design with respect to the expected different requirements and increased interest in the vicinity of urban area. In both cases, however, an adequate habitat was created, which supports the biodiversity of the site.

Conclusion

The article describes two examples of pond sites built on completely different sites and of different extent. In the case of the "Hastrman" pond, it is a locality in a forest environment at the bottom of the former pond, where there was a young willow stand. Five ponds of different sizes with differentiated slopes were designed, with the stumps placed in the bottom for greater diversity and the possibility of shelters. It also included loosening the route of part of the stream that flows here and leaving part of the young stumps.

In the "Sulíkov" locality, two ponds on a piped stream were designed. The place was waterlogged, overgrown with riots, inaccessible. In the area of the ponds, the pipeline was removed and the terrain was deepened to create a free surface of the ponds in the area of the extended valley. The surroundings of the ponds were modified and modeled with an excess of soil, willow plantings took place. The location is close to the village and is the destination of frequent walks by locals, some ponds are used for refreshments (even in winter they have become a welcome addition to local hardy people).

The above examples show that ponds can perform really different functions in the landscape, sometimes quite unexpected.

Regardless of some associated functions, both sites primarily fulfill the function of retaining water in the landscape, creating a water element that was missing in the sites and new habitat options for animals and plants.

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Souhrn

Jedním z mnoha možných krajinných zásahů pro zadržování vody je výstavba tůní, opatření v současnosti velmi rozšířené. Na první pohled jde o poměrně jednoduché opatření, co se týče

legislativy, návrhu i implementace. Často však dochází ke střetu požadavků jednotlivých orgánů veřejné správy s orgány ochrany přírody a také s možnostmi hospodaření s vodou. Konflikt může také nastat ohledně skutečné funkce, kterou mají tůně v konečném důsledku plnit. Odborníci primárně preferovaná biodiverzita, zadržování vody atd. se může často střetávat s požadavky na rekreační využití, zejména pokud je objekt blízko osídlení. V článku jsou prezentovány dvě lokality realizace tůní. Lokalita Hastrman je v lesním komplexu, jde o několik neprůtočných tůní spolu s revitalizací části toku. Lokalita Sulíkov je v blízkosti zástavby, jedná se o dvě průtočné tůně vzniklé na lokalitě, kde bylo odstraněno zatrubnění.

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WHAT ARE THE MAIN ASPECTS OF THE USE OF EDIBLE SEAWEEDS IN GUIMARAS ISLAND, PHILIPPINES? - CASE STUDY

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Abstract
Guimaras is a small touristic island situated between Panay and Negros islands in the Western Visayas. Its coastal waters are endowed with rich marine resources, including seaweed, which has become the coastal community's source of food, livelihood, and employment. This study aimed to determine the diversity, abundance, production and marketing practices of edible seaweeds in Guimaras Island, Philippines in the areas where recreation is set as well. Respondents were the 275 members of Seaweed Farmers Associations in the municipalities of Sibunag and Nueva Valencia using a researcher-made questionnaire. Seaweeds grown were not so diversified, only Cottonii brown, green and barako; and the Spinosum, green and brown. Cottonii-brown and green were the most widely grown seaweeds in the coastal barangays of Sabang, Sebaste and San Isidro in Sibunag and Panobolon in Nueva Valencia. The husbands mostly did production practices from site selection to harvesting and marketing, while wives took charge of recording, receiving, and keeping sales, cleaning, and maintenance. Challenges faced by seaweed growers include ice-ice disease, washed-out and untimely harvests, lack of drying equipment and buyers dictating prices of products.

Key words: cotonii-brown, spinosum, gender role, farming, challenges, tourism

Introduction
Seaweeds are marine resources of various economic uses. The economic importance of which, lies on its utilization as food, industry, pharmacy, medicine and tourism. Seaweed mariculture in the Philippines ranks number one in terms of amount of production among the marine-based products, and it is one of the top three export commodities, thus contributing large source of revenue to the country. For which, nearly 80% (777 963 tonnes) of the world's total *cottonii (Kappaphycus*) originates from the country (Elsevier, 2015; Ferdouse, et al., 2018). The commercial species of seaweed in the country are the red seaweeds, Carrageenan (*Eucheuma Cottonii and Spinosum*) and the Agar-agar (*Gracilaria* and *Gelidium*). Not only that seaweeds are harvested for direct consumption of the plant itself, but also for the intriguing and functional chemicals or "natural products" they produce, but also for human use. Chemicals derived from seaweed are used in medicines, food, beauty products, and industry. The red and brown algae produce *Phycocolloids* ("phyco"= seaweed, "colloid"=glue) that include agar, alginate and carrageenan. Green algae produce the antioxidant beta carotene which is a precursor to vitamin A (Seaweed Industry Association of the Philippines, 2015).
The use of the seaweeds extracts in food products took off in the second half of the 20th century as the demand for prepared foods increased. And, as more nations become more developed, the need for more prepared foods and pharmaceuticals will increase the demand for seaweed compounds (Brill and Lawrence, 2015).
Seaweed farming in Guimaras, though started few years ago, it has become a fast growing industry for its coastal communities, propagating a total coastal area of 40 hectares producing 10 tons per month yielded during peak months that starts at September and ends in April yearly. The harvested seaweeds are being dried and marketed to consumers and end users. However, the conflict arises in the moisture content declaration of the dried seaweeds among producers. Since the price of the goods is dependent on the moisture content, there is a big discrepancy in terms of sales that is lost during the transaction (Department of Science and Technology, 2015).
In order to respond to the increasing demand in the world market for edible seaweed extracts, and to contribute to the Philippine economy, there is first the need to identify edible seaweeds grown in Guimaras island and its potential of producing seaweed-based processed products for commercialization.
This study aimed to determine the diversity, abundance, production and marketing practices of edible seaweeds in Guimaras Island, Philippines. Specifically, it focused on determining the following: (1) variety of edible seaweeds grown in Guimaras Island; (2) specific locations of identified varieties of seaweeds abundantly grown in Guimaras; (3) gender division of labor in production practices from site selection to harvesting of identified varieties of edible seaweeds grown; (4) post harvest processing

practices employed by the seaweed growers; and (5) the marketing practices and challenges encountered in the disposal of seaweed products.

Methodology

Diversity and Abundance

In order to identify the seaweed farmers in Guimaras who were then actively engaged in seaweed farming, coordination was made with the Fishery Sector personnel of the Provincial Office for Agricultural Services (POAS). From the list taken, of the five municipalities of the Province, seaweed farmers' associations were active only in the municipalities of Nueva Valencia, Sibunag and San Lorenzo. Edible seaweeds were only grown from the first two municipalities. Using the researcher-made survey questionnaire, a total of 275 members of the seaweed farmers' association from the coastal barangays of Sebaste, Sabang and San Isidro from the municipality of Sibunag and Barangay Panobolon (98) from Nueva Valencia and where existing seaweed farms are maintained were identified as sources of information for the diversity and abundance of edible seaweeds produced per harvest. The retrieved survey was validated with the municipal Fishery and Aquatic Resource Management Council Chairs to assert validity and to cross-check works of hired enumerators who then were members of the association where they reside.

Practices

Using the same researcher-made questionnaire, gender division of labor in the existing seaweed production, processing and marketing practices of the local seaweed farmers in the selected coastal barangays were determined. These also included challenges encountered by the seaweed farmers on the disposal of their seaweed products.

Data Analysis

The data gathered were analyzed using frequency counts and percentages in determining the diversity, abundance, gender division of labor in the existing seaweed production, processing and marketing practices including the challenges encountered by these individual seaweed farmers.

Results

Diversity of edible seaweeds grown in Guimaras Island

Seaweeds grown in the identified coastal barangays were not so diversified (Table 1). The seaweed farmers only grew two varieties such as the Cottonii classified as the green, brown and barako; and the Spinosum, classified as the green and the brown. In multiple responses, Cottonii- green posed the highest (91.27%) responses, followed by those planting Cottonii- brown (69.09%), and barako (24.73%), only very few planted Spinosum both brown and green (2.18% and or 1,82%), respectively.

Tab. 1: Variety of seaweed grown*

Variety/ Type of Seaweed Grown	Frequency	%
Cottonii-Green	251	91.27
Cottonii- Brown	190	69.09
Barako	68	24.73
Spinosum- Green	5	1.82
Spinosum- Brown	6	2.18

**Note: 275 respondents with multiple responses*

Specific location of these edible seaweeds grown

The edible seaweeds are grown in the coastal barangays of the municipalities of Sibunag and Nueva Valencia, specifically in barangays Sabang, Sebaste and San Isidro in Sibunag and in barangay Panobolon in Nueva Valencia. It turned out that cottonii-brown is the most widely grown seaweed (214 growers) followed by cotonii-green (158 growers). However, cottonii-green is widely grown in Brgy. Panobolon (90 growers), while cottonii-brown is widely grown in Brgy. Sabang (87 growers). Also, it was noted that the salinity and water current have contributed to the growth of these seaweeds.

Volume of planting materials per specie

For planting materials, 214 planted Cottonnii-brown, of this, more than half (52.34%) planted between 26-50 kgs. each, followed by those (27.1%) planting 25 kgs and below, and 76-100 kgs. (16.82%); however, there were few (3.27%) who planted 176-200 kgs. There were 158 who also planted Cottonii-green. The highest volume planted by each (59.5%) grower was between 26-50 kgs., followed by those (22.15%) who planted 25 kgs and below, with only few 15.82%) planting between 76-100 kgs., while the highest volume of 176-200 kgs. was planted by only three growers. Of the total seaweed growers, 66 of them also planted Cottonii-Barako, with the majority (65.15%) having planted 25 kgs. and below each. Spinosum variety was also planted by very few seaweed growers.

Tab. 2: Specific location of variety of seaweed grown*

Variety	Location				Total Growers/ specie
	Sabang	**Sebaste**	**San Isidro**	**Panobolon**	
Cottonii Sakol-Green	27	20	21	90	158
Cottonii Sakol-Brown	87	40	51	36	214
Cottonii -Barako	26	26		14	66
Spinosum-Green				5	5
Spinosum-Brown	1			5	5
Total	**141**	**86**	**72**	**150**	

**Note: 275 respondents with multiple responses*

Tab. 3: Volume of Planting Materials

Volume /kg	Cottonii- Green		Cottonii-Brown		Barako		Spinosum-Green		Spinosum-Brown	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
25 and below	35	22.15	58	27.1	43	65.15	3	75.0	4	100.0
26-50	94	59.5	112	52.34	17	25.76				
51-75										
76-100	25	15.82	36	16.82	4	6.06	1	25.0		
101-125										
126-150	1	0.63	1	0.47						
151-175										
176-200	3	1.9	7	3.27	2	3.03				
Total	158	100	214	100	66	100	4	100	4	100

Period of planting and harvesting

Seaweed planting in the identified coastal barangays is whole year round (Table 4). It usually starts from the month of June of the current year until May of the succeeding year. Peak months of planting is from September to December and starts to decline from January to May. It can be noted that all varieties are planted from the months of June to September. However, only the Cottonii Green, Brown and Barako thrive whole year round. This means that these species are resistant with the changing weather condition though planting declines with the onset of summer season.

Harvesting is every after two months from planting or after 60 days cycle. There was a big drop in the harvest of seaweed from March to July for all species. This means that the growth of seaweeds is affected by the external factors such as changing weather condition which is uncontrollable and other controllable factors.

Volume of harvest

Table 5 presents the volume of harvest per specie. Average volume of harvest for Cottonii green and brown on a per quarter bases is from 251-500 kgs and 250 kgs and below. Volume of harvest is declining from the third to fourth quarter. While Spinosum though low in volume is planted and only few of the seaweed growers engaged in planting, volume of which is sustained from first to the fourth quarter for brown at 250 kgs and below to 501-750 kgs.

Gender division of labor

Production practices from site selection, planting to harvesting (Table 6) are mostly done by males/husbands, while wives took charge of cleaning/maintenance and gathering of washed-outs. Wives also take active part in the site selection, installation of lines and floats, in the procurement of planting materials, planting, cleaning. For some, sons and daughters or hired workers are sought to help in the production processes. This implies that seaweed production is the main gender role of the father and the mother.

Post-harvest processing practices employed by the seaweed growers

Post-harvest activities (Table 7) are mainly performed by the husband and the wife. Sacking and weighing are mostly done by the husbands, while, recording is mostly done by the wife. Only few children, son or daughter or other means such as hiring somebody help in the post harvest processing. This implies that post harvest processing practices are mainly the gender roles of both the father and the mother.

Marketing practices of seaweed growers

Marketing practices (Table 8) were mainly performed by the husband, such as, resacking, transporting, and transacting with buyers. However, recording and receiving/ keeping of sales are mainly performed by the wife. While only very few of the sons and daughters or hired personnel get involved in the marketing. This only means that marketing of seaweed is mainly the gender role or shared responsibility of the father and the mother so as to generate income for the family.

Tab. 4: Period Planted and Harvested

Months	**Cottonii-Green**		**Cottonii-Brown**		**Barako**		**Spinosum-Green**		**Spinosum-Brown**	
Planting	F	%	F	%	F	%	F	%	F	%
January	95	34.55	126	45.82	11	4				
February	63	22.91	22	8	7	2.55				
March	43	15.64	12	4.364	6	2.18				
April	32	11.64	11	4	5	1.82				
May	30	10.91	16	5.82	2	0.73				
June	109	39.64	88	32	28	10.18	2	0.73	3	1.09
July	92	33.45	108	39.27	32	11.64	3	1.09		
August	121	44	129	46.91	44	16	2	0.73	2	0.73
September	143	52	115	41.82	53	19.27	2	0.73	4	1.45
October	133	48.36	148	53.82	54	19.64	1	0.36		
November	117	42.55	187	68	56	20.36	1	0.36		
December	138	50.18	201	73.09	38	13.82	1	0.36		
Harvesting										
January	42	15.27	54	19.64	20	7.27				
February	124	45.09	66	24	15	5.45				
March	32	11.64	36	13.09	8	2.91	1	0.36		
April	68	24.73	16	5.82	7	2.55				
May	7	2.55	5	1.82	2	0.73				
June	2	0.73	2	0.73	1	0.36				
July	12	4.36	4	1.45	3	1.09				
August	71	25.82	19	6.91	6	2.18			6	2.18
September	35	12.73	64	23.27	7	2.55	1	0.36	1	0.36
October	32	11.64	44	16	27	9.82	1	0.36	1	0.36
November	95	34.55	92	33.45	26	9.45	3	1.09	5	1.82
December	45	16.36	85	30.91	33	12			2	0.73

**Note: 275 respondents with multiple responses*

Tab. 5: Volume Harvested

	1st Quarter		**2nd Quarter**		**3rd Quarter**		**4th Quarter**	
Cottonii- Green	F	%	F	%	F	%	F	%
250 and below	37	28.24	48	31.17	43	36.44	16	57.14
251-500	47	35.88	64	41.56	39	33.05	10	35.71
501-750	32	24.43	30	19.48	25	21.19	1	3.57
751-1000	4	3.05	1	0.65	2	1.694		
1001-1250	4	3.05	4	2.60	3	2.54	1	3.57
1251 and above	7	5.34	7	4.55	6	5.08		
Total	**131**	**100**	**154**	**100**	**118**	**100**	**28**	**100**
Cottonii-Brown								
250 and below	31	16.67	51	28.18	55	59.78	12	80
251-500	86	46.24	88	48.62	21	22.83	2	13.33
501-750	25	13.44	18	9.94	9	9.78	1	6.67
751-1000	21	11.29	11	6.08	2	2.17		
1001-1250	4	2.15	5	2.76	4	4.35		
1251 and above	19	10.22	8	4.42	1	1.09		
Total	**186**	**100**	**181**	**100**	**92**	**100**	**15**	**100**
Barako								
250 and below	42	66.67	45	73.77	5	35.71	1	100
251-500	11	17.46	9	14.75	4	28.57		
501-750	2	3.17	3	4.92	2	14.29		
751-1000	4	6.35	1	1.64	1	7.14		

1001-1250	2	3.17	1	1.64				
1251 and above	2	3.17	2	3.28	2	14.29		
Total	**63**	**100**	**61**	**100**	**14**		**1**	**100**
Spinosum-Green								
250 and below	2	66.67	2	66.67				
251-500								
501-750								
751-1000								
1001-1250								
1251 and above	1	33.33	1	33.33	1	100		
Total	**3**	**100**	**3**		**1**	**100**		
Spinosum-brown								
250 and below	1	16.67	1	20	1	16.67	1	50
251-500					1	16.67		
501-750	3	50	3	60	3	50	1	50
751-1000								
1001-1250								
1251 and above	2	33.33	1	20	1	16.67		
Total	**6**	**100**	**5**	**100**	**6**	**100**	**2**	**100**

Note: 275 respondents with multiple responses

Tab. 6: Production*

Production Practices	**Husband**		**Wife**		**Son**		**Daughter**		**Hired/ Others**	
	F	%	F	%	F	%	F	%	F	%
Site Selection	219	79.64	155	56.36	19	6.91	2	0.73	4	1.45
Installation	234	85.09	188	68.36	71	25.72	20	7.27	37	13.45
Lines	231	84	194	70.55	77	28	25	9.09	39	14.18
Floats	230	83.64	225	81.82	103	37.45	35	12.73	46	16.73
Planting materials procurement	180	65.45	160	58.18	25	9.09	7	2.55	5	1.812
Planting of Seaweeds	230	83.64	228	82.91	94	34.18	45	16.36	74	26.91
Maintenance/ Cleaning	180	65.45	232	84.36	54	19.64	25	9.09	20	7.27
Replanting	230	83.64	230	83.64	96	34.91	50	18.18	81	29.45
Gathering of washed out seaweeds	204	74.18	215	78.18	59	21.45	30	10.91	29	10.55
Sacking	217	78.91	257	93.45	88	32	28	10.18	66	24
Hauling	196	71.27	152	55.27	72	26.18	17	6.18	64	23.27

**Note: 275 respondents with multiple responses*

Tab. 7: Post- Harvest Processing Practices

Particulars	**Husband**		**Wife**		**Son**		**Daughter**		**Hired/Others**	
	f	%	f	%	f	%	f	%	f	%
Installation of drying facility	221	80.36	149	54.18	50	18.18	14	5.09	8	2.91
Drying	222	80.73	193	70.18	80	29.09	24	8.73	29	10.55
Weighing	221	80.36	164	59.64	61	22.18	13	4.73	22	8.00
Storing	219	79.64	171	62.18	57	20.73	14	5.09	11	4.00
Sacking	223	81.09	163	59.27	80	29.09	18	6.55	48	17.45
Recording	56	20.36	216	78.55	8	2.91	3	1.09	1	0.36

**Note: 275 respondents with multiple responses*

Tab. 8: Marketing practices

Particulars	Husband		Wife		Son		Daughter		Hired/ Others	
	f	%	F	%	f	%	f	%	f	%
Weighing	213	77.45	146	53.09	76	27.63	13	4.73	13	4.73
Resacking	220	80	135	49.09	83	30.18	18	6.55	28	10.18
Recording	90	32.73	194	70.55	19	6.91	5	1.82		
Transporting	217	78.91	113	41.09	85	30.91	12	4.36	7	2.55
Transact w/ buyers	186	67.64	166	60.36	24	8.73			3	1.09
Receiving/ Keeping Sales	44	16	221	80.36	5	1.82				

**Note: 275 respondents with multiple responses*

Challenges encountered in the disposal of seaweed products

Seaweed growers in the process of disposing seaweed products do encountered challenges from the production, post harvest processing and marketing of edible seaweeds (Table 9). During production process, the most common pests identified affecting the growth and volume of seaweeds grown were fish (49.09%), "terek" (36.73%), and algae "lumot-lumot" among others such as sea urchin, starfish and "guma-guma"; diseases such as, "ice-ice" (90.55%), as well as "bungot-bungot" and epiphytes; and other man-made factors such as fishing activities and stealing of seaweed at the farm site.

During harvest time, challenges encountered included reduced volume due to wash-out (42.55%), also slow growth of seaweeds (14.18%). Likewise, the untimely harvesting due to bad weather condition such as typhoon, big waves, and strong winds as revealed by almost half of the respondents (46.55%), and other man-made factors such as stealing and fishing activities. The lack of drying facilities especially during rainy days is the major challenge for the growers (53.45%) during processing after harvest. While during marketing of seaweed products, major challenge was that buyers are the ones dictating the price of dried seaweeds, the buyers are far from the farm site, and even products to be sold are in volume still the prices are the same.

Discussion

The cottonii-brown seaweed is the most widely grown seaweed in Guimaras. The main uses of brown seaweeds are foods and raw materials for extracting the hydrocolloid alginate. These are found in warmer waters but are less suitable for alginate production and rarely used as food. Originally, harvests of wild seaweeds were the only source. However, since the mid-twentieth century, demand has gradually outstripped the supply from natural resources, and cultivation methods have been developed. Today, seaweed for food comes mainly from farming rather than natural sources (Partnerships in Environmental Management for the Seas of East Asia, 2017).

The variety of seaweed planted is dependent on the type of seedlings made available to them at the time of planting season. However, the seaweed could not resist growing especially during summer time. This time is really good for practicing touristic activities. Changing of weathers greatly affects the growth of seaweeds. Seaweed usually grown and cultivated in nearshore areas for operational and logistical reasons and in order to get enough sufficient sunlight for photosynthesis. In terms of both investment and operating costs, nearshore operations are less expensive (Manjarrez, et al, 2021).

Tab. 9: Challenges encountered

Activities	Challenges	F	%
Production			
Pests	Fish	135	49.09
	Algae (lumot-lumot)	30	10.91
	Terek	101	36.73
	Sea Urchin	7	2.55
	Starfish	55	20.0
	Rubber-like (guma-guma)	23	8.36
Diseases	Ice-ice	249	90.55
	Epiphytes	24	8.73
	Beard-like (bungot-bungot)	61	22.18
Man-made	Fishing activities	23	8.36
	Stolen by others	25	9.09
Harvesting			
Volume	Washed-out	117	42.55
	Total washed out at times	13	4.73

	Smaller and slow growth at times	39	14.18
	Low volume (pests)	26	9.45
Age/timing	Bad weather condition (typhoon, big waves, strong wind)	128	46.55
	60 days (right age but of small stem and lighter weight)	42	15.27
	Washed-out	36	13.09
Man-made	Stolen by others	45	16.36
	Fishing activities	6	2.18
Processing			
Equipment	Lack of drying facility	10	3.44
Drying	Rainy season	147	53.45
Marketing			
Buyer	Low prices	92	33.45
	Far	85	30.91
Volume	Same price even in volume	28	10.18
Price of product	Php 23/kg	79	28.73
	Low price	169	61.45
Other Type	Raw dried seeds	32	11.68

**Note: 275 respondents with multiple responses*

Conclusion

Variety of seaweeds grown in the three coastal barangays in Sibunag and one island barangay in Nueva Valencia are *Cottonii* (sakol) green, brown, and barako; and Spinosum green and brown with cottonii green and brown. Peak months of planting from June to December and harvested after two months planting. Husbands perform most of the production, processing and marketing practices with wives performing lighter tasks such as cleaning/maintenance, recording of keeping of sales for products sold. Incidence of pests and diseases as well as changes in weather condition are the major challenges encountered by seaweed growers. They can prosper from recreation in the meantime.

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Souhrn
Pěstitelé mořských řas na ostrově Guimaras pěstovali pouze odrůdy mořských řas cottonii a spinosum. Pěstují se v pobřežních barangay Sabang, Sebaste a San Isidro v Sibunagu a barangay Panoblon v Nueva Valencia. Více než polovina zemědělců pěstovala hnědé mořské řasy cottonii o objemu 26-50 kg. Vrcholné měsíce výsadby jsou od září do prosince a začínají klesat od ledna do května. Sklizeň probíhá vždy po dvou měsících od výsadby nebo po 60 dnech cyklu. Průměrný objem sklizně bavlníku zeleného a hnědého na čtvrtletní základny je 251-500 kg a 250 kg a méně, zatímco u bavlníku hnědého, který se udržuje od prvního do čtvrtého čtvrtletí, je 250 kg a méně. Manžel a manželka se věnují hlavně produkčním, posklizňovým a obchodním postupům s menším zapojením dcer a synů. Při produkci většina označila ryby za škůdce a ledovku za choroby ovlivňující růst a objem řas. Dalšími faktory jsou rybolovné činnosti a krádeže mořských řas v místě farmy. Problémy, s nimiž se setkávají při sklizni, jsou menší objem v důsledku vyplavování, předčasná sklizeň v důsledku špatných povětrnostních podmínek a nedostatek sušícího zařízení. Hlavním problémem při uvádění produktů z mořských řas na trh je skutečnost, že cenu určují kupující a ceny zůstávají stejné bez ohledu na objem prodaného produktu.

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WHICH TYPES OF STOOLS (ACCORDING TO MORPHOLOGICAL FEATURES) CAN BE SEEN IN THE LANDSCAPE OF DRAHANSKÁ HIGHLAND?

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Abstract

We provide information on the results of mapping the relics of traditional coppice management in the Drahanská Highlands (Czech Republic). Three localities were selected where information on morphological features of stools and their occurrence in the landscape were collected. Stools were classified according to the established scheme with the aim to determine their cultural and historical value. It turned out that the final stool value is not affected by the locality, but by the tree species. European beech, sessile oak, small-leaved linden, and European hornbeam were evaluated. Oak and beech had a higher proportion of stools with lower values in comparison with linden and hornbeam. Differences in the average altitudes at which stools occurred essentially reflected different ecological demands of analysed species. The occurrence of stools could be sorted according to increasing altitude as follows: small-leaved linden – European hornbeam – sessile oak – European beech. European beech was the most widespread species. Its stools occurred from the lowest to the highest altitudes in the studied area. The authors recommend using the proposed classification scheme to determine the cultural and historical value of stools, especially with regard to planning their protection.

Key words: coppice, mapping, nature protection, cultural heritage, landscape protection

Introduction

The paper evaluates morphology and occurrence of stools - relics of traditional coppice management, in the Drahanská Highland. The idea to write this article was initiated by the fact that coppice have not been managed in our forests for at least 70 years. During this period, we have been losing the last remnants of this traditional management in the Czech landscape. We therefore believe that it is necessary to map the last coppice remnants, to determine their value and, if possible, to plan an adequate protection of these objects with high cultural and historical value. We consider the stools a part of our cultural heritage (Slach et al., 2021).

The coppice management (based on the resprouting ability of broadleaved trees after harvest) has traditionally taken place in our state for hundreds of years. According to the Czech National Forest Inventory (2001-2004) coppices occur on less than 1 % of the forest area (ÚHÚL, 2007). These forest stands (often called as quasi high forests) were originally coppice, but none of them are actively managed. If their occurrence will not further mapped and a procedure for their protection (management) will not be proposed, coppice will gradually disappear from our landscape (Slach et al., 2021).

The aim of the paper is to present:

a) a classification scheme for determining the cultural and historical value of the stools based on morphological features and verifying its use by field research,

b) a comparison of values of stools according to tree species (oak, beech, linden and hornbeam) and localities,

c) a comparison of the occurrence of stools in the field (defined by altitude) by tree species and localities.

Material and methods

Three localities with working titles: North (mainly includes cadastral areas Holštejn and Housko), Central (mainly cadastral areas Klepačov and Olomučany) and South (mainly the cadastral area Pozořice) were analyzed in the Drahanská Highland (Czech Republic).

Firstly, information about the distribution of the forest in the localities and in forest stands according to age and predominant tree species were obtained. Forest stands older than 80 years with predominant occurance of oak and beech were selected for field survey. The data were obtained from the Forest Management Institute Brandýs nad Labem. The ArcGIS Collector mobile application was used to collect data in the field, and the information was stored and subsequently evaluated in the ArcGIS

Online environment. Only structurally representative stools in the area were evaluated in the field (data collection did not involve capturing the occurrence of all stools). If there was a morphologically different stool in the vicinity of evaluated stool, this stool was also icluded; otherwise not. Every evaluated stool has classification values, GPS coordinates and a photograph in the database. The morphological features of stools were determined in the field based on the classification created for the given purpose (Table 1).

Tab. 1: Stool classification according to morphological features

Evaluated morphological features on the stool	Feature level	Feature level percentile (%)	Feature level value	Feature level description
Number of sprouts per stool	0	0	0	no sprout, but there are signs of a former stool at the base and the individual is visibly vital and viable (this is not a "stump torso")
	1	$11.1\overline{1}$	1	one sprout (there are marks of the former stool at the base or trunk)
	2	$22.2\overline{2}$	2	two sprouts
	3	$33.3\overline{3}$	3	three sprouts
	4	$44.4\overline{4}$	4	four sprouts
	5	$55.5\overline{5}$	5	five sprouts
	6	$66.6\overline{6}$	6	six sprouts
	7	$77.7\overline{7}$	7	seven sprouts
	8	$88.8\overline{8}$	8	eight sprouts
	9	100	9	nine and more sprouts
Original stump(s) presence	0	0	0	no (or not)
	1	50	4,5	(yes); visible cutting surface without noticeable stump disintegration
	2	100	9	yes, stump torso, partly decayed
Sprouts branching at the height of the original stump	0	0	0	no (there is only one sprout)
	1	$33.3\overline{3}$	3	no (fork is formed about 1 m above the ground or higher); it does not have to be a stool, but a fusion
	2	$66.6\overline{6}$	6	partially (some yes and some no)
	3	100	9	yes
Visible fusion of sprouts	0	0	0	no (there is only one sprout)
	1	$33.3\overline{3}$	3	yes, they are
	2	$66.6\overline{6}$	6	partial fusion only (former stool indication)
	3	100	9	not fused (sprouts far apart – indication of the former stool)
Presence of a dendrothelm	0	0	0	no
	1	100	9	yes

The percentiles were calculated for individual levels of morphological features. The range of values 0-9 was used as a rating scale for the levels of morphological features (this corresponds to the levels of the number of sprouts per stool that has the most levels). The resulting values for each feature level were calculated using the percentiles from this scale. The final stool value was determined as the sum of the values of the individual morphological features, and it ranged from 1 to 45. The final stool value is a discrete variable. For further analyses the stools were classified into three categories: stools with a value of 1-15, stools with a value of 16-30 and stools with a value of 31-45.

Four tree species (sessile oak, European beech, European hornbeam and small-leaved linden) were selected for the subsequent stool evaluations. In total, 431 stools were evaluated. Furthermore, altitude values (from the 5th generation digital relief model of the Czech Republic) were also assigned to every stool in the database.

As part of the data analysis, a comparison of the final stool values was performed between the studied tree species, resp. between the studied localities. Since both species and locality are categoric variables, the Pearson $\chi 2$ test of independence was chosen for this analysis. A comparison of the stool altitude values was performed between the studied tree species, resp. between the studied localities. Because the altitude did not meet the conditions of normal distribution and constant variance, a nonparametric one-way Kruskal-Wallis ANOVA, supplemented by Dunn's multiple comparison test were used. The results were processed in the jamovi and R software environments (https://www.jamovi.org/) (https://cran.r-project.org/) at a significance level of α = 0.05.

Results and Discussion

The basic characteristics of stool values are presented in Table 2. The maximum stool value was found in sessile oak in the locality South (38), the minimum value in sessile oak in the locality South and for beech in the localities South and North (1), see Figure 1.

Tab. 2: Basic characteristics of the analysed data set (tree species: sessile oak, European beech, small-leaved linden, European hornbeam)

Tree species	Locality	Number of stools	Stool values			
			modus	interquartile spread	minimum	maximum
oak	South	132	14.00	6.00	1.00	38.00
beech		67	14.00	6.00	1.00	35.00
linden		2	multiple	25.00	10.00	35.00
hornbeam		0	---	---	---	---
oak	Central	14	14.00	7.50	10.00	27.00
beech		131	14.00	4.00	5.50	37.50
linden		17	multiple	6.00	12.00	25.00
hornbeam		24	14.00	8.50	8.00	32.00
oak	North	0	---	---	---	---
beech		41	14.00	2.00	1.00	25.00
linden		0	---	---	---	---
hornbeam		3	19.00	2.00	19.00	21.00

Based on the performed Pearson χ2 test of independence, it can be stated that the stool value is not affected by the locality, but by the tree species. It was found that beech and oak are ranked mainly in category 1-15, while linden and hornbeam are ranked in category 16-30. The representation of stool values in category 31-45 is approximately the same for all tree species (Figure 2, right). The novelty of this article is determining the stool value. The presented scheme allows to evaluate stools not only between individual features, but also within one specific feature level. We consider this to be essential from the point of view of possible planning of protection (management) of stools. The number of sprouts affects the final stool value from 20 %, its influence can be described as one of the key ones when comparing the stools values of different tree species.

Regarding the altitude influence, it was found that only the North locality differs significantly from the two remaining localities. The influence of tree species on the distribution of altitudes was evident for European beech, which differed in altitudes from all other tree species, and a difference (just above the significance level) between sessile oak and small-leaved linden was documented. Figure 3 (on the right) shows clearly that the pattern of stool occurence across the altitude gradient is in accord with ecological demands of studied species (where beach occupies higher altitudes and oak and hornbeam lower altitudes). Therefore, according to increasing altitude, we can rank the occurrence of stools as follows: small-leaved linden - hornbeam - sessile oak - beech. Beech was the most widespread, its stools occurred from the lowest to the highest positions in the monitored localities.

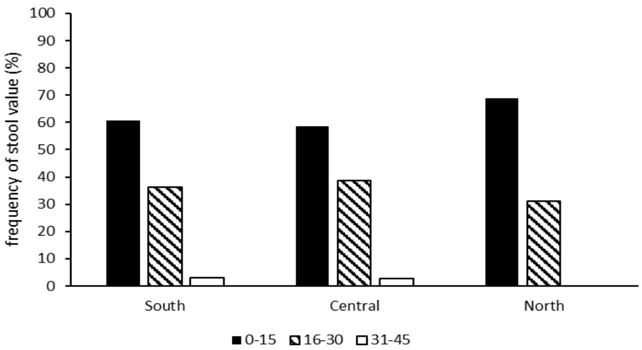
Tab. 3: Results of Pearson χ2 test of independence and Kruskal-Wallis ANOVA for comparison of stool values (resp. altitudes) between individual tree species and localities (DF – degree of freedom, χ2 - χ2-value of Kruskal-Wallis ANOVA or χ2-value of Pearson test, p - p-value)

Dependent variable	Factorial variable	DF	χ2	p
Stool value	Tree species	6	14.93	=0.021
	Locality	4	2.54	=0.638
Altitude (m a.s.l.)	Tree species	3	66.51	<0.001
	Locality	2	117.98	<0.001

sessile oak – stool value: 1, altitude: 406 m, locality: South

sessile oak – stool value: 38, altitude: 406 m, locality: South

Fig. 1: Stools with minimum (on the left) and maximum (on the right) value



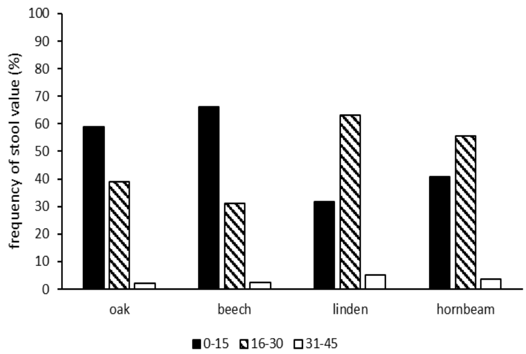


Fig. 2: Graphic representation of relative frequencies of stool values between compared localities (picture on the left) and tree species (picture on the right) (sessile oak, European beech, small-leaved linden, European hornbeam)

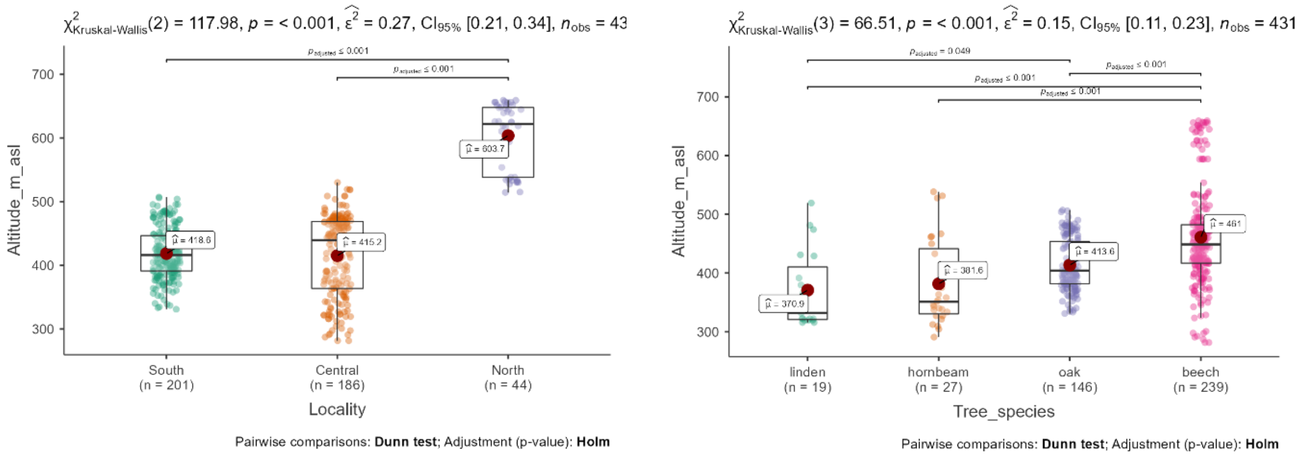


Fig. 3: Graphical representation of the results of Dunn's multiple comparison tests of stools altitudes between localities (picture on the left) and between tree species (picture on the right) (small-leaved linden, European hornbeam, sessile oak, European beech, n – number of evaluated individuals)

Conclusion

A new classification system for stool value assessment according to morphological features was established and verified in the field. The evaluation was performed at three selected localities in the Drahanská Highland. The system can be used to determine the stool values. We anticipate its use mainly with regard to protection (management) of stools - relics of traditional coppice management in forests. The aim of this contribution was to draw attention to stools in forests, emphasize their diversity and importance in the landscape. Coppices contribute to the diversity of the landscape. It is therefore important to preserve and protect these relics.

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Souhrn

Příspěvek podává informaci o hodnocení polykormonů, reliktů tradičního hospodaření pařezinami, v lesích na území Drahanské vrchoviny. Motivem k jeho napsání bylo povědomí, že se na našem území pařezinami již minimálně 70 let nehospodaří. Přitom hospodaření (těžba) je ale základním atributem existence pařezin. Proto, pokud opět nezačneme aktivně hospodařit v pařezinách, nebo pokud nezačneme plánovitě chránit poslední zbytky dokladů tohoto hospodaření (polykormony), pak o ně definitivně přijdeme. Domníváme se proto, že je zapotřebí poslední zbytky dokladů tohoto hospodaření dále mapovat, stanovit jejich kulturní a historickou hodnotu a pokud možno nastavit a naplánovat adekvátní ochranu (management) těchto objektů. Objekty polykormonů pařezin pokládáme za součást našeho kulturního dědictví v krajině.

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